MINISTRY OF EDUCATION AND RESEARCH

ECOLOGICAL UNIVERSITY OF BUCHAREST

FACULTATY OF PHYSICAL EDUCATION AND SPORT

International Scientific Conference

"ACTUALITIES AND PERSPECTIVES OF PHYSICAL EDUCATION AND SPORT SCIENCES"

6th edition

April, 03rd, 2025

Romania, Bucharest, Doina Cornea, no. 1G

EDITORIAL BOARD
Assoc. prof., Neder Florina, Ph.D. – Editor
Professor Vladimir Potop, Ph. D., D. Sc. – Editor

Editura PRINTECH

Tipar executat la:

S.C. ANDOR TIPO S.R.L. – Editura PRINTECH

Site: www.andortipo.ro; www.printech.ro

Adresa: Str. Tunari nr. 11, Sector 2, Bucharest

Proceedings of the International Scientific Conference
"Actualities and Perspectives of Physical Education and Sport Sciences"
6th edition, April, 03rd, 2025

ISSN 2734-8512

ISSN-L 2734-8512

President of Conference: **Ulareanu Marius-Viorel**, Assoc. prof. Ph. D., Dean of the Faculty of Physical Education and Sport, Ecological University of Bucharest

Chair conference: Neder Florina Liliana, Assoc. prof., Ph. D., Faculty of Physical Education and Sport, Ecological University of Bucharest

Members Scientific Committee:

Akhmetov Rustam, Professor, Doctor in Physical Education and Sports, Department of Theoretical and Methodological Foundations of Physical Education and Sports, Zhytomyr Ivan Franko State University, (Zhytomyr, Ukraine)

Borysova Olha, Professor, Doctor of Physical Education and Sport, Vice-Rector of scientific and pedagogical work of the National University of Ukraine on Physical Education and Sport, (Kiev, Ukraine)

Bosenko Anatoly, Professor, Doctor of Pedagogical Sciences, Head of the Department of Biology and Health, South Ukrainian National Pedagogical University named after K.D. Ushynsky, (Odesa, Ukraine)

Briskin Yuriy, Professor, Doctor of physical education and sport, Head of Academic Department of Theory of Sport and Physical Culture, Ivan Bobersky Lviv State University of Physical Culture, Ukraine (Lviv, Ukraine)

Carp Ion, Professor, Ph. D., Moldova State University, Institute of Physical Education and Sports, (Chisinau, Moldova)

Chernozub Andrii, Professor, Doctor of Biological Sciences, Lesya Ukrainka Volyn National University, (Lutsk, Ukraine)

Cieślicka Mirosława, Ph.D., Physical Education and Sport, Department of Human Physiology, Collegium Medicum Ludwik Rydygier in Bydgoszcz (Bydgoszcz, Poland).

Ciorbă Constantin, Professor, Doctor of Pedagogical Sciences, ”Ion Creangă” State Pedagogical University (Chisinau, Moldova)

Danylchenko I. Svitlana, Assoc. prof., Ph. D. of Medical Sciences, Department of Medical and Biological basics of sports and physical rehabilitation of Petro Mohyla Black Sea National University, (Mykolaiv, Ukraine)

Dobrescu Tatiana, Professor, Ph. D., Vice-Dean in charge with scientific research management, national and international relations, Faculty of Movement, Sports and Health Sciences, Vasile Alecsandri University from Bacau, (Romania)

Dorgan Viorel, Professor, Doctor of Pedagogical Sciences, CO of the Moldova State University, Institute of Physical Education and Sports, (Chisinau, Moldova)

Eshtaev Anvar, Associate Professor, Ph. D., department is headed of Gymnastics, Uzbek State University of Physical Education and Sports (Chirchiq, Uzbekistan)

Fleancu Julien-Leonard, Assoc. prof., Ph. D., Dean of the National University of Science and Technology Politehnica Bucharest, University Center Pitesti, (Piteşti, Romania)

Galan Yaroslav, Assoc. Prof., Ph. D., at the Faculty of Physical Culture and Human Health Yuriy Fedkovych Cernivtsi National University, Head of Young Scientists Council of Cernivtsi Region (Cernivtsi, Ukraine)

Ghervan Petru, Professor, Dean of the Faculty of Physical Education and Sport, Ştefan cel Mare University of Suceava, (Romania)

Iermakov Sergii, Professor, Doctor in Pedagogical Sciences, Faculty of Physical Education, Kharkiv National Pedagogical University, (Kharkiv, Ukraine)

Jurat Valeriu, Assoc. prof. Ph. D., Director of the Doctoral School, Moldova State University, Institute of Physical Education and Sports, (Chisinau, Moldova)

Korobeynikov Georgiy, Professor, Ph. D., Doctor of Biological Sciences, Uzbek State University of Physical Education and Sport, (Chirchiq, Uzbekistan); Ukraine National University of Physical Education and Sport (Kiev, Ukraine)

Kutek Tamara, Professor, Doctor in Physical Education and Sports, Dean of the Physical Education and Sports, Zhytomyr Ivan Franko State University, (Zhytomyr, Ukraine)

Kulbayev Aibol, Ph. D., Vice-Rector for Science, Academy of Physical Education and Mass Sports (Astana, Kazakhstan)

Makogonov Alexander, Professor, Executive Director of International Association of Physical Education and Sport Universities, (Almaty, Kazakhstan)

Manolachi Veaceslav, Professor, Doctor of Pedagogical Sciences, Moldova State University, Institute of Physical Education and Sports, (Chisinau, Moldova)

Mihăilă Ion, Professor, Ph.D., director Doctoral School of Sport science and physical education, National University of Science and Technology Politehnica Bucharest, University Center Pitesti, Romania

Mihăilescu Liviu, Assoc. prof., Ph. D., Head of Department, Faculty of Science, National University of Science and Technology Politehnica Bucharest, University Center Pitesti, (Pitești, Romania)
Moanță Alina, Professor, Ph. D., Faculty of Physical Education and Sport, National University of Physical Education and Sport, (Bucharest, Romania)
Moisescu Petronel Cristian, Professor, Ph. D., Faculty of Physical Education and Sport, "Dunarea de Jos" University of Galati, (Galati, Romania)
Nagel Adrian Constantin, Assoc. prof. Ph. D., Dean of the Faculty of Physical Education and Sports, West University of Timișoara, (Timisoara, Romania)
Niźnikowski Tomasz, Assoc. prof., Ph. D., D. Sc., Vice-Dean for General Academic Studies, Józef Piłsudski University of Physical Education in Warsaw, Faculty of Physical Education and Health, (Biała Podlaska, Poland)
Pelin Florin, Professor, Ph. D., National University of Physical Education and Sport, (Bucharest, Romania)
Potop Vladimir, Prof., Ph.D., D.Sc., National University of Science and Technology Politehnica Bucharest, University Center Pitesti, (Pitești, Romania)
Svetlichnaya Nailya, Asssoc. Prof. Ph.D., Uzbek State University of Physical Education and Sports (Chirchiq, Uzbekistan)
Timnea Olivia Carmen, Assoc. prof. Ph. D., Faculty of Physical Education, Sport and Kinetotherapy, Romanian-American University, (Bucharest, Romania)
Turcu Ioan, Assoc. prof. Ph. D., Dean of the Faculty of Physical Education and Mountain Sports, Transilvania University of Brașov, (Brasov, Romania)
Onoi Mihail, Assoc. prof. Ph. D. vice president National Agency for Quality Assurance in Education and Research, (Chisinau, Moldova)

Organizing Committee:

President:

Enescu George Alexandru Platini, Lecturer, Ph. D., Head of Department, Faculty of Physical Education and Sport, Ecological University of Bucharest, Romania

Members:

Anton Margareta, Assoc. prof., Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Stănescu Marius, Assoc. prof., Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Slăvilă Mircea, Assoc. prof., Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Cheran Cosmina, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Bucureşteanu Liliana, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Grigore Alin, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Grigore Maria Florica, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Ivanov Xenia, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Alexandrescu Nicoleta Cristina, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Ionescu Mihail Leonard, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Cojocaru Monica, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania
Frățilă Ion, Lecturer, Ph. D., F.P.F.S., Ecological University of Bucharest, Romania

TABLE OF CONTENTS

Session Physical Education 7

IMPROVING PSYCHOLOGICAL RESILIENCE IN LOWER SECONDARY SCHOOL STUDENTS BY PRACTICING CHESS AND PHYSICAL EXERCISE 9
Gheorghe Agache

EDUCATING MOTOR INTELLIGENCE AND PSYCHOMOTOR BEHAVIOR OF PRIMARY SCHOOL CHILDREN IN EXTRACURRICULAR SPORTS ACTIVITIES - FOOTBALL 18
Elena Mirela Dumitru, Veronica Visan, Vladimir Potop, Paul Florinel Visan

IMPACT OF HYBRID EDUCATION ON THE DEVELOPMENT OF THE INSTRUCTIONAL-EDUCATIONAL PROCESS AND THE ADAPTABILITY OF PRIMARY SCHOOL STUDENTS 30
Adrian Lungu

THE IMPORTANCE OF PHYSICAL EXERCISE IN THE PROCESS OF REDUCING OBESITY IN CHILDREN AGED 10-14 YEARS 38
Remus-Mihail Pozînărea, Viorica Calugher, Mihail Leonard Ionescu, Ecaterina Lungu

IMPROVING THE EFFORT CAPACITY OF HIGH SCHOOL STUDENTS BY IMPLEMENTING SPINNING IN THE PHYSICAL EDUCATION PROGRAM 42
Adelina Scheuleac

OPTIMIZING THE DEVELOPMENT OF MOTOR SKILLS THROUGH BADMINTON IN MIDDLE SCHOOL STUDENTS USING A PSYCHOMOTOR APPARATUS IN PHYSICAL EDUCATION 52
Bogdan Ionuț Tanasă

THE INTERACTIVE SIDES OF PSYCHOMOTOR SKILLS IN PRIMARY SCHOOL CHILDREN 63
Paul Florinel Visan, Veronica Visan, George Octavian Naiba, Mihai Popescu, Andreea Catanescu, Florin Cojanu

Session Sport Performance 73

STUDY ON THE PREPARATION OF JUNIOR BASEBALL PLAYERS FOR PARTICIPATION IN NATIONAL COMPETITIONS 75
Gabriel Adumitrachioaie

THEORETICAL AND METHODOLOGICAL PERSPECTIVES ON THE DEVELOPMENT OF MOTOR SKILLS IN FEMALE MINI-VOLLEYBALL PLAYERS 83
Aurelia Gabriela Ayza Berca, Veronica Visan, Vladimir Potop, Carmen Pârvu, Valentina Ștefănică, Ilie Mihai

DETERMINING THE VISUAL REACTION OF LOWER LIMBS IN PERFORMANCE SAMBO ATHLETES 90
Gheorghe Cristian Bodîrlău, Vladimir Potop, Victor Manolachi, Andrii Chernozub, Ilie Mihai

MODEL INDICATORS OF COMPETITIVE ACTIVITY OF HIGHLY QUALIFIED PLAYERS AS THE MAIN SELECTION CRITERION IN VOLLEYBALL 98
Olha Borysova, Olha Shlonska

ASSESSMENT OF STATIC BALANCE IN 6-8-YEAR-OLD CHILD DANCERS, 104
Diana Chilom, Cristina Ionescu, Maria Florica Grigore, Dmytro Strelnyk, Carolina Moga

RESEARCH ON FACTORS INFLUENCING THE SPECIFIC PHYSICAL TRAINING OF JUNIOR HANDBALL TEAMS 110
Marius Dănuleț, Ion Mihaila, Alexandru Acsinte, Daniela Corina Popescu, Ilie Mihai, Maura Stancu

METHOD FOR DETERMINING "HANDICAP" IN RELAY RUN 120
Ivan Derkachenko

MOTOR PREPARATION OF FOOTBALL PLAYERS IN THE GOALKEEPER POSITION 124
Alin Răzvan Dincă

THE IMPACT OF CAPITALIZING ON THE DEVELOPMENT OF JUNIOR GYMNASTS II MOTOR QUALITIES AT THE BASIC STAGE OF SPORTS SPECIALIZATION 133
Răzvan Constantin Dumitru

DETERMINING THE CHARACTERISTICS OF DYNAMIC BALANCE IN YOUNG FOOTBALL PLAYERS 138
Robert Aurel Enache, Vladimir Potop, Mihai Ilie, Ion Mihaila, Liviu Emanuel Mihailescu

COMPARATIVE STUDY ON THE NUMBER AND EFFICIENCY OF PASSING TYPES BETWEEN THE LATERAL DEFENDERS OF FOOTBALL TEAMS IN THE PLAY-OFF AND PLAY-OUT, LEAGUE I 148
Ion Frățilă, George Alexandru Platini Enescu

EFFECTIVENESS OF EXPERIMENTAL PROGRAMS ON THE TRAINING OF TECHNICAL-TACTICAL SKILLS IN MIXED MARTIAL ARTS 155
Ivan Gheorghiu, Ivan Carp, Natalia Reaboi

ANALYZING THE RELATIONS BETWEEN DYNAMIC BALANCE PARAMETERS IN YOUNG BOXERS 164
Mihai Iorgu, Valeriu Jurat, Vladimir Potop, Marius Viorel Ulareanu, Andrii Chernozub

THE ROLE AND IMPLICATIONS OF THE GAME MODEL IN PERFORMANCE HANDBALL 172
Dragoș Mădălin Lusca, Ion Mihaila, Daniela Corina Popescu, Alexandru Acsinte

PSYCHOLOGICAL PROFILE OF ATTENTION AND CREATIVITY IN YOUNG FOOTBALL PLAYERS 183
Bogdan Oprea, Vladimir Potop, Gheorghe Gabriel Cucui, Toni Lupu, Diana Ciobanu

ANALYSIS OF THE RELATIONS BETWEEN BIPEDAL DYNAMIC BALANCE INDICATORS IN YOUNG FENCERS 192
Simona Georgiana Popa, Vladimir Potop, Ilie Mihai, Paul Liviu Pavel

THE VALUE OF AFFECTIVE-ATTITUDINAL TRAITS IN FORMING ARTISTIC SKILLS IN 7-8 YEAR-OLD FEMALE GYMNASTS 200
Natalia Reaboi, Natalia Moloșag

INTEGRATION OF ADVANCED ANALYTICS AND WEARABLE TECHNOLOGIES IN PERFORMANCE MANAGEMENT OF U21 FOOTBALL PLAYERS 207
Răzvan Ionuț Rotaru, Vladimir Potop, Ion Mihaila, Paul Florinel Vișan, Doru Stoica

ANALYSIS OF STATIC BALANCE PARAMETERS IN YOUNG JUDOKAS 217
Călin Roșu, Vladimir Potop, Liviu Emanuel Mihailescu, Daniel Rosu, Ilie Mihai

POSITION-SPECIFIC ANTHROPOMETRIC PROFILES IN WOMEN'S FOOTBALL 225
Elena-Andreea Trandafirescu, Vladimir Potop, Gabriel Trandafirescu, Doru Stoica

231

Session Physical Therapy and Recovery

EFFECTIVENESS OF A PHYSIOTHERAPY PROGRAM INTEGRATING FASCIAL MOBILIZATIONS IN THE FUNCTIONAL RECOVERY OF PATIENTS WITH LOW BACK PAIN 233
Alexandra Aiftimie

PERCEPTION OF SPECIALISTS REGARDING THE EFFECTIVENESS OF PHYSIOTHERAPY IN THE REHABILITATION OF PATIENTS WITH REVISION TOTAL HIP ARTHROPLASTY WITH ACETABULAR DEFECTS- A QUESTIONNAIRE-BASED ANALYSIS 241
Nicoleta Florența Caraivan, Luminița Ionela Georgescu, Claudia Camelia Burcea, Elena Ioana Iconaru, Ion Mihăilă, Vladimir Potop

IMPROVING SCHOOL INCLUSION THROUGH THE USE OF ASSISTANT MATERIALS IN PHYSICAL EDUCATION BY STUDENTS WITH SPECIAL EDUCATIONAL NEEDS 250
Luminița-Magda Cazan, Elena Vizitiu Lakhdari

THE IMPORTANCE OF MANUAL TECHNIQUES IN THE TREATMENT OF ELBOW DISLOCATION 257
Cosmina Rodica Cheran, Florina Liliana Neder

ANALYSIS OF THE PARTICULARITIES OF POSTURAL CONTROL MANIFESTATION IN INDIVIDUALS WITH ORTHOPEDIC FOOT DISORDERS COMPARED TO HEALTHY SUBJECTS 264
Marina Cucu

RECOVERY OF HANDBALL PLAYERS AFTER OPERATIONAL TREATMENT OF SHOULDER DISLOCATION 271
Simona-Elena Dorobăț, Natalia Gîrlea

SYSTEMATIC REVIEW OF THEORETICAL, METHODOLOGICAL, AND CONCEPTUAL ASPECTS OF CARDIOVASCULAR RESPONSE TO SPECIFIC EFFORT IN FENCERS 278
Valentyna Dranus, Luminița Ionela Goergescu, Vladimir Potop, Ion Mihaila, Ioana Elena Iconaru, Mariana Tudor

THE METHOD OF PERSONALIZING PHYSICAL ACTIVITIES FOR STUDENTS WITH AUTISM SPECTRUM DISCORDER 290
Adina Mocanu

OPTIMIZING THE MORPHOFUNCTIONAL CAPACITY OF ADULTS THROUGH THE PRACTICE OF AQUATIC ACTIVITIES 296
Adriana Slusar

Session Varia 305

AGE DYNAMICS OF THE BODY'S FUNCTIONAL RESERVES 307
Anatolii Bosenko, Mariia Topchii, Yevhen Mykhaliuk, Mykhailo Khoroshukha, Yehor Horokhovskyi

THE IMPORTANCE OF EMOTIONAL DEVELOPMENT DURING PUBERTY 314
Marius-Eduard Feraru, Petronel-Cristian Moisescu, Dana Lucica Ciocoiu, Georgios Fakaros

THE RIGHT TOY AND YOUR CHILD'S MOTOR DEVELOPMENT – OVERVIEW 323
Gabriela Pană

LIFELONG LEARNING: INITIATIVES AND GOOD PRACTICES IN THE UNIVERSITY SECTOR OF THE REPUBLIC OF MOLDOVA 327
Aliona Luca, Alexandra Barbăneagră, Ecaterina Lungu

OCCURRENCE OF A DYSTONIC RESPONSE TO GRADED PHYSICAL EXERTION IN YOUNG ATHLETES IN TEAM SPORTS 334
Yevhen Mykhaliuk, Yehor Horokhovskyi, Anatolii Bosenko, Nadiia Orlyk, Valeriia Borshchenko

KNOWLEDGE AND DEEP COGNITION, PRODUCTIVE WAYS OF POSITIVE TRANSFER IN CREATIVE THINKING AND CREATIVITY 340
Natalia Nastas, Teodor Grimalschi

CONTRIBUTIONS ON TECHNIQUES AND PROCEDURES FOR SURVIVAL, LIVING AND LIFE IN EMERGENCY SITUATIONS 346
Liliana Neder, Vasile Dogaru, Antonică Constantin, Adela Melinte

MEANS OF GETTING THE ADULTS INTO FITNESS CLUBS 353
Serghei Stratulat

INTEGRATION OF A DIGITAL EDUCATIONAL PLATFORM FOR OPTIMIZING THE TEACHING PROCESS IN PHYSICAL EDUCATION AND SPORT LESSONS IN PRIMARY SCHOOL 360
Alina Petruța Țurcanu

THE ROLE OF MANAGEMENT IN THE WORK OF THE PHYSICAL EDUCATION TEACHER 367
Gheorghe Volcu

Session Physical Education

IMPROVING PSYCHOLOGICAL RESILIENCE IN LOWER SECONDARY SCHOOL STUDENTS BY PRACTICING CHESS AND PHYSICAL EXERCISE

Gheorghe Agache [1]

[1] *Institute of Physical Education and Sports, Andrei Doga Street 22, Moldova State University, Republic of Moldova*

Abstract

This paper analyzes the impact of practicing chess and physical exercises on the development of psychological resilience in middle school students. It aims to identify how these activities can improve concentration, stress management, and adaptability to school and social challenges. The research was conducted on a group of students, divided into two numerical value groups: an experimental group, which participated in chess programs and physical education lessons, and a control group, which followed only the standard physical education program. The program took place over a period of six months, and the students' progress was analyzed comparatively.
Hypothesis: It is assumed that implementing chess and physical exercises in the educational program of middle school students will lead to a significant improvement in psychological resilience, through the development of self-control, increased concentration, and improved stress management. The results indicate that this combined approach contributes to optimizing the cognitive and emotional performance of students, demonstrating that both intellectual and physical activities play an important role in the development of psychological resilience.

Key words: *psychological resilience, students, chess, physical exercises.*

1. Introduction

In today's fast-paced educational context, schools are increasingly recognizing the importance of supporting the comprehensive development of students. Integrating physical education and chess into the curriculum offers a distinct approach to achieving holistic development. While physical education promotes physical health and team spirit, chess contributes to the development of critical thinking and problem-solving skills. The results indicated a significant increase in working memory and attention span in students from the experimental group, compared to the control group, but no significant problem-solving capacity was observed. These findings suggest that the use of chess can be beneficial for stimulating memory and addressing attention span issues (Atashafrouz, A., 2019). It has also been observed that chess contributes to the cognitive growth of skills, adaptability, and problem-solving capacity, as well as the socio-affective development of children and adolescents faced with practical activities. However, these results are influenced by the personal characteristics of students who choose to engage in this activity (Aciego, R., García, L., & Betancort, M., 2012). Action in

groups of children has demonstrated that systematic chess practice in preparatory classes improves attention, memory, and text comprehension. These benefits can contribute to reducing functional illiteracy, a significant phenomenon among students in Romania (Mijarca, R., & Rendi, E., 2020). Although chess does not directly contribute to the physical development of children, there is a link between physical activities and chess (Nanu, CC, Coman, C., Bularca, MC, et al., 2023). In both domains, the energy for brain activity initially comes from glycogen in the brain, muscles, and liver, and later from adipose tissue. When the brain or muscles need additional energy, resources are shared between them. Energy expenditure and oxygen consumption during chess games are comparable to the marathon event in athletics, which underscores the importance of maintaining good physical condition for chess players (Golf, S., 2015). Consistent practice of a stimulating cognitive activity, such as chess, can contribute to maintaining a healthy cognitive, social, and psychological state (Cibeira, N., et al., 2021). Chess players are more capable of accepting and managing crisis situations, both in chess and in real life, being more focused and efficient in the face of challenges. They develop their analytical skills and adopt a healthier lifestyle. In conclusion, chess, especially in its competitive form, contributes to the development of resilience (Medvegy, Z., Mihalovits, M., Medvegy, M., et al., 2022). As physical education teachers and coaches, we are dedicated to staying up-to-date with the latest developments in the field and learning the most effective methods and techniques to support student participation in physical education and sports (Agache, G., & Vizitiu, E., 2022). Physical education, along with other motor activities, is a fundamental component in promoting harmonious physical development and maintaining optimal health for all population groups. As technology has evolved, its application in various fields has brought considerable benefits (Țurcanu, AP, & Vizitiu Lakhdari, E., 2024)."

2. Material and method

The main purpose of the study is to identify how activities from the game of chess and physical education can contribute to increasing students' concentration abilities, stress management, and adaptability to school and social challenges. The hypothesis of the study assumes that implementing chess and physical exercises into the educational program of middle school students will lead to a significant increase in mental resilience through the development of self-control and increased attention span. The research was conducted on a group of 24 students, divided into two value groups: the experimental group participated in chess programs and physical education classes, while the control group followed only the standard physical education program, without additional chess activities. The program was conducted over two modules in the 2024-2025 school year, and student progress was analyzed comparatively between the two groups. Inclusion criteria: age between 11 and 15 years, students who were available to actively participate in the chess program and

physical education classes throughout the study (6 months), absence of major physical or mental conditions, parental consent, and the ability to understand the rules of chess. Chess materials: complete chess sets (boards, pieces, and chess clocks) for all participants, visual aids with chess lessons and strategies for instruction, scheduled playing time for each training and competition lesson. Physical education materials: sports teaching materials (balls, ropes, etc.) used for various types of physical exercises.

Lesson Plan Model for Enhancing Mental Resilience Through Chess and Physical Exercise

Week 1 - *Lesson 1 (Chess).* Activity: Introduction to basic chess rules (piece movement). Objectives: Increase focus and self-control by learning basic chess rules. Stimulate attention and strategic thinking. Materials: Chess sets, chess board, chess pieces. Visual materials with movement examples. Duration: 45-60 min.

Lesson 2 (Physical Education). Activity: Coordination and endurance exercises. Objectives: Improve physical endurance and coordination. Enhance self-control and the ability to adapt to physical stress. Materials: Balls, ropes, obstacles. Warm-up exercises, running, and jumping. Duration: 45-60 min.

Week 2 - *Lesson 3 (Chess).* Activity: Basic strategy: controlling the central area and defending important pieces. Objectives: Develop strategic thinking and planning skills. Increase mental resilience by managing resources (pieces). Materials: Chess sets, chess board, chess pieces. Visual aids with strategy examples. Duration: 45-60 min.

Lesson 4 (Physical Education). Activity: Strength and physical endurance exercises. Objectives: Improve physical strength and endurance. Boost confidence in one's ability to overcome physical and mental challenges. Materials: Small weights (dumbbells), mats, ropes. Strength exercises: push-ups, squats, sit-ups. Duration: 45-60 min.

Week 3 - *Lesson 5 (Chess).* Activity: Chess endgames: checkmate with rook and king versus king. Objectives: Understanding and applying chess endgames. Increase mental resilience by focusing on the endgame and managing psychological pressure. Materials: Chess sets, chess board, chess pieces. Endgame examples and practical situations. Duration: 45-60 min.

Lesson 6 (Physical Education). Activity: Exercises to increase flexibility and joint mobility. Objectives: Improve range of joint motion and muscle elasticity. Reduce muscle tension and stress through relaxation techniques and stretching exercises, promoting focus and mental balance. Materials: Exercise mats, gym balls, stretching equipment (elastic bands, massage rollers). Exercises: Dynamic and static stretching, joint mobilization, and controlled rotations. Duration: 45-60 min.

Week 4 - *Lesson 7 (Chess).* Activity: Advanced strategies and time management in chess. Objectives: Understand advanced strategies and apply them under pressure. Develop self-control and time management skills under stress. Materials: Chess sets,

chess clocks for timed games. Chess board with chess clock for time management exercises. Duration: 45-60 min.

Lesson 8 (Physical Education). Activity: Speed and reaction. Objectives: Improve reaction speed and coordination under pressure. Increase adaptability and mental resilience through activities requiring quick reactions. Materials: Cones, balls, team game equipment. Exercises: Sprinting and change of direction, team games focusing on quick reactions. Duration: 45-60 min.

3. Results and Discussions

In the Cooper Test, the mean ($\bar{x}$) shows an increase in the distance covered from 2004.58m to 2249.67m, indicating a significant increase in aerobic capacity of 231m. The standard deviation (α) values are 211.40 and 242.15, suggesting a slight increase in the individual variation of performance between TI (initial test) and TF (final test), which may reflect individual differences in response to lessons. The Cv% values are similar (10.55% at TI and 10.76% at TF), indicating a relatively constant distribution of performance among students.

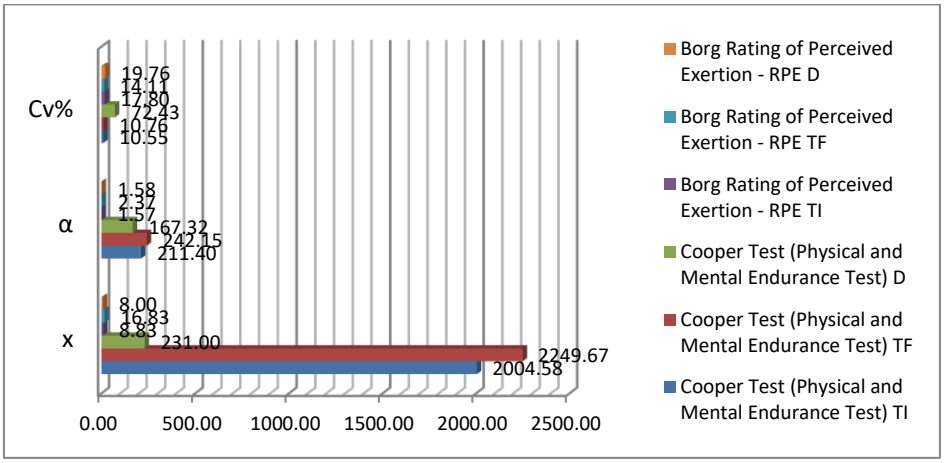


Figure 1. *Experimental group - Evolution of physical performance and perceived exertion between initial and final testing*

However, the high value for the difference D (72.43%) suggests great variability in individual progress. In the Borg Scale test, the mean ($\bar{x}$) represents an increase from 8.83 to 16.83 and indicates a significantly higher perception of effort at the end of the test. This aspect can be attributed to the intensification of lessons or increased awareness and effort. The standard deviation (α) shows an increase from 1.57 to 2.37, suggesting a greater variation in the perception of effort among students. A slight decrease in Cv% from 17.80% to 14.11% indicates a trend towards a more uniform perception of effort. However, the high variability of the difference of 19.76% shows that some students experienced a much more pronounced increase in

the perception of effort compared to others."

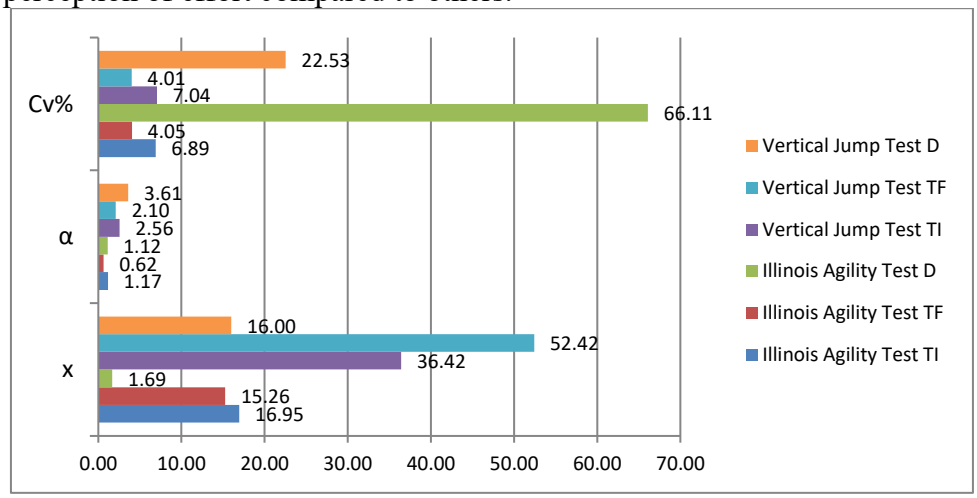


Figure 2. *Experimental group - Interpretation of physical parameters through statistical variable analysis*

Following the analysis, the results of the Illinois Agility Test (TI) show an average performance of 16.95 seconds, with a standard deviation of 1.17 seconds and a coefficient of variation of 6.89%. This suggests a relatively consistent performance, but with moderate variability among participants. Regarding the vertical jump test (TF), the average was 52.42cm, with a standard deviation of 2.10cm and a coefficient of variation of 4.01%. These values indicate a more uniform performance, with low variability among participants. Comparing the two tests, it is observed that the Illinois Agility Test (TI) shows greater variability than the vertical jump test (TF), but both tests show fairly consistent results within the group.

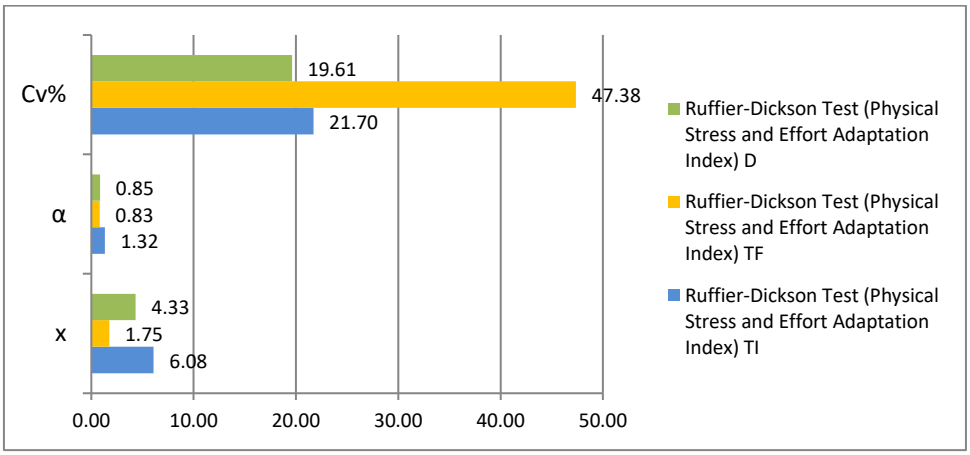


Figure 3. *Experiment group - Interpretation of physical parameters through statistical variable analysis*

In the case of the Ruffier-Dickson Test, a significant decrease in the index was observed, from 6.08 to 1.75, with a difference of 4.33, indicating a major increase in cardiovascular capacity. The standard deviation decreased from 1.32 to 0.83, showing a homogenization of progress among the students. The coefficient of variation recorded a significant fluctuation, from 21.70% (initial test - TI) to 47.38% (final test - TF), with a difference of 19.61% (D), indicating a greater initial variation, but a subsequent stabilization of results."

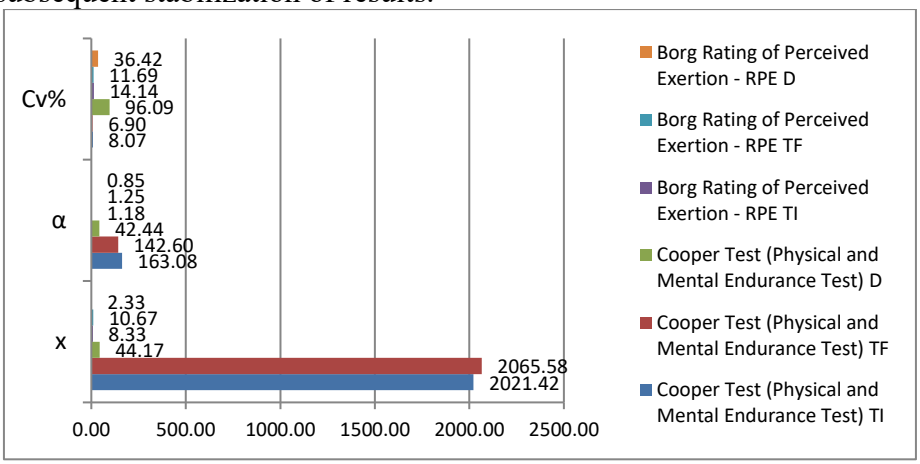


Figure 4. *Control Group - Evolution of Physical Performance and Perception of Effort Between Initial and Final Tests*

In the Cooper Test analysis, the average distance covered increased from 2021.42m to 2065.58m, with a difference of 44.17m, indicating a slight increase in physical endurance. The standard deviation decreased from 163.08m to 142.60m, suggesting more uniform performance, and the coefficient of variation (Cv%) decreased from 8.07% to 6.90%, signaling greater stability of results.

Regarding what is identified on the Borg Scale of perceived exertion, the average score increased from 8.33 to 10.67, with a difference of 2.33, indicating a more intense perception of effort. The standard deviation remained almost constant from 1.18 to 1.25, and the coefficient of variation decreased from 14.14% to 11.69%, signifying more stable performance, but still with some differences between students.

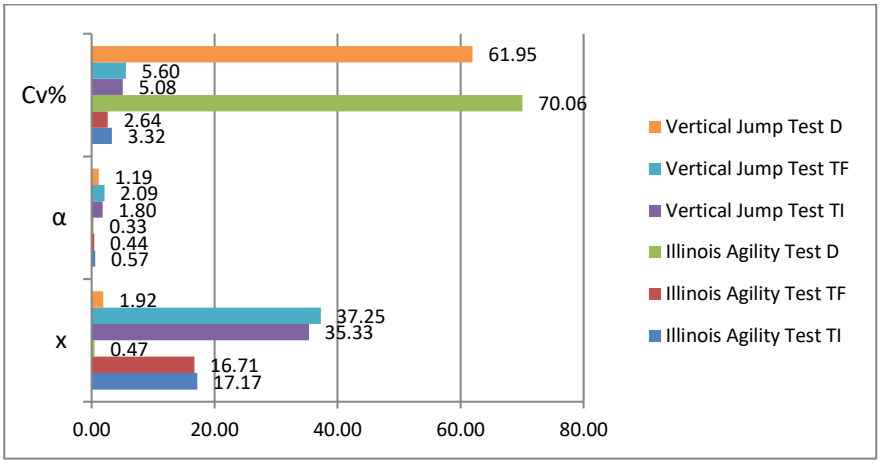


Figure 5. *Control Group - Interpretation of Physical Parameters Through Statistical Variable Analysis*

In the analysis of the Illinois Agility Test (TI), the average time was 17.17 seconds for TI and 16.71 seconds for TF, with a difference of 0.47 seconds, indicating a slight increase in performance. The standard deviation for TI was 0.57 seconds, and for TF it was 0.44 seconds, suggesting a fairly consistent performance with low variability among students. The coefficient of variation (Cv%) was 3.32% for TI and 2.64% for TF, indicating low variability in performance.

Regarding the Jump Test, the average was 35.33cm for TI and 37.25cm for TF, with a difference of 1.92cm, suggesting a slight increase in performance. The standard deviation was 1.80cm for TI and 2.09cm for TF, indicating higher variability compared to the agility test. The coefficient of variation (Cv%) was 5.08% for TI and 5.60% for TF, signifying more variable performance in the jump test.

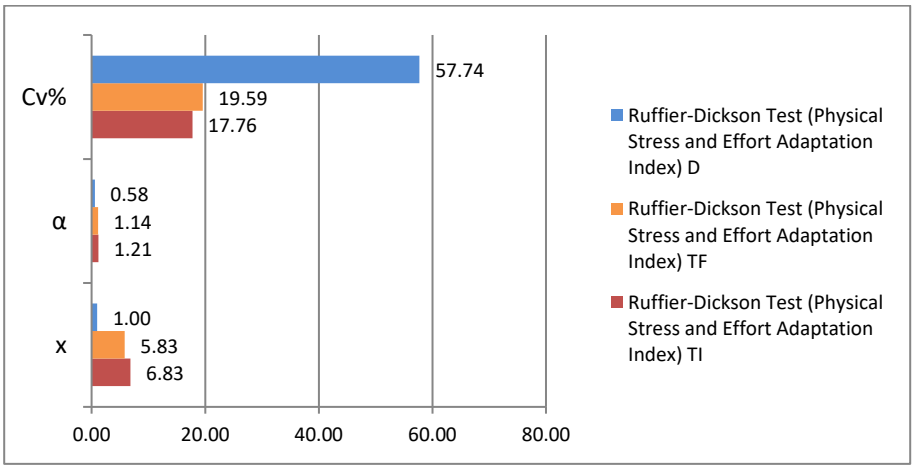


Figure 6. *Control Group - Interpretation of physical parameters through statistical variable analysis*

In the Ruffier-Dickson Test (Cardiovascular Recovery Assessment), the average difference between the initial and final pulse was 1.00, decreasing from 6.83 (TI) to 5.83 (TF), indicating a slight but significant recovery of cardiac recovery capacity, suggesting a recovery of heart rate. The standard deviation decreased from 1.21 to 1.14, indicating a slight homogenization of the recovery process, although there is a notable variability among students. The coefficient of variation (Cv%) increased from 17.76% to 19.59%, signalling a greater variability in results, indicating that some students recover much faster than others.

4. Conclusions

Student participation in chess and physical education activities had a significant impact on the development of their attention concentration skills and stress management abilities. Students in the experimental group, who practiced both activities, demonstrated improved attention concentration and better management of stressful situations compared to the control group, which only followed the standard physical education program. The research results showed a significant increase in mental resilience among students who practiced chess and physical education, due to the development of self-control and the ability to cope with challenges. Students in the experimental group learned to make quick decisions, stay calm in the face of challenges, and manage their emotions, which led to the overall development of their mental resilience. The integration of chess and physical exercise into the educational program had a positive impact on the overall development of students, not only physically but also mentally.

Bibliography

1. Aciego, R., García, L., Betancort, M. (2012). *The benefits of chess for the intellectual and social-emotional enrichment in schoolchildren*. The Spanish journal of psychology, *15*(2), 551-559. doi:10.5209/rev_SJOP.2012.v15.n2.38866.
2. Agache, G., Vizitiu, E. (2022). *Impact of the COVID-19 pandemic on psychomotric components in chess games for children aged 8–10.* In *Biomedical Engineering Applications for People with Disabilities and the Elderly in the COVID-19 Pandemic and Beyond* (pp. 267-312). Academic Press.https://doi.org/10.1016/B978-0-323-85174-9.00016-9.
3. Atashafrouz, A. (2019). *The effectiveness of chess on problem-solving, working memory, and concentration of male high school students.* Iranian Evolutionary Educational Psychology Journal, 1(4), 249-258. DOI:10.29252/ieepj.1.4.2, http://ieepj.hormozgan.ac.ir.
4. Cibeira, N., Lorenzo-López, L., Maseda, A., Blanco-Fandino, J., López-López, R., & Millán-Calenti, J. C. (2021). Effectiveness of a chess-training program for improving cognition, mood, and quality of life in older adults: a pilot

study. *Geriatric Nursing*, *42*(4), 894-900.https://doi.org/10.1016/j.gerinurse.2021.04.026.

5. Golf, S. (2015). Biochemistry and psychology of chess and classical physical exercise: Concurring or conflicting evidence. *Journal of Sports Medicine and Doping Studies*, *5*(2), 158., DOI: 10.4172/2161-0673.1000158.

6. Medvegy, Z., Mihalovits, M., Medvegy, M., Zabos, I., Sterbenz, T. (2022). *Does playing chess strengthen resilience?. Studia Universitatis Babes-Bolyai, Educatio Artis Gymnasticae*, *67*(3)., DOI:10.24193/subbeag.67(3).19.

7. Mijarca, R., Rendi, E. (2020). *The chess–means of developing attention, memory and understanding text to children of 6-7 years old from preparatory class*. *Bulletin of the Transilvania University of Braşov. Series IX: Sciences of Human Kinetics*, 201-210.,https://doi.org/10.31926/but.shk.2020.13.62.2.26

8. Nanu, C. C., Coman, C., Bularca, M. C., Mesesan-Schmitz, L., Gotea, M., Atudorei, I., ... & Negrila, I. (2023). *The role of chess in the development of children-parents' perspectives*. *Frontiers in Psychology*, *14*, 1210917., https://doi.org/10.3389/fpsyg.2023.1210917.

9. Țurcanu, A., P., Vizitiu Lakhdari, E. (2024). *Opportunities and possibilities for implementing information technologies in physical education and sport in primary education.* The Annals of the "Ştefan cel Mare" University of Suceava. Physical Education and Sport Section. The Science and Art of Movement eISSN 2601 - 341X, ISSN 1844-9131.https://doi.org/10.4316/SAM.2024.0120.

EDUCATING MOTOR INTELLIGENCE AND PSYCHOMOTOR BEHAVIOR OF PRIMARY SCHOOL CHILDREN IN EXTRACURRICULAR SPORTS ACTIVITIES - FOOTBALL

Elena Mirela Dumitru [1], Veronica Visan [2], Vladimir Potop [3], Paul Florinel Visan [4]

[1,2] *Elementary School No. 13 of Pitesti, PhD Candidate*
[3,4] *National University of Science and Technology Politehnica Bucharest, University Center Pitești, Romania*
[3] *Moldova State University, Institute of Physical Education and Sport, Chisinau, Republic of Moldova*

Abstract

The study examines how designing physical education content around the structure of psychomotor capacity can improve both general motor skills and psychomotor development among students in 3rd and 4th grades, employing a complex action system tailored to children's development. The methodology combines quantitative and qualitative approaches (literature review, observations, questionnaires, standardized psychomotor and motor tests), and data were analyzed statistically. In the experimental phase, initial and final assessments were conducted on experimental and control groups, including eight motor tests and four psychomotor tests, plus evaluations of experts' views on psychomotor means. The results indicate that thematic units with a predominant psychomotor content can influence both the magnitude and quality of psychomotor capacity, whereas initial assessments showed no significant psychomotor differences in some tests; by final testing, three of four psychomotor tests showed significant differences. The overarching conclusion is that a psychomotor-focused approach can foster comprehensive development in pupils, with positive effects on team cohesion, technical execution, and passing accuracy in sport-related activities.

Key words: *psychomotor capacity, physical education, motor development, thematic units, psychomotor assessment.*

1. Introduction

Fundamental motor skills (FMS), defined as organized basic movements involving two or more body segments, are essential for body posture development from childhood to adulthood, including locomotor, stability, and manipulative skills (Dewi & Verawati, 2022; Barnett et al., 2016). The elementary school curriculum emphasizes these skills to encourage children's participation in physical activities and support both fine and gross motor development. Walking, running, and jumping are complemented by catching, throwing, or balancing, laying the foundation for later physical engagement.

Physical education in primary schools extends beyond skill acquisition, fostering cooperation, teamwork, leadership, and lifelong interest in health and fitness.

Integrating FMS in sports also influences cognitive and emotional growth. Research shows that complex, coordinative motor tasks are more closely linked to cognitive development than simple tasks (Planinsêc & Pisôt, 2006; Alesi et al., 2014b). Cerebellar activation improves working memory, attention speed, and accuracy (Budde et al., 2008). Football, in particular, supports both motor and cognitive growth (Vestberg et al., 2012). Kun and Toth (2012) note that young football players learn to classify and organize information, thus improving formal thinking and tactical-cognitive skills.

The influence of physical education complements moral, aesthetic, and intellectual education. However, many school programs allocate little space to the correct development of motor capacities, often limiting them to "refreshing exercises." Motor capacity is defined as "the total number of native and acquired skills enabling varied efforts" (Raţă, G. & Raţă, C. B., 2006), while psychomotor capacity integrates mental processes ensuring both information reception and motor response. "Psychomotricity is the totality of motor functions in relation to cerebral activity" (Ardelean, 2006). Psychomotor, intellectual, and socio-affective development are closely linked (Tourrette & Guidetti, 1998), with the psychic and motor seen as "the bipolar expression of the same adaptive process" (Dragnea & Bota, 1999).

The quality of the educational process depends on teaching strategy, understood as a coherent system of methods and tools aimed at operational objectives (Cerghit, 1997; Colibaba & Evuleţ, 2007). Yet, children increasingly lose spontaneous play abilities, often due to modern technologies (phones, computers, internet) provided without limits. These bring intellectual benefits but may inhibit children's active behavior (Cojanu, 2009).

Specialist studies indicate insufficient development of psychomotor capacity nationwide, with primary school pupils in grades 3–4 disproportionately represented in this category. An analysis of planning documents for physical education and sports at the elementary level reveals aspects that can be effectively improved. It is essential to focus on enhancing psychomotor capacity, through both general and specific motor means, and through psychomotor elements adapted to the didactic process.

2. Material and method

The research methodology integrated both qualitative and quantitative approaches. A specialized literature review provided the theoretical framework, complemented by the observation method, the questionnaire method, and a set of examinations and control tests designed to assess indicators of general motor skills and parameters of psychomotricity in elementary school pupils.

Research Hypotheses

H1. If elementary physical education content is designed and developed from a comprehensive perspective on psychomotor capacity, then the corresponding action-

related parameters will show an improvement in both motor readiness and psychomotor readiness.

H2. From the standpoint of an action strategy aimed at optimizing psychomotor capacity, the quality of the development process for the two parameter sets (motor and psychomotor) will improve only through the creation of thematic action systems with a predominantly psychomotor content, adapted to the instructional process and supported by measurable and observable operational objectives (quality of the didactic process).

Psychomotor capacity was evaluated through four standardized tests:

- Test 1 – Concentration ability (Bourdon test);
- Test 2 – Visual capacity (Lalume test);
- Test 3 – General coordination (Matorin test);
- Test 4 – Vestibular balance (Romberg test).

Preliminary Research Strategy

In line with the study's objectives regarding psychomotor capacity in elementary school, a comprehensive testing protocol was designed to evaluate both the general motor profile and the psychomotor profile of pupils in the development cycle (3rd and 4th grades), as defined by the national curriculum (MEN, CNC, 1999). The examinations targeted:

- Fundamental motor abilities and skills (running, jumping, throwing, etc.);
- Motor qualities such as speed, agility, explosive force, coordination, and strength;
- Psychomotor parameters including concentration, visual memory, and general coordination.

Purpose of the experimental research

To design physical education content around the structure of psychomotor capacity so as to positively affect both components—general motor skills and psychomotricity—by employing a complex action system, with specific means and materials within the PE lesson, while also identifying new, optimally aligned action strategies according to students' current physical and psychical development in elementary school. Additionally, the study aims to investigate and analyze experts' perspectives on the systematization and use of psychomotor means in PE and sports classes at the elementary level; to pilot, in a preliminary process, the thematic unit of learning we designed; and to identify psychomotor capacity parameters using tests and assessments appropriate for both general motor skills and psychomotricity.

Practical objectives of the research report

Select the didactic environment, recruit samples, present the proposed and designed thematic units, identify the level of general motor skills parameters while prioritizing key psychomotricity parameters, and implement the thematic units within a predefined time frame on the experimental sample.

1.Identify and present thematic units of learning with a predominant psychomotor content, accompanied by measurable operational objectives.

2.Identify psychomotricity-specific tests that align with essential psychomotor parameters, and optimize them formatively and cumulatively within PE classes.

3.Inventory data from initial and final tests, enter them into an electronic database, and perform statistical analysis and interpretation.

4.Propose new directions for action based on conclusions from the preliminary process, leading to the design of new didactic strategies to be implemented in current PE classes, with a quality impact on optimizing pupils' psychomotor capacity in grades 3 and 4.

The experimental stage employed eight tests for general motor assessment, alongside the four psychomotor tests, in order to identify essential parameters and determine their level of development. The outcomes were intended to guide the integration of psychomotor means into thematic learning units through application tracks, relays, and dynamic games, adapted to the complexity of pupils' psychomotor capacity.

Opinions and suggestions on psychomotor means in physical education

A questionnaire survey was conducted to collect the views of physical education teachers working in elementary schools. The instrument included 19 items covering: professional background, sporting tradition, the use of psychomotor methods in lessons, opinions on the curricular status of physical education, interdisciplinary integration, participation in competitions, and the perceived influence of psychomotor behavior on pupils' development.

Responses were gathered from teachers in Piteşti and other towns within Argeş County (Mioveni, Topoloveni, Curtea de Argeş, Cîmpulung, Costeşti). Findings revealed a cautious approach to implementing psychomotor methods, reflecting both the challenges of curricular integration and the evolving terminology in specialized literature, as highlighted by recent authors in the context of human development.

Stages of experimental testing and programming of thematic units with predominant psychomotor content

Stage 1

Initial testing of the experimental and control samples occurred October 22–26, 2023, establishing baselines for both the preliminary and main experiments. Subsequently, thematic learning units integrating general motor skills with psychomotor content were systematically implemented, with a focus on psychomotor components. We hypothesize that both motor and psychomotor elements will enhance the psychomotor capacity of students in grades 3 and 4, and we pursue this through empirical validation.

Stage 2

Final testing within the preliminary experiment (intermediate stage 1) occurred December 17–22, 2023. This phase records the first data on both samples, addressing

general motor and psychomotor behavior. Results are expected to illuminate the impact of the proposed thematic units and to provide insights into the complexity of psychomotor capacity parameters in elementary pupils.

Stage 3

Intermediate testing 2 occurred March 18–22, 2024. This stage yielded the most consistent data regarding improvements in psychomotor capacity parameters for grades 3 and 4.

Stage 4

Final testing occurred June 17–21, 2024. Outcomes will indicate the effect of the thematic units—combining psychomotor and general motor systems, with a predominance of psychomotor content—on the key parameters of psychomotor capacity.

Additionally, the statistical-mathematical method and graphical representation were employed for data processing and interpretation.

3. Results and Discussions

În această secțiune prezentăm cadrul analitic al evoluției rezultatelor în cadrul testelor experimentale, precum și direcțiile strategice de acțiune menite să optimizeze capacitatea psihomotorie în rândul elevilor din clasele a III-a și a IV-a, prin utilizarea unităților tematice axate pe mijloace psihomotorii în cadrul orei de educație fizică.

Table 1. Percentage separation and number of responses given in question no. 14 of the questionnaire

QUESTION 14		NO. OF ANSWERS			
		0-20 %	20-50%	50-80 %	80-100%
How many hours of physical education do you manage to carry out from the content of the syllabus, acting directly on the psychomotricity components?	Pitești	0	0	14	42
	Argeș County	0	2	12	10

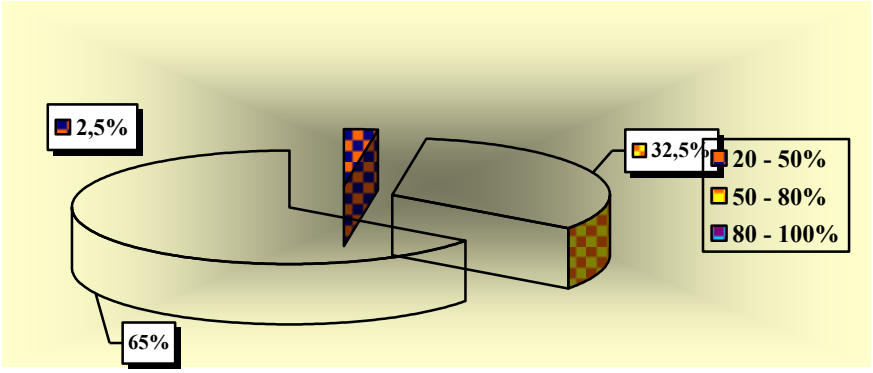


Figure 1. Percentage weight of carry out of the themes specific to the hours of physical education by psychomotor means

Table 1 and Figure 1 indicate that a substantial proportion of respondents report implementing psychomotor content in PE curricula at moderate-to-high levels (50-80%, and 80-100%). Regional variation exists, with differences between Pitești and Argeș County suggesting contextual factors affecting the adoption of psychomotor means.

Table 2. Percentage separation and number of responses given in question 16 of the questionnaire

QUESTION		NUMBER OF ANSWERS		
		YES	NO	I DON'T KNOW
Do you think the didactic process within physical education hours may result in a qualitative increase of the psychomotor behavior in pupils from elementary school?	Pitești	41	8	1
	Argeș County	29	6	8

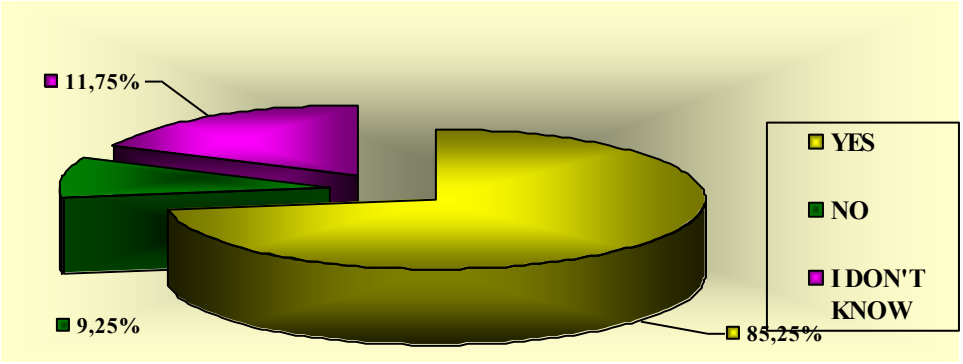


Figure 2. *Distribution of responses concerning the quality of the didactic process within physical education hours and the psychomotor behavior's influencing*

Table 2 and Figure 2 show that opinions regarding the didactic process in PE contributing to qualitative improvements in pupils' psychomotor behavior are predominantly positive in both sites, albeit with a non-negligible minority expressing uncertainty or negative views. In particular, YES responses outnumber NO and I don't know in both locations, though Argeș County displays a higher proportion of NO expressions and a notable I don't know category.

The data support the study's premise that psychomotor-focused thematic units embedded in PE can influence both the quantity and quality of psychomotor development, motivating further experimental validation and controlled analyses.

The preliminary experimental study has proposed to research the actual level of motor and psychomotor training in pupils within the 3rd and 4th grades reference. Thus, within the preliminary experiment, we pursued to demonstrate hypothesis number 2, which states that: *from the perspective of the strategy to act on the optimization of the psychomotor capacity, we think we will be able to improve the quality process of development of the two sets of parameters, motor and psychomotor, only if we will create thematic systems of acting with a predominant*

content of psychomotor means adapted to the process and provided by operational objectives measurable and noticeable (quality of the didactic process), fact proven correct by the results obtained following the carry out of eight general motor skills tests and four tests which capture the main components of psychomotricity. We think that this process to improve the component parameters of the general motor skills side as a support pillar and within the own practical experiment, thus laying the support base for the psychomotor capacity developed by pupils from elementary school, 3rd and 4th grades.

On the evolution of results in the 4th grade in initial testing, we notice that to the comparative analysis of significance t- test of the two samples under research (control-experimental), none of the **eight trials** making up the general ***motor skills profile*** was statistically different.

Table 3. t-test Analysis of the General Motor Skills Profile in Grade 4

t; p	***25 m***	***Standing long jump***	***4-cycle exercises***	***Agility***	***Hanging exercise***	***Abdomen***	***Push-ups***	**Target throw**
Initial Testing	**1,54**	**1.14**	**1,52**	**1,57**	**1.69**	**1.94**	**1.87**	**1.88**
	0.128	**0.259**	**0.134**	**0.122**	**0.09**	**0.06**	**0.07**	**0.07**
Final Testing	**2.24**	**4.01**	**2.91**	**3.32**	**1.97**	**2.47**	**3,5**	**2,87**
	0.02	**0.0002**	**0.005**	**0.001**	**0.06**	**0.01**	**0.001**	**0.006**

However, we can see that *on the evolution of results in the 4th grade in the final testing,* the comparative analysis by the t-test of the two samples under research (control-experimental) shows that one (*Hanging exercise)* in the eight trials making up the general *motor skills profile* was not statistically different.

In the examinations regarding the *evolution of results in the 4th grade in the initial testing*, the comparative analysis by the t-test of the two samples under research (control-experimental) shows that none of the four trials making up the *psychomotricity profile* was statistically different.

Table 4. t-test Analysis of the Psychomotor Profile in Grade 4 (Initial Testing)

t; p	***Bourdon T.***	***Lalume T.***	Matorin T.	**Romberg T.**
Initial Testing	**1.08**	**0,428**	**0,839**	**0.682**
	0.283	**0.670**	**0.405**	**0.498**
Final Testing	**2,08**	**2,43**	**1.53**	**2,14**
	0.04	**0.01**	**0.131**	**0.03**

Hoverer, we can see that *on the evolution of results in the 4th grade in the final testing,* the comparative analysis by the t-test of the two samples under research (control-experimental) shows that three of the four trials making up the *psychomotricity profile* were statistically different, except for the Matorin Test.

The specific strategic directions to act in relation to the optimization of the psychomotor capacity in the pupils from elementary school, 3rd and 4th grades are:

The essence of strategic approaches to optimizing psychomotor capacity in elementary school pupils (grades 3–4) lies in implementing systems of psychomotor means specifically designed and adapted to physical education lessons. Within the preliminary experiment, thematic units were applied to two classes totaling 50 pupils (25 in grade 3 and 25 in grade 4). These units introduced differentiated instructional activities emphasizing direct engagement with psychomotor means integrated with general motor skills. The adapted content, employing varied materials and accessories, fostered improved motor skill retention and enhanced execution under diverse conditions.

The findings align with growing evidence identifying psychomotor capacity as central to holistic child development. Enhanced psychomotor capacity supports not only motor performance but also cognitive and affective competencies, validating the pedagogical focus on psychomotor content in physical education (Purwanto & Susanto, 2020; Cojanu & Vișan, 2017). Similar benefits of psychomotor-oriented thematic units have been reported, showing gains in fundamental motor skills and instructional quality (Costa et al., 2015; Romiszowski, 2013). Sustained emphasis on psychomotor content was associated with better coordinative control and motor execution, consistent with prior longitudinal findings (Romiszowski, 1993, 2013).

The assessment framework, incorporating psychomotor and motor tests, aligns with established diagnostic practices such as the Bourdon, Lalume, Matorin, and Romberg batteries, confirming their utility across contexts (Pirová, 2020; Atmojo et al., 2023). Regional variability in outcomes reflects differences in teacher preparation and resource access, underscoring the importance of contextual adaptation and professional development (Cojanu & Vișan, 2017).

In conclusion, integrating psychomotor content into physical education enhances both the magnitude and quality of psychomotor development. Future research should refine thematic-unit strategies, ensure consistent implementation, and expand mixed-methods inquiry to capture the mechanisms underpinning observed improvements.

4. Conclusions and propositions

The experimental procedures and methods increased the density and intensity of the lessons, and the progress observed among pupils indicates that most participants maintained an active and attentive engagement during instruction.

A substantial improvement in individual performance was noted across the cohort, with pronounced gains among pupils who initially exhibited weaker results.

The arithmetic mean of results rose across trials while the coefficient of variation declined, indicating a trend toward greater homogeneity within value groups.

Improvements in pass accuracy enhanced the ability to execute attacking drills, solve positional tasks, and scoring opportunities.

The introduction of an in-house passing system—reflecting collective team play—highlighted improved tactical understanding among players and contributed to team cohesion.

Pass precision, as a tactical component, enhanced the overall effectiveness of the team's play.

The selected exercises should align with pupils' levels of physical, theoretical, tactical, and technical training.

From a methodological standpoint, there is a strong justification for developing ambidexterity in ball striking as a foundational skill for future football-related activities.

Propositions:

- Pass precision should be refined by all players, irrespective of their position within the team or section.
- All passing procedures should be perfected.
- Passing techniques should be introduced from as early an age as feasible to foster skill acquisition in ball striking.
- Pass refinement should occur under conditions that integrate tactical awareness and situational pressure.
- Students should be encouraged and stimulated to devise new passing procedures, particularly those with lower in-game effectiveness.

Bibliography

1. Alhassan, S.; Nwaokelemeh, O.; Ghazarian, M.; Roberts, J.; Mendoza, A.; Shitole, S. Effects of locomotor skill program on minority preschoolers' physical activity levels. *Pediatr. Exerc. Sci.* **2012**, *24*, 435–449.
2. Amri Hammami, Randers, M. B., Kasmi, S., Razgallah, M., Tabka, Z., Chamari, K., & Bouhlel, E. (2018). Effects of soccer training on health-related physical fitness measures in male adolescents. Journal of Sport and Health Science, 7(2), 169-175. https://doi.org/10.1016/j.jshs.2017.10.009
3. Ardelean,T. (2006), Psihomotricitatea în cadrul motricităţii umane, Sesiunea internaţională de comunicări ştiinţifice, A.N.E.F.S., Bucureşti. p. 48 (*Psychomotricity within human motor skills, International session of scientific communications , A.N.E.F.S., Bucharest, p. 48).*
4. Atmojo, I. R. W., Adi, F. P., Ardiansyah, R., Saputri, D. Y., & Mahendrati, G. (2023, December). Analysis of Psychomotor Assessment Techniques in the K13 Integrated Thematic Book. In 6th International Conference on Learning Innovation and Quality Education (ICLIQE 2022) (pp. 598-609). Atlantis Press.

5. Barnett, L.M.; Stodden, D.; Cohen, K.E.; Smith, J.J.; Lubans, D.R.; Lenoir, M.; Iivonen, S.; Miller, A.D.; Laukkanen, A.; Dudley, D.; et al. Fundamental movement skills: An important focus. *J. Teach. Phys. Educ.* **2016**, *35*, 219–225.
6. Chaplyhin, V. P., Gaevyi, V. Yu., & Gaeva, N. I. (2024). Features of speed qualities development in football players. Scientific Journal of National Pedagogical Dragomanov University, 3K(176), 500-504.
7. Chen, S.-T.; Yan, J. Prevalence and selected sociodemographic of movement behaviors in schoolchildren from low-and middle-income families in Nanjing, China: A cross-sectional questionnaire survey. *Children* **2020**, *7*, 13.
8. Chepeliuk, A., Bihun, V., & Holub, O. (2023). The use of artificial intelligence in modern sports: a philosophical view on the problem. Bulletin of Science and Education, 11(17), 1235-1245.
9. Cojanu Florin in (2009), in his, Study of rethinking the structure on the project used for teaching the lesson of physical education, Magazine No. 3., Vol. 24, September - Journal of Physical Education an Sport - University of Piteşti. Vol. 24. http://efsupit.ro/images/stories/imgs/JPES/2009/5%20Cojanu.pdf
10. Cojanu, F., & Visan, P. (2017). New Perspectives To Develop Psychomotor Capacity For Romanian Childrens From Primary School. In E. Soare, & C. Langa (Eds.), Education Facing Contemporary World Issues, vol 23. European Proceedings of Social and Behavioural Sciences (pp. 1423-1431). Future Academy. https://doi.org/10.15405/epsbs.2017.05.02.174.
11. Colibaba, E.D, (2007), Praxiologie şi proiectarea curriculară în educaţie fizică şi sport, Ed. Universitaria, Craiova; (*Praxiology and curricular design in physical education and sports, Universitaria Publishing House of Craiova);*
12. Colibaba,E., D., (1996) *Proiectarea didactică ştiinţifică şi implementarea ei în activitatea sportivă de performanţă*, în Ştiinţa sportului nr. 2, Bucureşti (*Scientific didactic design and its implementation to the professional sports activity in Sport Science no. 2, Bucharest)*
13. Costa, H. J. T., Abelairas-Gomez, C., Arufe-Giráldez, V., Pazos-Couto, J. M., & Barcala-Furelos, R. (2015). Influence of a physical education plan on psychomotor development profiles of preschool children. Journal of Human Sport and Exercise, 10(1), 126-140.
14. Dewi, R.; Verawati, I. The effect of manipulative games to improve fundamental motor skills in elementary school students. *Int. J. Educ. Math. Sci. Technol.* **2022**, *10*, 24–37.
15. Donath, L.; Faude, O.; Hagmann, S.; Roth, R.; Zahner, L. Fundamental movement skills in preschoolers: A randomized controlled trial targeting object control proficiency. *Child Care Health Dev.* **2015**, *41*, 1179–1187.
16. Dragnea, A. şi Mate-Teodorescu, S. (2002) - Teoria sportului. Bucureşti, Ed. Fest (*Sports Theory, Bucharest, Fest Publishing House)*
17. Dragnea, A., Bota, A; (1999), Teoria activităţilor motrice, Ed. Didactică şi

Pedagogică, R.A , Bucureşti Pag. 44.- 48. (*Theory of motor activities, Didactic and Pedagogical Publishing House, R.A., Bucharest, pages 44- 48)*

18. Gamma, T. V., Grygus, I. M., Orel, I. O., & Girak, A. M. (2022). Physical therapy for children aged 10-12 years with grade II scoliosis. Rehabilitation and Recreation, 11, 10-17. https://doi.org/10.32782/2522-1795.2022.11.1

19. Godlevskyi, P. M., Zubrytskyi, B. D., & Spryn, O. B. (2024). Development of special physical qualities of football players. Rehabilitation and Recreation, 18(1), 218-226. https://doi.org/10.32782/2522-1795.2024.18.23

20. Hernandez-Martin, A., Garcia-Unanue, J., Martínez-Rodríguez, A., Manzano-Carrasco, S., Felipe, J. L., Carvalho, M. J., Gallardo, L., & Sanchez-Sanchez, J. (2021). The effects of football practice on nutritional status and body composition in children: a systematic review and meta-analysis. Nutrients, 13(8), 2562. https://doi.org/10.3390/nu13082562

21. Holiaka, S. K., Spryn, O. B., & Levchenchuk, O. A. (2023). Research on the impact of football club activities on the physical fitness of middle school students. Perspectives and Innovations of Science (Series "Pedagogy", Series "Psychology", Series "Medicine"), 1(19), 77-85.

22. Mihăilescu, L, (2008), Teoria educaţiei fizice şi sportului, note de curs, Ed. Universităţii din Piteşti (*Theory of physical education and sports, course notes, Publishing House of the University of Piteşti)*

23. Mihăilescu, L; Mihăilescu, N., (2006), Atletism în sistemul educaţional, Editura Universităţii din Piteşti (*Athletics in the education system, Publishing House of the University of Piteşti)*

24. Orlick, T. *Cooperative Games and Sports: Joyful Activities for Everyone*; Human Kinetics Publication, Inc.: Champaign, IL, USA, 2006.

25. Pirová, V. (2020). Assessment of psychomotor development of preschool children: A review of eight psychomotor developmental tools. World Academy of Science, Engineering and Technology, International Journal of Sport and Exercise Sciences, 14(11), 366-375.

26. Planinsêc, J., and Pisôt, R. (2006). Motor coordination and intelligence level in adolescents. *Adolescence* 41, 667–676.

27. Programa şcolară Educaţie Fizică şi Sport pentru ciclul liceal, (2008). Ed. Ministerul Educaţiei, Cercetării şi Inovării, Bucureşti (*School curriculum for Physical Education and Sports for high school education, Publishing House of the Ministry of Education, Research and Innovation, Bucharest);*

28. Purwanto, S., & Susanto, E. (2020, February). Development of Physical Education Model Based on Character for Improving Affective, Cognitive, and Psychomotoric Values in Elementary School. In International Conference on Educational Research and Innovation (ICERI 2019) (pp. 319-323). Atlantis Press.

29. Raţă, G., (2004) *Didactica educaţiei fizice*, Ed. Alma Mater, (*Didactic of*

physical education, Alma Mater Publishing House, Bacău)

30. Raţă, G., Constantinescu, E., (2002), *Didactica predării educaţiei fizice şi sportului,* Ed. Alma Mater, Bacău*; (Didactic of teaching physical education and sports, Alma Mater Publishing House, Bacău)*

31. Raţă, G., Raţă, C-tin, B. (2006). Aptitudinile în activitatea motrică, Editura, EduSoft, Bacău, pag. 13 -17. (*Skills related to motor activity, Edu Soft Publishing House, Bacău, pages 13-17)*

32. Romiszowski, A. J. (1993). Psychomotor principles. Instructional message design: Principles from the behavioral and cognitive sciences, 2, 127-190.

33. Sacară, L., Dămian, I., Macarie, G.F., Tebeanu, A.V. (2006), Psihopedagogia în sinteze, Editura EduSoft, Bacău – pag. 85; (*Psychopedagogy in syntheses*, *Edu Soft Publishing House, Bacău, p. 85)*

34. Scarlat, E., (1993) *Educaţie fizică a copiilor de vârstă şcolară*, Ed. pentru Tineret şi Sport, Bucureşti (*Physical education for school-age children, Publishing House for Youth and Sports, Bucharest)*

35. Scarlat, E., (1993) *Lecţia de educaţie fizică*, Ed. Editis, Bucureşti; (*Physical education lesson, Editis Publishing House, Bucharest)*

36. Tourrette, C., Guidetti, M. (1998), Introduction a la psychologie du development. Du bebe a l'adolescent, Editeur Armand Collin, Paris, Petit Larousse Edition Larousse, Paris.

37. Vestberg, T., Gustafson, R., Maurex, L., Ingvar, M., and Petrovic, P. (2012). Executive functions predict the success of top-soccer players. *PLoS ONE* 7:e34731. https://doi.org/10.1371/journal.pone.0034731

IMPACT OF HYBRID EDUCATION ON THE DEVELOPMENT OF THE INSTRUCTIONAL-EDUCATIONAL PROCESS AND THE ADAPTABILITY OF PRIMARY SCHOOL STUDENTS

Adrian Lungu[1]

[1] *Institute of Physical Education and Sports, Andrei Doga Street 22, Moldova State University, Republic of Moldova*

Abstract

The work addressed consisted of the influence of the combination of online and face-to-face education (hybrid education) on the physical performance of primary school students, with a special emphasis on physical education. In the context of the digitization of education and the pandemic, the research aims to identify the effectiveness of this method on the involvement of students and the development of cognitive and motor skills, especially for grades III-IV. Methodology: The study was conducted on two classes of students from "Marginea" School, who participated in hybrid sessions, including both face-to-face lessons and online sessions, within the physical education discipline. Research instruments included a questionnaire applied to teaching staff and measurements of students' physical abilities. The collected data were analyzed and interpreted to identify correlations between the use of digital platforms and performance in physical education. The paper's hypothesis: It is assumed that by implementing hybrid education, it contributes to the physical improvement of primary school students, by facilitating a more flexible and personalized educational process. It is also estimated that adapted online physical education can boost students' motivation and physical development. Conclusions: The results indicate that hybrid education can optimize both the educational and physical performance of students through a coherent implementation of online and face-to-face activities, contributing to a well-rounded educational development.

Key words: *hybrid education, adaptability, students, primary school*

1. Introduction

In the context of continuous changes in contemporary society, the education system is in a state of continuous adaptation, and the professional development of teachers becomes essential for overcoming obstacles that may hinder students' access and participation in the educational process (Lungu, 2024). The knowledge society requires a closer connection between individuals and communities, and new information and communication technologies, essential for the conduct of human activities, are increasingly present in educational practice (Ilie, 2019).

The hybrid implementation of pedagogical models helps to overcome the limitations of a single pedagogical model, having a positive impact on student learning outcomes in physical education (Shen & Shao, 2022). Thus, it is stated that a learning environment supported by a collaborative approach, building on the strengths of universities and schools, provides expanded learning opportunities for

teachers and, implicitly, more effective training. The term "hybrid space" defines the ideal environment of shared partnership, in which knowledge is co-created, promoting collaborative egalitarianism between the parties involved (Lynch, 2015).

Hybrid teaching, an innovative approach, involves providing teaching resources to students through online learning, combined with offline teaching sessions, to facilitate knowledge acquisition and increase the efficiency of the learning process (Bao & Yu, 2021). In the digital age, current information technology plays an essential role in the educational process, having a significant impact on various subjects, including physical education. This study analyzes how information technology can be applied in physical education classes for primary school students, comparing the efficiency and impact on student performance and engagement (Țurcanu, Tanase, & Vizitiu Lakhdari, 2024).

By integrating the acmeology concept into professional development, physical education teachers become essential in adapting the learning experience to the individual needs of students. They adjust teaching strategies to support students' personal progress, improving physical performance and promoting a healthy lifestyle. By applying acmeology, teachers encourage students to overcome limits, discover their abilities and build optimal physical health (Slusar & Vizitiu, 2024).

Among the many sports games, we propose a study that explores the learning of badminton technique during the COVID-19 pandemic, using information technology through the online platform (Tănasă & Vizitiu, 2020). This holistic approach emphasizes the importance of integrating information technologies and applying a hybrid pedagogical framework to support the development of students' development and to improve the educational process in general.

2. Material and method

The experiment aimed to test and evaluate the effect of hybrid education on the physical development and motivation of students in primary grades (III-IV), by integrating online and face-to-face physical activities, especially in the context of physical education. It was intended to observe how this combination of learning influences the physical performance and motivation of students. Hypothesis of the work: It is assumed that by implementing hybrid education, it contributes to the physical improvement of students in primary grades, by facilitating a more flexible and personalized educational process. It is also estimated that adapted online physical education can stimulate the motivation and physical development of students.

The experiment aimed to test and evaluate the effect of hybrid education on the physical development and motivation of students in primary grades (III-IV), by integrating online and face-to-face physical activities, especially in the context of physical education. It was intended to observe how this combination of learning influences the physical performance and motivation of students. The experiment was

conducted with two classes of students from the "Marginea" School, a 3rd grade class and a 4th grade class, with a total number of 10 students/class.
Student inclusion criteria: Students who voluntarily chose to participate in the experiment, given their interest in physical activities. Students who had parental consent to participate in the experiment. Approval of the school principal and the teachers involved. Students who do not have medical contraindications to participate in physical activities. The experiment was structured over a period of 7 weeks, combining face-to-face activities (within physical education classes) and online activities (to support and complement physical learning).
Types of activities: Face-to-face activities, physical exercises, group games, physical tests (jumps, balance, endurance, flexibility) and online activities, video sessions for learning and demonstrating physical exercises, individual challenges, interactive coordination and balance games.

Table 1 *Physical Education Program – Module 3 (7 Weeks, Hybrid Learning, Grades III–IV)*

Week	Objective	Face-to-Face Session (1 hour)	Online Session (1 hour)
1. Movement and socialization games	Developing team spirit and adapting to physical activities through games.	- Game "Animal Relay" (walking like different animals). - Game "Grab the Tail" (students try to grab a scarf tied to a classmate's belt).	- Online coordination game (e.g. children follow video commands for movement). - Mini-challenge: finding 3 favorite warm-up exercises.
2. Coordination and balance	Improving balance and body awareness.	- Walking in a straight line. - Jumping on one leg. - Game "Step on the stones" (circles placed on the ground).	- Balance exercises with an object on your head. - Challenge: maintain balance for 30 seconds on one leg.
3. Strength and endurance	Increased muscle strength and physical endurance.	-Kneeling push-ups. - Squats. - Easy running relays.	- Bodyweight exercises: planks, lunges, jumps. - Video demonstration with correct techniques.
4.Flexibility and mobility	Increased joint mobility and muscle flexibility.	- Dynamic and static stretches. - Yoga exercises for children. Întinderi dinamice și statice. - Exerciții de yoga pentru copii.	- Tutorial with stretching exercises. - Challenge: achieving a flexibility position .

Week	Objective	Face-to-Face Session (1 hour)	Online Session (1 hour)
5.Speed and reaction	Improving reaction time and execution speed.	- Short distance running (10m sprint). - Game "React quickly" (teacher gives commands for quick movements) .	-Online game: reaction to visual/audio signals. - Jumping exercises rapide (jumping jacks).
6. Endurance cardio	Increasing cardiovascular capacity through dynamic activities.	- Easy running 3-5 minutes. - Relays and applicative courses.	- Aerobic exercises at home (e.g. jumping rope, jumping jacks). - Challenge: 3 minutes of non-stop exercise.
7. Applicative games and fun	Applying skills developed within playful activities.	- Game "Obstacle course" (jumps, balance, running). - Game "Capture the flag" (team competition).	- Interactive movement games (e.g. synchronized dancing to a video). - Mini-quiz on the benefits of exercise.

3. Results and Discussions

The correlation between the IT Jumping in Place Test and the FT Jumping in Place Test is r = 0.9943. This almost perfect correlation suggests that the performances obtained on the jumping in place test are very similar between the IT and FT. This result may indicate either a high stability of the neuromuscular capacities or a consistent and replicable testing methodology.

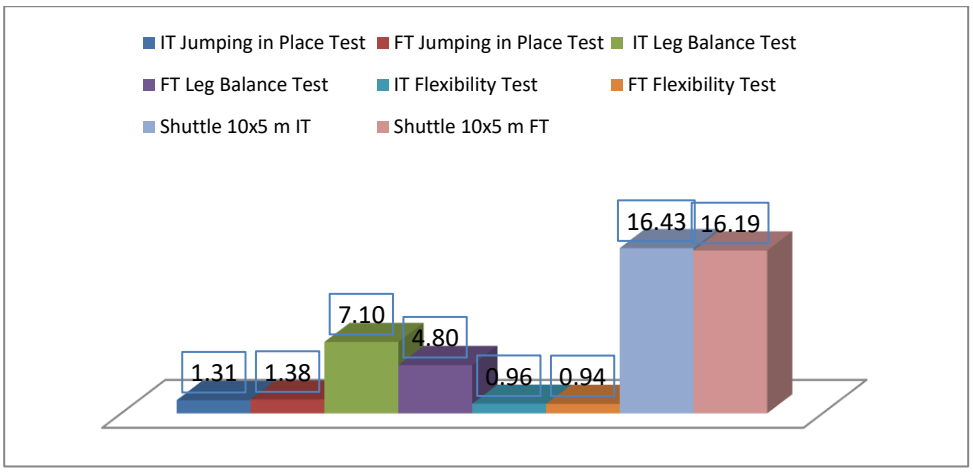


Figure 1 *The mean values of performance in the physical fitness tests (3rd grade – mean)*

Table 1 *Analysis of correlations between physical performance tests – 3rd grade*

Tests	IT Jumping in Place Test	FT Jumping in Place Test	IT Leg Balance Test	FT Leg Balance Test	IT Flexibility Test	FT Flexibility Test	Shuttle 10x5 m IT	Shuttle 10x5 m FT
IT Jumping in Place Test	1.00							
FT Jumping in Place Test	0.99	1.00						
IT Leg Balance Test	-0.45	-0.50	1.00					
FT Leg Balance Test	0.04	0.00	0.73	1.00				
IT Flexibility Test	0.30	0.33	-0.73	-0.50	1.00			
FT Flexibility Test	0.30	0.33	-0.73	-0.53	0.99	1.00		
Shuttle 10x5 m IT	-0.80	-0.82	0.55	-0.03	-0.27	-0.26	1.00	
Shuttle 10x5 m FT	-0.79	-0.81	0.54	-0.07	-0.25	-0.24	0.98	1.00

The correlation between the IT Leg Balance Test and the FT Leg Balance Test is r = 0.7366.A strong correlation between these two variables suggests that the ability to maintain balance on one leg is a stable attribute between the two test moments (IT and FT). This may indicate that the biomechanical and neuromuscular factors responsible for balance control are relatively constant over time. The correlation between the IT Flexibility Test and the FT Flexibility Test is r = 0.9971. The value close to 1 indicates an extremely strong relationship, suggesting that the flexibility measured in the initial and final tests is almost identical. This result can be explained either by an intrinsically stable flexible capacity of the students or by a limited effect of the intervention on flexibility during the analyzed period. The correlation between the Shuttle 10x5 m IT and the Shuttle 10x5 m FT is r = 0.9882. This extremely high correlation indicates a consistency in the measurement of speed and agility by the Shuttle 10x5 m test. This result suggests that motor performance is well preserved between IT and FT testing and that the 10x5 m Shuttle test is a reliable tool for assessing these characteristics.

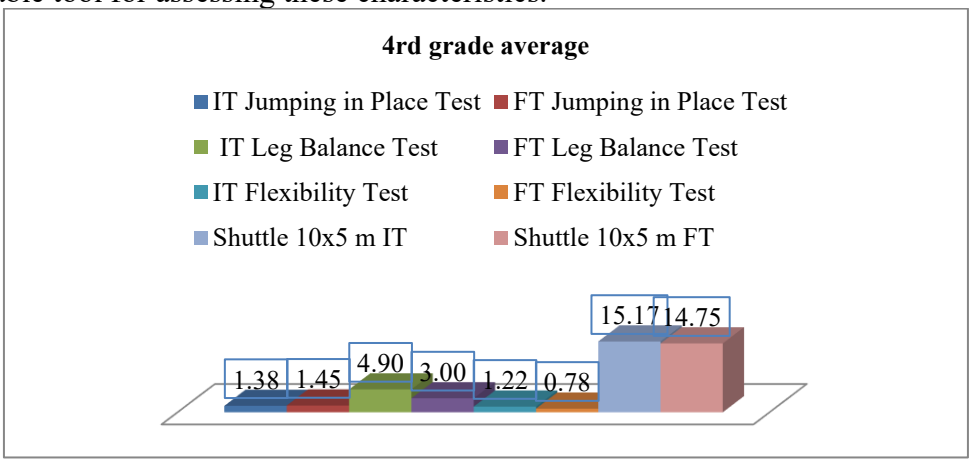


Figure 2 *The mean values of performance in the physical fitness tests (4rd grade – mean)*

Table 2 *Analysis of correlations between physical performance tests – 4rd grade*

Tests	IT Jumping in Place Test	FT Jumping in Place Test	IT Leg Balance Test	FT Leg Balance Test	IT Flexibility Test	FT Flexibility Test	Shuttle 10x5 m IT	Shuttle 10x5 m FT
IT Jumping in Place Test	1.00							
FT Jumping in Place Test	0.98	1.00						
IT Leg Balance Test	0.06	0.06	1.00					
FT Leg Balance Test	-0.02	0.00	0.59	1.00				
IT Flexibility Test	0.26	0.24	0.50	0.62	1.00			
FT Flexibility Test	0.29	0.28	0.52	0.60	0.99	1.00		
Shuttle 10x5 m IT	-0.61	-0.66	0.11	0.05	0.03	0.00	1.00	
Shuttle 10x5 m FT	-0.63	-0.70	0.17	-0.04	-0.05	-0.09	0.95	1.00

The correlation between the IT Jumping in Place Test and the FT Jumping in Place Test is r = 0.9893. This result suggests either a consistent testing technique or a consistent neuromuscular capacity of the participants. The correlation between the IT Flexibility Test and the FT Flexibility Test is r = 0.9912. The extremely high correlation between the flexibility tests indicates a very consistent measurement of this physical characteristic between the IT and FT assessments. This stability may reflect either a precise testing methodology or a limited influence of the lesson on flexibility over the time frame analyzed.The correlation between the IT Leg Balance Test and the FT Leg Balance Test is r = 0.5958. This moderate to strong correlation suggests a significant relationship between the balance ability assessed in the IT and FT tests. Although the value is not as high as for other variables, the result still indicates a consistency between the two measurements. The correlation between the IT Flexibility Test and the IT Leg Balance Test is r = 0.5069.This moderate correlation suggests a possible interdependence between flexibility and balance. Increased joint mobility may contribute to better postural management and dynamic stability. The correlation between the IT Flexibility Test and the FT Leg Balance Test is r = 0.6206. This positive correlation indicates a link between flexibility and balance, which may suggest that participants with better flexibility tend to score better on balance tests as well. The correlation between the FT Flexibility Test and the FT Leg Balance Test is r = 0.6021. Similar to the previous relationship, this correlation indicates that participants who exhibit better flexibility also have a higher ability to maintain balance in FT tests. The correlation between the Shuttle 10x5 m IT and the Shuttle 10x5 m FT is r = 0.9554. This very high correlation suggests that performance in the speed and agility test is highly consistent between the IT and FT assessments, indicating the high reliability of the Shuttle 10x5 m test as a measure of these characteristics.

In the Jumping in Place Test, both grades recorded a similar improvement, which suggests a balanced adaptability in the development of this aspect of motor skills. In the One-Leg Balance Test, a decrease in balance performance is observed for both grades, but the 3rd grade has a more pronounced decline. This could indicate

a greater difficulty in adapting to the changes brought about by hybrid education for younger students. In the Flexibility Test, the flexibility of the 4th grade students decreased significantly, while in the 3rd grade it remained almost constant. This result could suggest that older students were more affected in the development of body mobility. In the 10x5 m Shuttle Test, the 4th grade students recorded a greater improvement in reaction time and endurance than the 3rd grade students, which could indicate a better capacity for recovering physical condition.

4. Conclusions

The results suggest that hybrid education can contribute to both optimizing educational performance and physical development of students, through a balanced and coherent implementation of online and face-to-face activities, thus favoring holistic educational development. The differences observed in the performances of students in grades 3 and 4 indicate that age and educational experience influence how they adapt to the transitions imposed by hybrid education. Older students showed a more significant decrease in flexibility and balance, which could signal a greater vulnerability to this type of education, unlike students in grade 3, who demonstrated superior adaptability. In contrast, students in grade 4 recorded significant results in speed and endurance tests, suggesting a greater capacity to recover physical condition.

Bibliography

1. Bao, L., Yu, P. (2021). *Evaluation method of online and offline hybrid teaching quality of physical education based on mobile edge computing*. *Mobile Networks and Applications*, *26*(5), 2188-2198. https://doi.org/10.1007/s11036-021-01774-w.
2. Ilie, V. (2019). *The flipped classroom*. *Education Quarterly Reviews*, *2*(2), 395-407. DOI: 10.31014/aior.1993.02.02.72
3. Lungu, C., A. (2024*). Educația continuă a specialiștilor în cadrul educației hibride-abordarea investigativă*. International Scientific Conference "Actualities and Perspectives of Physical Education and Sport Sciences" 5th Edition, p. 209. ISSN 2734-8512, https://www.ueb.ro/
4. Lynch, T. (2015). T*eacher education physical education: In search of a hybrid space.* Cogent Education, *2*(1), 1027085. https://doi.org/10.1080/2331186X.2015.1027085
5. Shen, Y., Shao, W. (2022). *Influence of hybrid pedagogical models on learning outcomes in physical education: a systematic literature review*. *International journal of environmental research and public health*, *19*(15), 9673. https://doi.org/10.3390/ijerph19159673.
5. Slusar, A., Vizitiu, E. (2024*). Implementarea conceptului acmeologic în formarea profesională a profesorilor de educație fizică în vederea optimizării*

condiției fizice a elevilor. In: Formarea continuă a specialistului de cultură fizică în conceptul acmeologic modern, Ed. 3, 15 februarie 2024, Chișinău. Chișinău, Republica Moldova: Dapartamentul Sporturi de Lupte și Gimnastică al USEFS, 2024, Ediția 4, pp. 117-121. ISBN 978-9975-68-504-7.

6. Tănasă, B. I., Vizitiu, E. (2020). *Study on the technique of the game of badminton by using information technology during the pandemic covid-19 in students aged 10-12 years. Annals of the "Ştefan Cel Mare" University: Physical Education and Sport Section-The Science and Art of Movement*, *13*(2), 112-120.
7. Ţurcanu, A., P., Tanase, E., Vizitiu Lakhdari, E. (2024). *Comparative Study on the Application of Information Technology in Physical Education Lessons for Primary School Students.* Gimnaziul: Jurnalul Științific de Educație, Sport și Sănătate, 2024, Vol 25, Numărul 2, p51, DOI 10.29081/gsjesh.2024.25.2.4.

THE IMPORTANCE OF PHYSICAL EXERCISE IN THE PROCESS OF REDUCING OBESITY IN CHILDREN AGED 10-14 YEARS

Remus-Mihail Pozînărea [1], Viorica Calugher [2], Mihail Leonard Ionescu [3], Ecaterina Lungu [4]

[1] *"Vasile Alecsandri" National Colege, Bacau, Romania*
[2] *Center for Continuing Education in the Electoral Field, Chisinau, Republic of Moldova*
[3] *Ecological University of Bucharest, Faculty of Physical Education and Sport, Romania*
[4] *"Ion Creangă" Pedagogical State University of Chisinau, Republic of Moldova*
[4] *Moldova State University, Institute of Physical Education and Sport, Chisinau*
[4] *"Dunarea de Jos" University of Galati, Romania*

Abstract

Middle school students enter a stage of their life characterized by significant morphophysiological, motor, and psychological transformations, specifically the beginning of the maturation process. The student's status and role undergo essential changes determined by new professional and social requirements. Physical education has a series of objectives to fulfill in this educational cycle, closely related to the morphofunctional and psychological characteristics presented by this age. The present study is an experimental one, conducted on a sample of 13 overweight students, male and female, aged between 10 and 14 years, from "Vasile Alecsandri" National College and "George Bacovia" Middle School, Bacău, Romania. Within our research, we designed a physical training program that utilized means of action from various sports branches, adapted to the specifics of middle school students' age. The main results of the research refer to evaluating the impact of the training program applied to the experimental group, reflected in the evolution of anthropometric indicator measurements in the subjects included in the research.

Key words: *obesity, physical exercise, fitness*

1. Introduction

The World Health Organization (WHO) has recognized obesity as a chronic disease that requires long-term management and represents a serious public health problem, being responsible for approximately 44% of type II diabetes cases, about 23% of heart diseases, and in 7% – 41% of cases, for the onset of certain types of cancer. According to WHO, globally, over 1 billion people suffer from obesity, of which 650 million are adults, 340 million are adolescents, and 39 million are children (one in three school-aged children is overweight or obese). It is estimated that by 2035, one in four children and about 1.9 billion adults worldwide will suffer from obesity! The estimated global economic impact of overweight and obesity will reach up to 4.32 trillion USD (WHO Report, 2022). In our work, we tested the hypothesis

that designing and applying a physical preparation program adapted to the particularities of overweight students, outside of physical education classes, in specialized centers, contributes favorably to improving physical condition, by decreasing adiposity and increasing the degree of motor skills.

2. Material and methods

Through this work, we aimed to analyze the extent to which the means and methods of influencing physical fitness in overweight middle school students during their free time contribute to improving metabolic condition and to forming the habit of independent physical exercise practice. We also wanted to elaborate training programs for young people less accustomed to physical activity. The following were used as primary indicators for hypothesis validation: body mass index, body fat percentage, and the results obtained in physical tests targeting 4 basic psychomotor skills (speed, strength, mobility, and endurance).

Objectives of the research are as follows:

- Highlighting the components of physical fitness and their specifics at the ages studied;
- Studying the effects that the means and methods of physical education produce on physical fitness in overweight children.

To achieve the set objectives, we proposed the realization of the following *tasks:*

- Selection of a group of overweight students aged between 10 and 14 years to participate in the research and drafting of observation sheets;
- Selection of anthropometric indicator measurements and psychomotor test sets necessary for investigating the level of physical fitness, respectively the value of its components in the subjects included in the research;
- Developing a specific training program according to the general goal of the research;
- Statistical-mathematical processing of the results.

The research was organized and carried out in the municipality of Bacău, Romania, in the following locations:

- Athletics Hall
- Weightlifting Hall within the Athletics Hall
- Swimming Pool
- FC Bacău Sports Base
- Gymnastics Hall – "Vasile Alecsandri" National College
- Sports Hall - "George Bacovia" School in Bacău.

The material base consisted of: outdoor field, sports hall, gymnastics benches, wall bars, cones, balls of various sizes, dumbbells with variable weights, swimming pool, elastic cords, mats, fitness equipment.

In our scientific endeavor, we used the following *methods:* Documentation method; Observation method; Tests method; Survey method through questionnaire and interview: Statistical-mathematical method; Graphical representation method.

The research was conducted on a sample of 13 overweight students, male and female, aged between 10 and 14 years, from "Vasile Alecsandri" National College and "George Bacovia" Middle School, Bacău, Romania. The results of the research refer to the evaluation of the impact of the training program applied to the experimental student group, which will be reflected in the evolution of anthropometric indicator measurements in the subjects included in the research.

3. Results and Discussions

From the analysis of the results obtained during the initial and final tests applied to the experimental group, we observe an improvement in both anthropometric indicators (weight, body composition) and the results obtained in psychomotor skills tests, confirming the hypothesis formulated for our research (Table 1). Moreover, the obtained results also support the results of similar studies existing in the specialized literature.

Table 1. *Student's t-test results for anthropometric indicators*

Nr.	Name	Student's t-test	Observations
1	Weight	t_{12}=11.63, p<0.005, t_{crit}=3.05	
2	Body Composition	t_{12}=5.08, p<0.005, t_{crit}=3.05	*
3	Ruffier Test	t_{12}=14.69, p<0.005, t_{crit}=3.05	

** reserve regarding data normality*

In the case of anthropometric indicators, the results are statistically significant, as reflected in Table 1, with the exception of body composition, where the test results are obtained against a background of results that cannot be accepted as normally distributed. A plausible explanation would be the calculation method for body fat composition, which uses distinct formulas for boys and girls. For all subjects involved in the research, weight decreased, concurrent with a decrease in body fat percentage and an improvement in effort capacity. The obtained results coincide with those obtained in other similar studies (Owens, 1999; Watts & al, 2005).

Table 2. *Student's t-test results for scores recorded in physical tests*

Nr.	Name	Student's t-test	Observations
1	Push-ups 30 sec	t_{12}=9.45, p<0.005, t_{crit}=3.05	
2	Trunk raising from supine position	t_{12}=11.43, p<0.005, t_{crit}=3.05	
3	Standing long jump	t_{12}=5.06, p<0.005, t_{crit}=3.05)	*
4	Squats 30 sec	t_{12}=7.41, p<0.005, t_{crit}=3.05	*
5	50m speed run	t_{12}=8.17, p<0.005, t_{crit}=3.05	
6	Mobility test	(t_{12}=4.67, p<0.005, t_{crit}=3.05	

** reserve regarding data normality*

In the case of physical tests, we note a positive evolution of the results obtained (Table 2), statistically confirmed with the exception of 2 out of the 6 tests, due to the non-normality of the recorded data (standing long jump and 30-second squats). The results thus confirm our research hypothesis, namely that the design and application of a physical preparation program adapted to the particularities of overweight students, outside of physical education classes, in specialized centers, contributes favorably to improving physical condition, by decreasing adiposity and increasing the degree of motor skills.

4. Conclusions

The phenomenon of obesity in children is real and takes on alarming dimensions, on the one hand due to over-technologization, which favors sedentarism and the lack of social interactions (phone, tablet, PC, etc.), and on the other hand, due to a lack of interest from society in understanding and promoting the benefits of physical exercise.

Physical exercise does not only act as an energy consumer; it also intervenes in certain metabolic and enzymatic processes, accelerating the "burning" of adipose mass. In this sense, for example, physical effort breaks the vicious cycle of hyperinsulinism, which characterizes obese individuals, as obesity has a diabetogenic effect.

At the same time, the number of hours allocated to the physical education discipline in the curriculum is not sufficient for the complete development of students' psychomotor qualities and skills. A training program, coordinated by a professional and carried out in specialized sports institutions, are elements that contribute to achieving objectives in a much shorter time, avoiding injuries and risks that would result from a wrong approach to physical exercise.

Bibliography

1. Owens, S., Gutin, B., Allison J., et al.(1999). Effect of physical training on total and visceral fat in obese children, *Medicine and Science in Sports and Exercise,* Jan;31(1): pg.143-148. DOI: 10.1097/00005768-199901000-00022. PMID: 9927022.
2. *Raportul European privind Obezitatea* (2022) al Organizației Mondiale a Sănătății: https://ansp.md/raportul-oms-privind-obezitatea-in-regiunea-europeana-anul-2022/
3. Watts, K., Jones, T.W., Davis, E.A. et al (2005). Exercise Training in Obese Children and Adolescents, *Sports Med* 35, pg.375–392 (2005). https://doi.org/10.2165/00007256-200535050-00002

IMPROVING THE EFFORT CAPACITY OF HIGH SCHOOL STUDENTS BY IMPLEMENTING SPINNING IN THE PHYSICAL EDUCATION PROGRAM

Adelina Scheuleac[1]

[1] *Institutul de Educație Fizică și Sport, strada Andrei Doga 22, Universitatea de Stat din Moldova, Republica Moldova*

Abstract

The study investigates the impact of the implementation of spinning in the physical education program on the effort capacity of high school students. The aim is to compare the effects of standard physical education lessons with additional spinning lessons, in order to evaluate the improvements in the physical parameters and sports performance of the students. Methodology: The sample consisted of high school students, divided into two groups: a control group that followed the standard physical education program and an experimental group that also participated in spinning sessions. Exercise capacity was assessed by physical endurance tests and physical performance monitoring. Objectives: To compare the effects of spinning sessions versus the standard physical education program on the exercise capacity of high school students. To determine the impact of spinning sessions on improving general fitness and the ability to sustain prolonged exercise. Analysis of the relationship between the frequency of spinning sessions and the increase in exercise capacity in high school students. Conclusions: Implementing spinning in the physical education program, high school students achieved significant improvements in effort capacity, thus contributing to the optimization of physical performance and the development of a superior physical condition.

Key words: *improvement, exercise capacity, students, spinning, physical education*

1. Introduction

Recent studies highlight the positive impact of exercise on physical fitness, as well as on students' emotional and hormonal well-being. Next, we will analyze recent research and expert-proposed solutions for optimizing the learning process and engaging in physical activity. The rapid increase in obesity among young people has become a global health concern, making the promotion of physical activity a priority (Ickes, Erwin, & Beighle, 2013). In this regard, studies have shown that high-intensity workouts, such as HIIT (High-Intensity Interval Training), can significantly improve physical fitness, including cardiovascular endurance and muscular strength. Additionally, these workouts have been found to have a positive impact on premenstrual and menstrual symptoms by regulating hormones and inflammation (Huang, Chiu, & Ho, 2022). A study conducted by (Duda, Różycki, Stanek, Kąkol & Kubieniec, 2014) examined the effects of spinning on a group of women who practiced this sport recreationally. The participants, who were not engaged in other recreational physical activities, voluntarily chose spinning and reported significant improvements in physical fitness and overall health, highlighting the importance of

regular exercise in daily life. The stationary bike is also an effective therapeutic tool for enhancing joint range of motion, particularly in the hip, knee, and ankle. Research indicates that cycling helps mobilize the ankle throughout its full range of motion, while the mobility of the knee and hip remains more restricted. Additionally, the primary muscles involved in this activity include the tensor fasciae latae, sartorius, quadriceps femoris, and tibialis anterior (He, Lo, & Chen, 2024). In another study by (Ghaleb, Khalaf, Ramadan, Ragab & Badwelan, 2020), it was demonstrated that cycling had no negative effects on individuals performing assembly tasks. Moderate physical activities, such as cycling, were found to have beneficial effects on participants' health and safety, reinforcing the importance of exercise for individual well-being. Currently, information technology plays a crucial role in physical education, significantly influencing the way educational physical activities are conducted. Given the rapid pace of technological advancements, it is essential to understand how they influence students' mindsets and how we can reshape these perspectives to enhance the educational process and motivation for physical activity (Agache & Vizitiu, 2022). With students' dependency on computers and mobile phones increasing, this trend raises concerns about how to foster healthy habits. Various studies emphasize the importance of developing a knowledge and motivation system that contributes to sustaining long-term physical activity habits (Avram & Vizitiu, 2020). In this context, sports science specialists have proposed innovative solutions for optimizing the learning and training process. Modern technologies, equipment, and facilities have been developed, significantly enhancing the physical training process and promoting an active and healthy lifestyle (Milici, Rață, & Milici, 2007).

2. Material and method

The study investigates the impact of implementing spinning sessions in the physical education program on the exercise capacity of high school students. The aim is to compare the effects of standard physical education lessons with additional spinning sessions, to evaluate improvements in physical parameters and students' sports performance. Methodology: The sample consisted of high school students, divided into two groups: Control group: followed the standard physical education program. Experimental group: participated in additional spinning sessions along with the standard program. Exercise capacity was assessed through physical endurance tests and performance monitoring. Objectives: To compare the effects of spinning sessions versus the standard physical education program on the exercise capacity of high school students. To determine the impact of spinning sessions on overall fitness improvement and the ability to sustain prolonged exercise. To analyze the relationship between the frequency of spinning sessions and the increase in exercise capacity in high school students. Research Methods: Experimental method- Independent variable: Introduction of two additional spinning sessions per week for

the experimental group. Dependent variable: Physical performance measured through specific tests (endurance, strength, VO_2max, etc.). Observation method- Used to monitor students' progress and identify potential difficulties or factors that could influence results (e.g., motivation, attendance, lifestyle). Direct observations conducted during spinning training sessions and physical tests. Testing and measurement method- Stationary bike endurance test – measuring speed (km/h) and power output (W). Burpee Test – counting the number of repetitions performed within a given time frame. Cooper Test – measuring distance covered in 12 minutes, an indicator of cardiovascular endurance. Ruffier-Dickson Test – evaluating cardiovascular recovery capacity. VO_2max estimation – indicating maximum oxygen consumption levels and cardiovascular system efficiency. This study was conducted at Wender Gym Suceava and involved 30 high school female students, divided into two groups: Experimental group: participated in two additional spinning sessions per week outside regular physical education classes. Control group: attended only regular physical education classes. Inclusion Criteria: Students without medical conditions that would prevent participation in intense physical activities. Study Duration: 8 weeks. Training Program: Spinning sessions for the experimental group started at 35 minutes and gradually increased to 45 minutes per session. Each session included: warm-up (5-7 min), main workout (25-35 min), cool-down (5 min). Intensity was varied, combining moderate and high-effort intervals to improve aerobic capacity and muscular endurance. Expected Results: It is anticipated that the experimental group will show significant improvements in cardiovascular performance and muscular endurance compared to the control group. Specifically, the following outcomes are expected: Increased distance covered in the Cooper Test; Decreased Ruffier-Dickson values, indicating better recovery capacity. Increased number of repetitions in the Burpee Test. Improved power output on the stationary bike. Higher VO_2max values, indicating greater cardiovascular efficiency.

Two-Week Spinning Program Model

Duration: 2 weeks; Frequency: 2 sessions per week; Training Duration: Week 1: 35 minutes per session; Week 2: 45 minutes per session; Week 1 (35 minutes per session)

Day 1 – Endurance Training

Objective: Improve cardiovascular endurance

1. Warm-up – 5 min (light pedaling, 60-70 RPM)
2. Block 1: 8 min – Steady pedaling, medium resistance (70-80 RPM)
3. Block 2: 10 min – Alternating 2 min high intensity (80-90 RPM) / 1 min recovery
4. Block 3: 8 min – Increased resistance (simulating a climb, 60-70 RPM)
5. Cool-down – 4 min (light pedaling and stretching))

Day 2 – High-Intensity Intervals

Objective: Increase power and maximum effort capacity

1. Warm-up – 5 min (light pedaling, progressively increasing cadence)
2. Block 1: 5 min – Medium resistance pedaling (75-85 RPM)
3. Block 2: 12 min – Sprint intervals (30 sec sprint / 1 min recovery)
4. Block 3: 8 min – High resistance pedaling (simulating a long climb)
5. Cool-down – 5 min (light pedaling and stretching)

Week 2 (45 minutes per session)

Day 3 – Endurance and Strength

Objective: Improve muscular and cardiovascular endurance

1. Warm-up – 7 min (light pedaling)
2. Block 1: 10 min – Alternating 3 min moderate intensity / 2 min high resistance
3. Block 2: 10 min – Controlled sprints (45 sec sprint / 1 min recovery)
4. Block 3: 12 min – High-resistance pedaling (simulating a climb)
5. Cool-down – 6 min (light pedaling and stretching)

Day 4 – HIIT (High-Intensity Interval Training)

Objective: Increase explosiveness and fat burning

1. Warm-up – 7 min (light pedaling + mobility exercises)
2. Block 1: 10 min – Alternating intense sprints (20 sec) and active recovery (40 sec)
3. Block 2: 12 min – Climbing intervals (1 min high resistance / 1 min recovery)
4. Block 3: 10 min – Alternating 30 sec fast pedaling / 30 sec heavy resistance pedaling
5. Cool-down – 6 min (light pedaling and stretching)

3. Results and Discussions

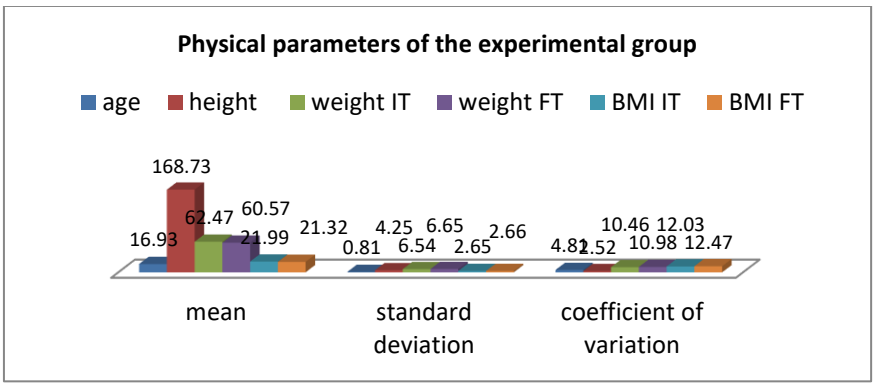


Figure.1 *Experimental Group*

In the experimental group, the average age is 16.93 years, indicating a relatively homogeneous group of adolescents. The average height is 168.73 cm, and the average weight decreased from 62.47 kg to 60.57 kg after the intervention. The Body Mass Index (BMI) decreased from 21.99 to 21.32, suggesting an improvement in body composition. The standard deviation reflects the dispersion of values around

the mean. Height has a low variation of 4.25 cm, indicating a relatively homogeneous distribution. Weight and BMI have higher standard deviation values of 6.5 and 2.6, suggesting greater variability among participants.
The coefficient of variation (Cv%) is an indicator of data homogeneity or dispersion. Height has the lowest Cv% at 2.52%, meaning it is the most homogeneous variable. Weight and BMI have higher coefficients of variation, ranging from 10-12%, indicating greater differences among participants.

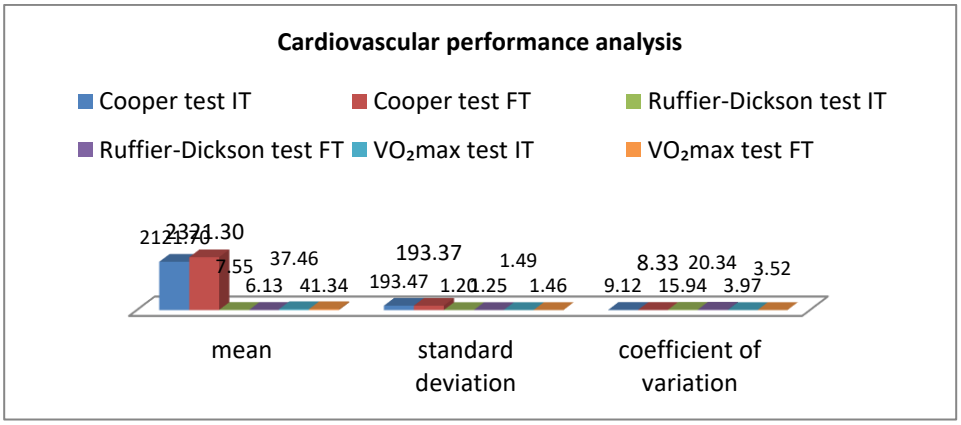


Figure 2. *Experimental Group*

The mean values for each test at initial testing (IT) and final testing (FT) indicate significant improvements in physical performance: In the Cooper Test, the average distance increased from 2121.70 m to 2321.30 m, reflecting an improvement in aerobic endurance and cardiovascular capacity. In the Ruffier-Dickson Test, the score decreased from 7.55 to 6.13, suggesting better cardiovascular recovery and a positive adaptation to effort. In the VO_2max Test, the values increased from 37.46 ml/kg/min to 41.34 ml/kg/min, indicating a significant enhancement in maximum oxygen consumption capacity. The standard deviation values remained relatively constant between IT and FT, meaning that performance variation among participants was similar before and after training. In the Cooper Test and VO_2max Test, the standard deviation was low (relative to the mean), suggesting a relatively homogeneous performance level among participants. In the Ruffier-Dickson Test, the standard deviation was higher, indicating greater variability in cardiovascular recovery ability among participants. The coefficient of variation (CV%) further highlights changes in performance consistency: Cooper Test: CV% decreased from 9.12% to 8.33%, indicating a more uniform performance level after training. Ruffier-Dickson Test: CV% increased from 15.94% to 20.34%, suggesting that some participants improved more than others in cardiovascular recovery. VO_2max Test: CV% decreased from 3.97% to 3.52%, demonstrating greater consistency in performance across the group after training.

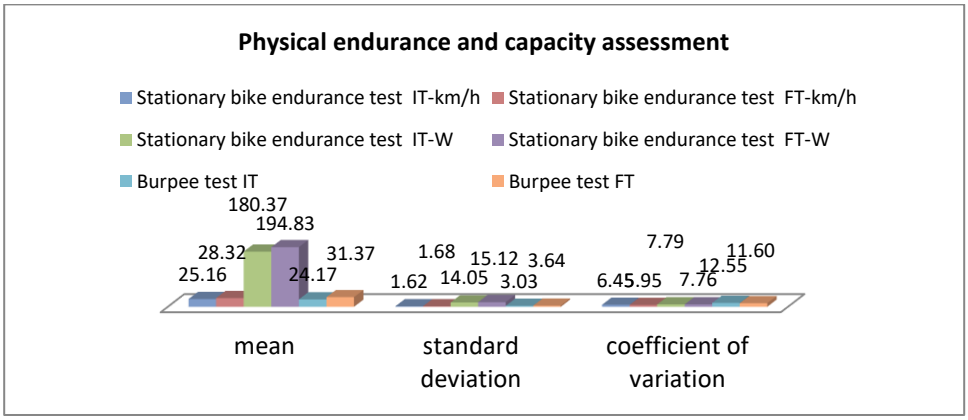


Figure 3. *Experimental Group*

In the stationary bike endurance test, the initial speed was 25.16 km/h, while the final speed increased to 28.32 km/h, representing an approximate improvement of 12.6%, indicating enhanced performance. The initial power output was 180.37 W, and the final power output reached 194.83 W, reflecting an 8.1% increase, which suggests a positive adaptation to effort. In the Burpee Test, the initial number of repetitions was 24.17, while the final count increased to 31.37, showing a significant improvement of 29.8%, which indicates greater endurance and explosive strength. For the stationary bike test, the values remained relatively close to the mean, with a low standard deviation: Speed: 1.62-1.68 km/h Power output: 14.05-15.12 W. This suggests a high degree of homogeneity in performance among participants. In the Burpee Test, the standard deviation was higher, ranging from 3.03-3.64 repetitions, indicating greater variability among participants regarding endurance and explosive strength. The coefficient of variation (CV%) further highlights performance consistency: In the stationary bike test, CV% ranged from 5.95% to 7.79%, suggesting low variability and relatively uniform results among participants.In the Burpee Test, CV% was higher (11.60%-12.55%), indicating greater variability, possibly due to individual differences in training, technique, or fitness levels.

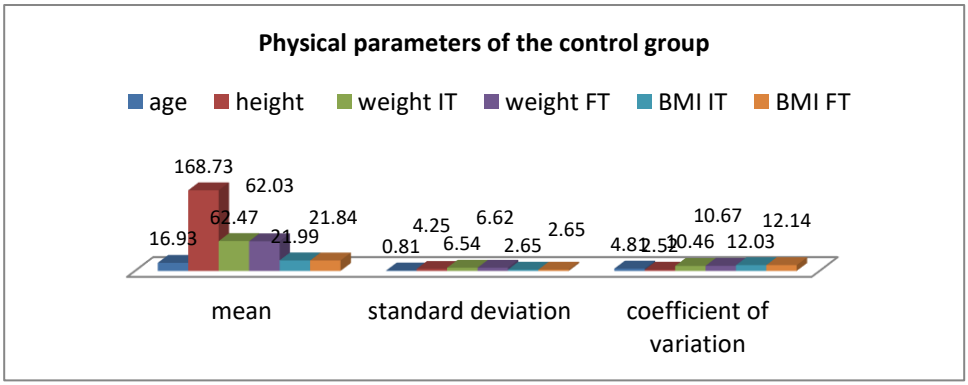


Figure 4. *Control Group*

The average age of participants is 16.93 years. The average height is 168.73 cm. The average weight slightly decreased from 62.47 kg (IT) to 62.03 kg (FT). The BMI (Body Mass Index) changed insignificantly from 21.99 to 21.84, indicating stability in body composition. The greatest variability is observed in weight (6.54-6.62) and BMI (2.65), meaning greater differences between participants in these measurements. Height has a low standard deviation of 4.25 cm, indicating a more homogeneous distribution of height within the group. The highest coefficient of variation (CV%) is recorded for BMI (12.03-12.14%), suggesting significant differences among individuals in terms of weight-to-height ratio. Weight has a CV of around 10.5%, indicating moderate variability. Height and age have the lowest CVs at 2.52% and 4.81%, reflecting a more uniform distribution.

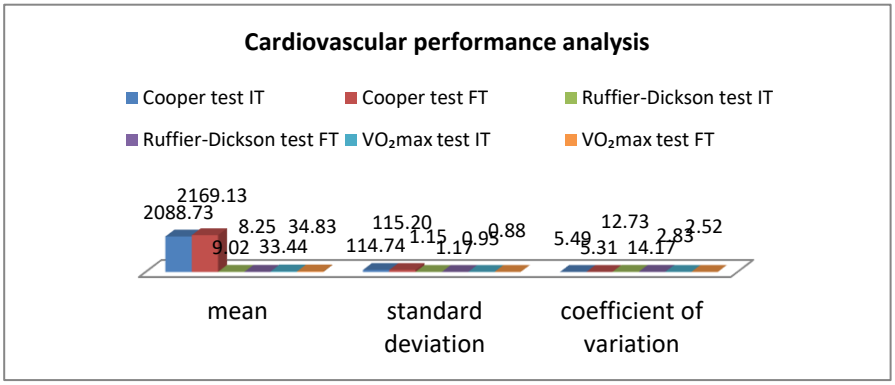


Figure 5. *Control Group*

The average distance covered in the Cooper Test increased from 2088.73 m (IT) to 2169.13 m (FT), indicating an improvement in aerobic endurance. In the Ruffier-Dickson Test, the average score decreased from 9.02 to 8.25, suggesting an enhancement in cardiovascular recovery capacity. In the VO_2max Test, maximum oxygen consumption slightly increased from 33.44 ml/kg/min to 34.83 ml/kg/min, indicating an improvement in aerobic capacity. The standard deviation values are relatively small, indicating a balanced distribution of performance among participants. The greatest variability is observed in the Cooper Test (114.74-115.20), showing larger differences among participants in terms of endurance. The Ruffier-Dickson and VO_2max Tests have lower standard deviations, meaning that results are more uniform among participants. The coefficient of variation (CV%) highlights differences in performance consistency: The Ruffier-Dickson Test has the highest CV% (12.73%-14.17%), indicating larger differences among participants in cardiovascular recovery. The Cooper Test has a moderate CV% (5.49%-5.31%), indicating some variability among participants' performances.The VO_2max Test has

the lowest variability (2.83%-2.52%), suggesting that most participants had similar results.

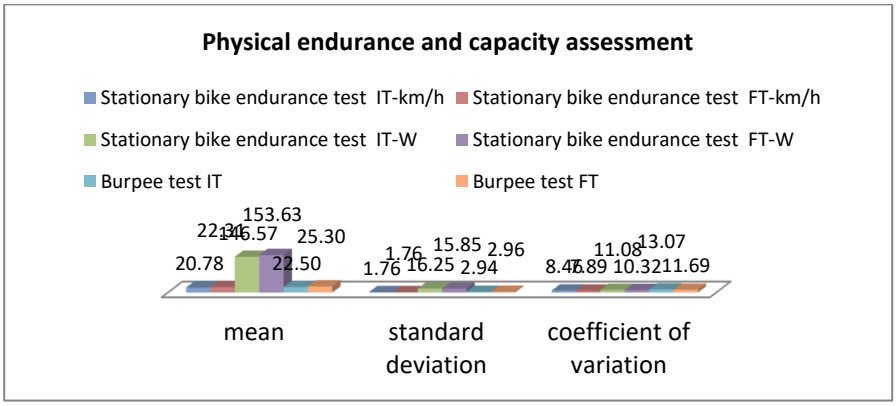


Figure 6. *Control Group*

The average speed in the stationary bike endurance test increased from 20.78 km/h to 22.31 km/h, indicating an improvement in endurance. The average power output (Watt) increased from 146.57 W to 153.63 W, reflecting a growth in the force generated during pedaling. The average number of repetitions in the Burpee Test increased from 22.50 to 25.30, indicating improvements in strength, endurance, and cardiovascular capacity. The standard deviation values highlight the variability in performance among participants: Power output on the stationary bike had the highest standard deviation (16.25-15.85 W), suggesting greater differences between participants. The Burpee Test had a standard deviation of approximately 2.94-2.96 repetitions, indicating relatively consistent performances among participants. The coefficient of variation (CV%) further emphasizes performance consistency: The highest variation was observed in the Burpee Test (13.07% at IT and 11.69% at FT), suggesting significant differences between participants in muscular and aerobic capacity. The stationary bike test had a lower coefficient of variation (approximately 8-11%), indicating greater homogeneity in performance levels.

Discussions

In the study conducted by Yoon, Kim, & Rhyu (2017), no significant differences in body weight were observed, but Body Mass Index (BMI) and body fat percentage showed significant improvements in the spinning group. Physical fitness improved in both groups, with greater progress in the spinning group, especially in lifting strength, back strength, and lateral steps. Blood parameters revealed significant differences between groups, and group-time interactions were notable for glucose levels and reactive oxygen species. In conclusion, 16 weeks of spinning resulted in positive changes in body composition, physical fitness, and blood constituents, demonstrating the benefits of indoor cycling compared to a conventional bicycle. Our study provides a detailed analysis of the impact of

spinning on high school students' exercise capacity, comparing the effects of this training with the standard physical education program. It highlights how an additional spinning program could significantly improve physical parameters and student performance, contributing to better physical fitness and increased endurance capacity.

4. Conclusions

The implementation of two additional spinning sessions per week led to a significant improvement in cardiovascular performance and muscular endurance among the students in the experimental group. The increase in distance covered in the Cooper Test, better results in the Burpee Test, and higher VO_2max values indicate enhanced aerobic capacity and greater cardiovascular efficiency. The spinning sessions combined endurance exercises, sprints, and HIIT training, resulting in complex physiological adaptations, including better recovery capacity, increased strength, and muscular endurance. Structured and varied training can have a significant effect on students' physical performance, compared to a standard physical education program. The results suggest that spinning can be an effective method for improving students' physical fitness, particularly in terms of cardiovascular endurance and exercise capacity. Incorporating this type of training outside regular physical education classes may have substantial benefits for students' health and overall performance.

Bibliography

1. Agache, Ghe., Vizitiu, E. (2022). Mentalitatea profesională a profesorului de educatie fizică și sport. In: *Formarea continuă a specialistului de cultură fizică în conceptul acmeologic modern*, Ed. 3, 1 decembrie 2022, Chișinău. Chișinău, Republica Moldova: Dapartamentul Sporturi de Lupte și Gimnastică al USEFS, 2022, Ediția 3, pp. 5-10. ISBN 978-9975-68-473-6.
2. Avram, L., E., Vizitiu, E. (2020). *Study on the importance of physical education and sport classes in current societyinvestigative approach.* The Annals of the "Stefan cel Mare" University, ISSN – 1844 – 9131, eISSN 2601 – 341X Volum XIII issue 2/ 2020, pg.28-33. https://web.archive.org/web/20220704080107id_/https://usv.ro/
3. Duda, H., Różycki, P., Stanek, L., Kąkol, K., Kubieniec, P. (2014). *Influence recreational training–spinning at improving physical fitness of women*, HEALTH AND WELLNESS 3/2014 WELLNESS AND FAMILY, pg.11
4. Ghaleb, A. M., Khalaf, T. M., Ramadan, M. Z., Ragab, A. E., Badwelan, A. (2020). *Effect of cycling on a stationary bike while performing assembly tasks on human physiology and performance parameters.* International journal of environmental research and public health, 17(5), 1761. https://doi.org/10.3390/ijerph17051761

5. He, M. Y., Lo, H. P., Chen, W. H. (2024). *Effects of Stationary Bikes and Elliptical Machines on Knee Joint Kinematics during Exercise*. *Medicina*, *60*(3), 498. https://journals.lww.com/jbjsjournal/abstract/1959/41010/an_analysis_of_muscle_action_and_joint_excursion.14.aspx
6. Huang, W. C., Chiu, P. C., Ho, C. H. (2022). *The sprint-interval exercise using a spinning bike improves physical fitness and ameliorates primary dysmenorrhea symptoms through hormone and inflammation modulations: a randomized controlled trial.* Journal of Sports Science & Medicine, 21(4), 595. ,doi: 10.52082/jssm.2022.595
7. Ickes, M. J., Erwin, H., Beighle, A. (2013). *Systematic review of recess interventions to increase physical activity.* Journal of Physical Activity and Health, 10(6), 910-926.,DOI: https://doi.org/10.1123/jpah.10.6.910.
8. Milici, D., Rață, E., Milici, M. R. (2007). *Study of new graphical method for sportman evaluation.* International Journal of Computers and Communications, (4), 99-107. https://d1wqtxts1xzle7.cloudfront.net/
9. Ţurcanu, P. A., Tanase, E., & Vizitiu Lakhdari, E. (2024). *Studiu comparativ privind aplicarea tehnologiei informației în lecțiile de educație fizică pentru elevii din ciclul primar*. *Gimnaziul: Jurnalul Științific de Educație, Sport și Sănătate*, *25*(2), 51. https://doi.org/10.29081/gsjesh.2024.25.2.4.
10. Yoon, J. G., Kim, S. H., Rhyu, H. S. (2017). *Effects of 16-week spinning and bicycle exercise on body composition, physical fitness and blood variables of middle school students.* Journal of exercise rehabilitation, 13(4), 400., doi: 10.12965/jer.1735052.526.

OPTIMIZING THE DEVELOPMENT OF MOTOR SKILLS THROUGH BADMINTON IN MIDDLE SCHOOL STUDENTS USING A PSYCHOMOTOR APPARATUS IN PHYSICAL EDUCATION

Bogdan Ionuț Tanasă[1]

[1] *Institute of Physical Education and Sports, Andrei Doga Street 22, Moldova State University, Republic of Moldova*

Abstract

The present study analyzes the impact of using a psychomotor device in physical education classes, with the main objective of optimizing the development of the motor skills of middle school students through the game of badminton. The purpose of the research is to determine the effectiveness of integrating this device into the teaching process, evaluating improvements in coordination, reaction speed and control of student movements. The hypothesis of the study assumes that the use of the psychomotor apparatus in physical education classes will lead to a much better motor development compared to traditional methods, by increasing the students' precision, balance and reaction capacity. The objectives of the research include: Analysis of the impact of the use of the device on the motor and psychomotor parameters of the students. Comparison of results obtained by traditional methods and by using the device. Formulation of recommendations regarding the integration of this device into the physical education curriculum. The conclusions of the study indicate that the use of the psychomotor device contributes significantly to the development of motor and psychomotor qualities of students, providing an effective method of optimizing the educational process in physical education.

Key words: *psychomotor device, optimization, motor skills, physical education, students*

1. Introduction

Badminton, due to its specific characteristics, necessitates the development of both technical and tactical skills, as well as motor and psychomotor abilities, exerting a beneficial effect on overall physical fitness (Tanasă, I., 2024). It is widely recognized that in-depth knowledge among educators is essential for effective instruction. Teachers can adapt content based on students' needs, and a well-founded educational approach, supported by research, contributes to the creation of efficient learning environments (Kim, I., 2017). The objective of this study was to develop a badminton teaching system integrating wearable technology to enhance the learning process. The proposed system enables the automatic retrieval of similarity scores by comparing a student's movements and force application with those of a highly trained expert model (Lin, K. C., Wei, C. W., Lai, C. L., Cheng, I. L., & Chen, N. S., 2021). Mobile applications can play a crucial role in the development of students' motor skills by providing instant and augmented feedback. This study integrated an

application-based technology designed to support both students' skill improvement and progress in badminton within an educational unit dedicated to the sport (Yu, H., Van Der Mars, H., Hastie, P. A., & Kulinna, P. H., 2021). Badminton is a widely popular activity in physical education, yet individualized instruction remains challenging. This study utilized OpenPose technology to develop a mobile application that delivers real-time feedback, enhancing students' smash skills. The findings indicated that the application was effective for all students, regardless of their skill level (Lin, K. C., Ko, C. W., Hung, H. C., & Chen, N. S., 2023). Currently, information technology plays a fundamental role in education, significantly impacting various disciplines, including physical education (Ţurcanu, P. A., Tanase, E., & Vizitiu Lakhdari, E., 2024). By applying the acmelogic concept in professional development, physical education teachers become key facilitators in personalizing the learning experience, adapting teaching strategies to match each student's needs and abilities, ultimately placing students at the center of the educational process (Slusar, A., & Vizitiu, E., 2024).

2. Material and method

The present study examines the impact of using a psychomotor device in physical education lessons, with the primary objective of optimizing the motor skill development of middle school students through badminton training. The research aims to determine the effectiveness of integrating this device into the teaching process, by evaluating improvements in coordination, reaction speed, and movement control among students. The hypothesis of the study assumes that the use of a psychomotor device in physical education lessons will lead to significantly better motor development compared to traditional methods, by enhancing precision, balance, and reaction capacity in students. Research Objectives: Analyze the impact of the device on students' motor and psychomotor parameters. Compare results obtained through traditional methods versus the use of the psychomotor device. Formulate recommendations for integrating this device into the physical education curriculum. The experiment was conducted at "Al. I. Cuza" Middle School in Fălticeni, as part of a study on optimizing motor skill development through badminton training and the integration of a psychomotor device into physical education lessons. The experimental group consisted of 25 students who used the psychomotor device throughout the 7-week duration of Module I. These students participated in physical education lessons that incorporated the device to enhance coordination, reaction speed, and balanceThe control group also consisted of 25 students, who followed standard physical education lessons without the use of the psychomotor device. Module I Details: Duration: 7 weeks. Number of lessons: 2 lessons per week. Materials used: Gymnasium, badminton rackets, shuttlecocks, psychomotor device (for the experimental group). Inclusion Criteria: Participants must be middle school students, aged 11 to 14 years. No physical limitations that

could affect performance in physical education lessons. Students must demonstrate an active interest in sports, particularly badminton. Full availability to attend all lessons during the experimental period. Parental informed consent must be obtained.

In our experiment, the experimental group utilized this psychomotor device (Fig. 1) to assess and enhance students' motor skill development.

Figure 1. *Psychomotor training: agility, coordination and balance*

The "psychomotor device" used in this study is designed to enhance motor skill development through specific exercises aimed at agility, coordination, and balance. It is structured into three distinct sections, each corresponding to a color and a specific type of exercise: Red section – dedicated to agility exercises. This includes components that allow students to practice quick movements and directional changes, contributing to improved reaction speed and mobility. Yellow section – focused on hand-eye coordination. Students refine their ability to synchronize hand movements with visual perception, a crucial skill for accurately hitting the shuttlecock in badminton. Green section – designed for balance training. It consists of elements that assist in body stabilization and postural control, essential for maintaining proper positioning and stability on the badminton court.

Table 1 *Program for Optimizing Motor Skill Development Through Badminton Using the Psychomotor Device in Middle School Physical Education*

The Week	Lesson	Objective	Red Exercise (Agility)	Yellow Exercise (Hand-eye coordination)	Exercise Blue (Balance)
Week 1	**Lesson 1**	Psychomotor device familiarization and warm-up exercises	Move quickly between red markers, change direction on signal	Throwing a tennis ball and hitting it with a racket	Balance on a balance device for 10 seconds
	Lesson 2	Improve coordination and reaction speed	Fast moving between red markers, with badminton shot when changing direction	Tracking the object and quickly hitting the butterfly with the rocket	Maintaining balance on a balance device while changing body weight
Week 2	**Lesson 1**	Advanced reaction speed drills	Sprints between red markers and quick badminton strokes	Throw the badminton butterfly and hit it fast	Swinging on an unstable platform, hitting the badminton butterfly
	Lesson 2	Improve reaction to visual stimuli	Change direction quickly between red marks	Hitting the butterfly coming from different angles	Maintaining balance on an unstable platform and hitting the badminton butterfly
Week 3	**Lesson 1**	Developing hitting technique and field mobility	Quick changes of direction and bumps between red marks	Quickly hit the badminton shuttlecock from different positions	Striking the flyer on an unstable platform, maintaining balance
	Lesson 2	Increasing the complexity of exercises	Quick change of direction between red marks with ball striking	Kicking the butterfly from different angles on the ground	Balance movements on an unstable platform, hitting the butterfly with the rocket
Week 4-7	**Lesson 1**	Improve agility, coordination and balance	Rapid direction changes with bumps between cones	Hitting the badminton butterfly with different trajectories	Practicing balance on unstable platforms
	Lesson 2	Assess progress and adjust exercises	Improving quick changes of direction and kicks	Quick butterfly kicking exercises from different positions	Improving balance on unstable platforms and badminton butterfly badminton

3. Results and Discussions

Table 2 *Experimental Group*

Statistical Indicators	Manual Reaction Speed Test – Statistical Indicators			Hand-Eye Coordination Test – Statistical Indicators			Static Balance Test – Statistical Indicators		
	TI	TF	D	TI	TF	D	TI	TF	D
x	0.97	0.55	0.42	15.96	20.72	4.76	8.32	4.40	3.92
α	0.10	0.04	0.11	2.20	2.57	2.35	0.97	0.75	1.09
Cv%	10.40	7.26	25.84	13.78	12.40	49.46	11.64	17.01	27.87
Max	1.15	0.64	0.63	20.00	24.00	10.00	10.00	6.00	6.00
Min	0.82	0.50	0.19	13.00	14.00	1.00	7.00	3.00	2.00

Based on the statistical indicators presented for the manual reaction speed test, hand-eye coordination test, and static balance test, the following observations can be made:

In the Manual Reaction Speed Test, the mean ($\bar{x}$) was 0.97 for the initial group (IT) and 0.55 for the final group (FT), indicating a significant improvement in reaction speed within the experimental group, with a difference of 0.42 (D). The standard deviation (α) was small in both groups (0.10 for IT and 0.04 for FT), indicating low variation in the results, suggesting that most students in the final group achieved similar outcomes. Although the coefficient of variation was higher in TI (10.40%) and lower in TF (7.26%), there was a reduction in variability in the final group, which suggests a more uniform performance after the intervention with the device. The maximum and minimum values were similar between the two groups, but the final group performed better compared to the initial group. In the Hand-Eye Coordination Test, the mean ($\bar{x}$) was 15.96 for TI and 20.72 for FT, with a difference of 4.76 (D), indicating a considerable improvement in coordination after using the device. The standard deviation (α) was 2.20 (TI) and 2.57 (FT), suggesting greater variation in performance in the final group compared to the initial group, but still under control. While the initial group had a coefficient of 13.78%, the final group had 12.40%, indicating a slight reduction in variability in the final group, despite a higher standard deviation.The difference between maximum and minimum values suggests improved performance and greater variation within the final group (10-point difference between max and min). In the Static Balance Test, the mean ($\bar{x}$) was 8.32 for TI and 4.40 for TF, with a difference of 3.92 (D), suggesting an improvement in static balance, but with better overall performance in the initial group. The standard deviation was higher for the final group (1.09) compared to the initial group (0.97), indicating greater variability in the final group. In TI, the coefficient of variation was 11.64%, while in TF it was 17.01%, indicating an increase in variability in the final group, suggesting that students did not achieve consistent performance in the balance

test. The maximum and minimum values for this test reflect variable performance, with a significant difference between the best and worst results.

Table 3 *Experimental Group*

Statistical Indicators	Shuttle Run Test (5x6 meters) for Agility			Badminton Precision Test		
	TI	TF	D	TI	TF	D
x	12.40	11.40	1.00	3.44	6.12	2.67
α	0.24	0.27	0.35	0.85	0.59	0.99
Cv%	1.92	2.35	35.12	24.78	9.61	36.98
Max	12.79	11.78	1.70	5.00	7.00	4.00
Min	12.00	11.01	0.43	2.00	5.00	0.00

In the Shuttle Run Test (5x6 meters) for agility, the mean ($\bar{x}$) was 12.40 for the initial group (IT) and 11.40 for the final group (FT), with a difference of 1.00 (D), indicating an improvement in the time required to complete the distance in the final group, meaning a reduction in reaction time. The standard deviation (α) was 0.24 for IT and 0.27 for FT, showing greater variability in the final group, but overall, a small deviation, meaning that most students achieved results close to the group average. In IT, the coefficient of variation was 1.92%, and in FT, it was 2.35%. These values are very low, suggesting a uniform distribution of performances and high consistency in achieving times. The maximum values for IT and FT were 12.79 and 11.78, respectively, showing a slight improvement in performance. In contrast, the minimum values for IT and FT were 12.00 and 11.01, and the difference between them suggests better performance in the final group. In the Badminton Precision Test, the mean ($\bar{x}$) was 3.44 for IT and 6.12 for FT, with a difference of 2.67 (D), suggesting a considerable improvement in shot accuracy in badminton. Students in the final group managed to hit the shuttlecock more accurately. The standard deviation (α) was 0.85 for TI and 0.59 for FT, indicating lower variation in the final group. This suggests a more consistent and focused performance in the final group. In TI, the coefficient of variation was 24.78%, and in TF, it was 9.61%, reflecting a significant decrease in variability in the final group, indicating greater consistency in executing shots in the final group compared to the initial group. The maximum values were 5.00 for TI and 7.00 for TF, and the minimum values were 2.00 for IT and 5.00 for TF. The increase in the maximum value in the final group suggests improved performance in precision shots, as well as a better distribution of results.

Table 4 *Control Group*

Statistical Indicators	Manual Reaction Speed Test – Statistical Indicators			Hand-Eye Coordination Test – Statistical Indicators			Static Balance Test – Statistical Indicators		
	TI	TF	D	TI	TF	D	TI	TF	D
x	0.97	0.73	0.24	16.96	18.64	1.68	10.60	8.04	2.56
α	0.13	0.04	0.15	2.42	2.67	0.88	0.57	0.66	0.90
Cv%	13.58	6.16	61.66	14.30	14.31	52.49	5.34	8.24	35.08
Max	1.20	0.80	0.52	20.00	22.00	3.00	11.00	9.00	4.00
Min	0.81	0.65	0.01	12.00	13.00	0.00	9.00	7.00	1.00

In the Manual Reaction Speed Test, the mean ($\bar{x}$) was 0.97 for the initial group (TI) and 0.73 for the final group (TF), with a difference of 0.24 (D). This suggests an improvement in reaction time in the final group, meaning a decrease in the time required for response. The standard deviation (α) was 0.13 for TI and 0.04 for TF, indicating lower variability in the final group, suggesting more consistent performance within this group. The coefficient of variation (Cv%) was 13.58% in TI and 6.16% in TF. The coefficient of variation decreased significantly in the final group, indicating more uniform performance and a reduction in score differences. The maximum values for TI and TF were 1.20 and 0.80, and the minimum values were 0.81 and 0.65. These values suggest improved performance in the final group, with a notable difference between the initial and final groups. In the Hand-Eye Coordination Test, the mean ($\bar{x}$) was 16.96 for TI and 18.64 for TF, with a difference of 1.68 (D). This indicates an improvement in hand-eye coordination performance, suggesting an increase in precision and coordination ability in the final group. The standard deviation (α) was 2.42 for TI and 2.67 for TF, which suggests slightly greater variability in the final group's results. Although performance improved, there was greater diversity in this group. The coefficient of variation (Cv%) was 14.30% for TI and 14.31% for TF, indicating similar variability between the two groups. However, the improvement in the final group's performance suggests that most students achieved better scores. The maximum and minimum values for TI and TF were 20.00 and 22.00 (maximum values) and 12.00 and 13.00 (minimum values), which suggests varied but improved performance in the final group. In the Static Balance Test, the mean ($\bar{x}$) was 10.60 for TI and 8.04 for TF, with a difference of 2.56 (D). This indicates a decline in static balance in the final group. Although a decrease in the score was observed, this may be attributed to increased difficulty in the exercises or inconsistencies in test application. The standard deviation (α) was 0.57 for TI and 0.66 for TF, suggesting a slight increase in variability in the final

group. This may indicate more diverse performance but slight instability in the final group's results. The coefficient of variation (Cv%) was 5.34% for TI and 8.24% for TF, which suggests an increase in variability in the final group. Although the mean score decreased, performance diversity increased, possibly due to the test's difficulty. The maximum and minimum values for TI and TF were 11.00 and 9.00 (maximum values) and 9.00 and 7.00 (minimum values), reflecting a decline in static balance in the final group, but with relatively close performance scores within the group.

Table 5 *Grupa de control*

Statistical Indicators	Shuttle Run Test (5x6 meters) for Agility			Badminton Precision Test		
	TI	TF	D	TI	TF	D
x	12.32	11.96	0.36	3.44	4.44	1.00
α	0.06	0.08	0.11	0.98	1.24	0.69
Cv%	0.45	0.68	30.78	28.58	27.83	69.28
Max	12.40	12.08	0.59	5.00	7.00	2.00
Min	12.21	11.80	0.19	2.00	2.00	0.00

In the Shuttle Run Test (5x6 meters) for agility, the mean ($\bar{x}$) was 12.32 for the initial group (IT) and 11.96 for the final group (FT), with a difference of 0.36 (D), which suggests an improvement in agility performance, with a decrease in the time required to cover the distance. The standard deviation (α) was 0.06 for TI and 0.08 for FT. These values are very small, indicating low variation in results, meaning that most students had similar performance levels. The coefficient of variation (Cv%) was 0.45% for IT and 0.68% for TF. This very low coefficient suggests extremely uniform performance in both groups, indicating good consistency in results. The maximum values for IT and FT were 12.40 and 12.08, while the minimum values were 12.21 and 11.80, which indicates similar performance between the two groups, with a slight improvement in the final group. In the Badminton Precision Test, the mean ($\bar{x}$) was 3.44 for IT and 4.44 for TF, with a difference of 1.00 (D), suggesting a significant improvement in shot accuracy in badminton within the final group. The standard deviation (α) was 0.98 for IT and 1.24 for FT, indicating greater variation in results in the final group. This suggests greater diversity in student performance in the final group. The coefficient of variation (Cv%) was 28.58% for IT and 27.83% for FT, indicating significant but stable variation in performance across both groups. The decrease in the coefficient in the final group suggests improved performance consistency. The maximum values for IT and FT were 5.00 and 7.00, while the minimum values were 2.00 and 2.00, showing an improvement in maximum performance in the final group but also greater variability in minimum results.

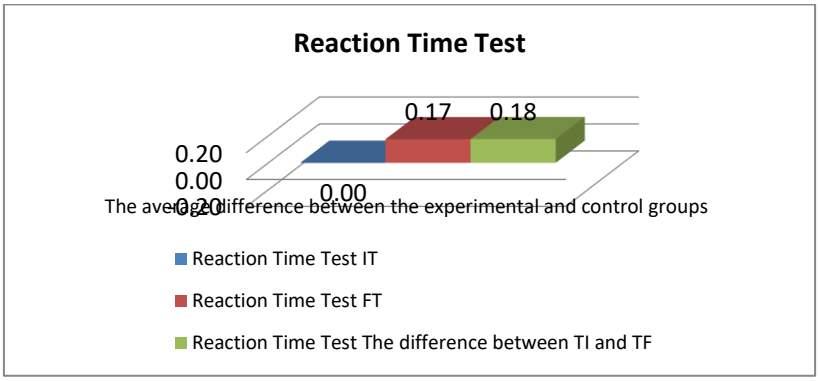


Figure 2. *The average difference between the experimental and control groups*

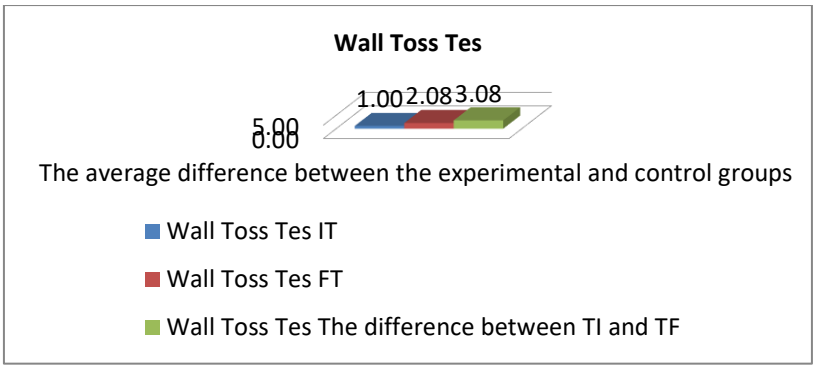


Figure 3. *The average difference between the experimental and control groups*

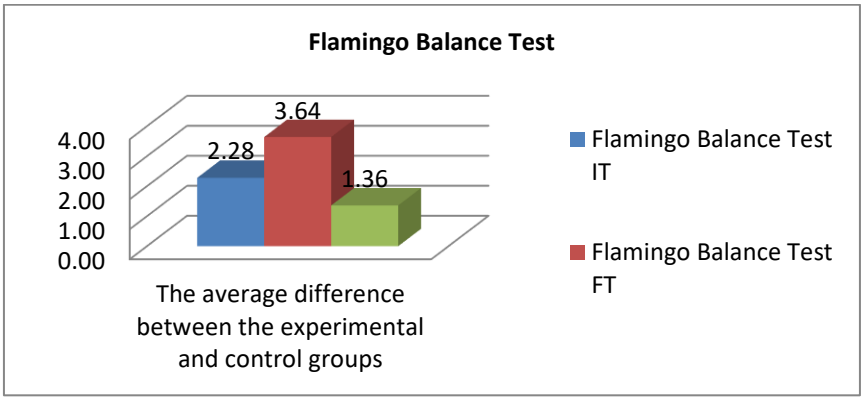


Figure 4. *The average difference between the experimental and control groups*

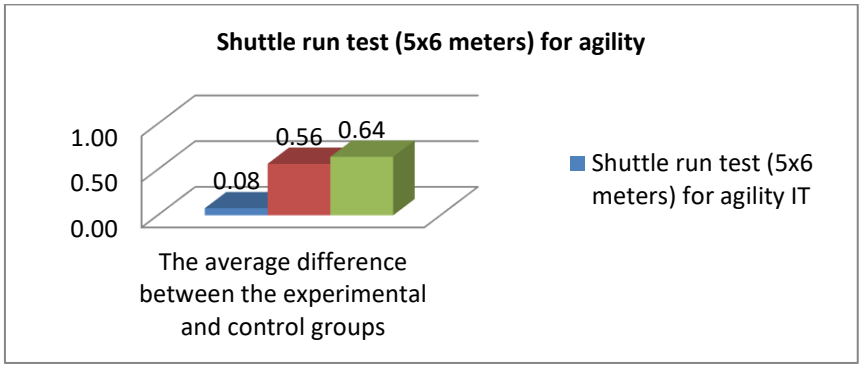


Figure 5. *The average difference between the experimental and control groups*

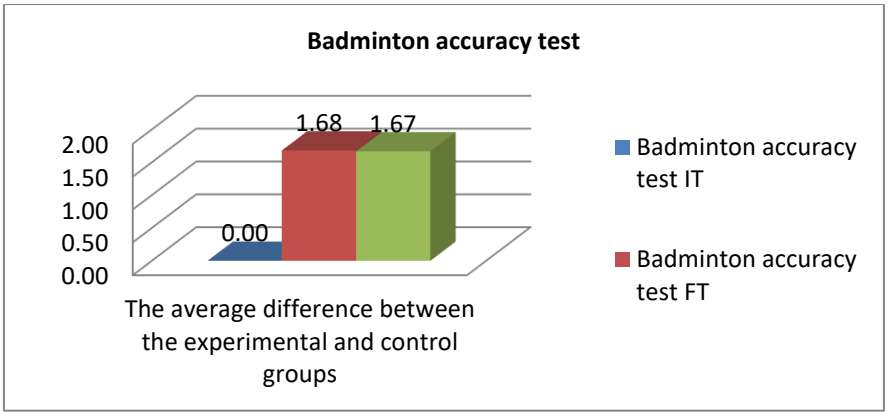


Figure 6. *The average difference between the experimental and control groups*

In our study, it can be emphasized that the integration of a psychomotor device in the educational process not only supports students' physical development but also has a positive impact on cognitive and emotional aspects. Through the activities provided by this device, students are encouraged to enhance their fundamental motor skills, such as coordination, balance, flexibility, and strength.

4. Conclusions

The study suggests that the use of the psychomotor device has a significant impact on students' motor development, particularly in terms of agility, coordination, and balance. According to the results in Table 1 and Table 2, the performance of students in the experimental group improved significantly compared to the control group, emphasizing the importance of specific exercises targeting these skills. The findings indicate that as students' progress through structured lessons, their performance in agility tests and badminton precision significantly improves. This suggests that integrating exercises that combine multiple motor skills (agility, coordination, balance) into a structured program can lead to substantial improvements in students' overall physical performance. Although the control group

also showed some improvements, they were not as significant as those in the experimental group. This indicates that implementing a dedicated psychomotor device can have a more pronounced positive effect on students' physical development than traditional physical activities. The improvements in the control group were more limited, suggesting that without such a device, progress in agility and coordination would be much slower. The results suggest that psychomotor devices can be a highly effective method in physical education, particularly at the middle school level. In the future, wider implementation of such devices could be considered, adapting exercises to meet the needs of each student to maximize the benefits in motor development and sports performance.

Bibliography

1. Kim, I. (2017). Teaching badminton through play practice in physical education. *Journal of Physical Education, Recreation & Dance*, *88*(8), 7-14. https://doi.org/10.1080/07303084.2017.1356768
2. Lin, K. C., Ko, C. W., Hung, H. C., & Chen, N. S. (2023). The effect of real-time pose recognition on badminton learning performance. *Interactive Learning Environments*, *31*(8), 4772-4786. https://doi.org/10.1080/10494820.2021.1981396
3. Lin, K. C., Wei, C. W., Lai, C. L., Cheng, I. L., & Chen, N. S. (2021). Development of a badminton teaching system with wearable technology for improving students' badminton doubles skills. *Educational Technology Research and Development*, *69*, 945-969. https://doi.org/10.1007/s11423-020-09935-6
4. Slusar, A., & Vizitiu, E. (2024). Implementarea conceptului acmeologic în formarea profesională a profesorilor de educație fizică în vederea optimizării condiției fizice a elevilor. In *Formarea continuă a specialistului de cultură fizică în conceptul acmeologic modern* (p. 15). Chișinău, Republica Moldova.
5. Tanasă, I. (2024). Analysis of technical-tactical and psychomotor performance in badminton practice. *Annals of "Dunarea de Jos" University of Galati. Fascicle XV, Physical Education and Sport Management*, *2*(3), 62-74.
6. Ţurcanu, P. A., Tanase, E., & Vizitiu Lakhdari, E. (2024). Studiu comparativ privind aplicarea tehnologiei informației în lecțiile de educație fizică pentru elevii din ciclul primar. *Gimnaziul: Jurnalul Științific de Educație, Sport și Sănătate*, *25*(2), 51. https://doi.org/10.29081/gsjesh.2024.25.2.4
7. Yu, H., Van Der Mars, H., Hastie, P. A., & Kulinna, P. H. (2021). Incorporating a motion analysis app in middle school badminton unit. *Journal of Teaching in Physical Education*, *41*(4), 729-737. https://doi.org/10.1123/jtpe.2021-0043

THE INTERACTIVE SIDES OF PSYCHOMOTOR SKILLS IN PRIMARY SCHOOL CHILDREN

Paul Florinel Visan [1], Veronica Visan [2], George Octavian Naiba [3], Mihai Popescu [4], Andreea Catanescu [5], Florin Cojanu [6]

[1,3,6] *Department of Physical Education and Sport, Faculty of Sciences, Physical Education and Informatics, National University of Science and Technology Politehnica Bucharest, Pitesti University Center, Pitesti, Romania*
[2] *"Mircea cel Batran" Secondary School Pitesti, Romania*
[4] *High School with Sport Program Viitorul Pitesti, Pitesti, Romania*
[5] *Department of Physical Education and Sport, Faculty of Physical education and Mountains Sports, University Transylvania Brasov, Romania*

Abstract
Physical education, as a component of general education, contributes to the development and improvement of the child in terms of motor skills; stimulating the intellectual activity and certain affective processes; developing certain group relations; sense of the ball, sense of rhythm, of tackling, peripheral vision, tactical thinking, motor memory, etc Among the general objectives that physical education proposes to achieve is also the one concerning the harmonious development of human personality by influencing both in terms of prophylaxis (prevention of negative outcomes), and remedial (remedying the negative traits which can appear at some point).

Key words: *elementary school, psychomotor capacity, didactic strategy*

1. Introduction

"Psychomotricity is generally defined as: Totality of motor functions considered under their relations as cerebral activity, especially with psychism" (Catanescu, 2019). The problems of normal Psychomotricity is part of the child's development psychology, targeting succession and interaction "psychomotor, intellectual, social-affective development" defining note by (Stancu, 2018): "The psychic and the motor are not two distinct categories, one subjected to thought and the other to physical and physiological mechanisms; on the contrary, they are the bipolar expression of one process, that of effective, flexible adaptation to external conditions" (Dragnea & Bota, 1999).

The didactic strategy conditions the quality of the training process. It gives a basis from design to action. It can show us how to proceed in order to solve a problematic situation of a lesson type without giving a precise solution (Rada et al., 2024; Raţă & Constantinescu, 2002). The strategy could also mean a manner of programming a teaching-learning activity under maximum effectiveness (Rosu, Cojanu, Stefanica, & Enache, 2022). By didactic strategy is understood a coherent system of methods, didactic materials, means, reinforced by a number of principles, rules, teaching/learning styles and forms of organization of activity, combined

fortunately so as to fully achieve well-defined operational objectives" (Cojanu & Visan, 2019).

It seems paradoxical, but it is real and noticeable the fact that there are children who no longer know how to play and this is where several factors come in which, many times stop and result in the behavioral inhibition of children (Schneider, 2004; Tourrette & Guidetti, 1998).

A first aspect of the new system of modern technologies that are put at their disposal, many times by their parents (Colibaba, 2007) who are modern, but on the other side, insensible); here, we are referring to the cell phones having different technologies, computer, internet, etc. (Raţă, G. & Raţă, C-tin, B., 2006). We do not wish to be misunderstood, they come with great advantages in children's intellectual development and baggage of knowledge; however, most of the times, they are put at their disposal with no limit of use, quote by Cojanu & Visan, (2017).

Motivating the theme's choice:

Specialty studies show an insufficient development of psychomotor capacity nationally, pupils in the elementary school in 3rd and 4th grades being in this category. After analysis of specialty studies relating to the planning documents in the physical education and sports subject for elementary school, certain aspects were revealed, which we think may be improved effectively.

We think it is essential that the bases of practical imprint may be put on improving psychomotor capacity, both on the general and specific motor skills means, and on psychomotricity by specific means adapted to the didactic process.

Purposes, objectives and tasks related to objectives

*Purpose of the experimental research***:**

The purpose is to design the physical education's contents through psychomotor capacity's structure, which would impact positively the two components, general motor skills and psychomotricity by using a complex system of action using specific means and materials within the physical education lesson, but also the identification of new strategies of acting in an optimum manner in accordance with the current level of physical and psychical development of pupils from elementary school. Also, we wish to question and analyse the ideas of the specialists in the field relating to the systematization and use of psychomotor means in the physical education and sports hours within elementary school, to experiment in a preliminary process the thematic unit of learning that we have designed, to identify the parameters of psychomotor capacity using tests and assessment examinations, appropriate both to the general motor skills, and to psychomotricity.

The research report's purpose gives rise to the following practical objectives:

1. Choice of the didactic environment to apply the practical preliminary experimental part, selection of samples, presentation of the thematic units proposed and designed by us, identification of the level of general motor skills parameters, but first, the most important parameters appropriate to psychomotricity's components,

putting into practice the thematic units on a pre-set period of time on the experimental sample;

2. Identification and presentation under any type of example of thematic units of learning by implementing psychomotor means with a predominant percentage, comprising noticeable and measurable operational objectives;

3. Identification of tests specific to psychomotricity which would correspond first to the essential parameters of psychomotricity's components which can be optimized formatively and cumulatively in the process specific to the physical education and sports hours in elementary school;

4. Storage of data issued from applying initial and final tests within the preliminary experimental process, both within the experimental sample, but also in the control sample, introduction to the electronic database, analysis and interpretation from a statistical point of view;

5. Setting out new directions to act based upon the conclusions drawn from the preliminary experimental process, which will lead to designing new strategies to act within the current didactic process in the physical education and sports hour in elementary school, that would act with a quality impact on the optimization of the psychomotor capacity of pupils from elementary school, 3rd and 4th grades.

*Hypotheses of the experimental research***:**

1. We think that if we design and make the physical education's contents for elementary school from the complex perspective of psychomotor capacity, we will then be able to determine the enhancement of the parameters to act on the appropriate readiness, both of the motor, and the psychomotor side.

2. From the perspective of the strategies to act on the optimization of the psychomotor capacity, we think we will be able to improve the quality process of development of the two sets of parameters, motor and psychomotor, only if we will create thematic systems of acting with a predominant content of psychomotor means adapted to the process and provided by operational objectives measurable and noticeable (quality of the didactic process).

Methods

Study of the specialized literature;
Observation method;
Questionnaire method;
Measurements method – examinations and assessment tests used to identify values of the general motor skills indicators and the level of psychomotricity's parameters;

Testing the psychomotricity of pupils in elementary school:

- Test no. 1. – Ability to focus (Bourdon test);
- Test no. 2. – Visual capacity (Lalume test);
- Test no. 3. – General coordination (Matorin test);
- Test no. 4. – Vestibular balance (Romberg test).

Statistical- mathematical and graphical representation methods.

tests carry out and programming the application of thematic units having a predominant percentage content of psychomotor action systems.

1st stage: Initial testing of the two samples – experimental and control- took place during the period October 22nd -October 26th, 2021; this stage constituted the initial testing both for the preliminary experiment, and for the experiment itself. Over the following period it was begun the systematized application of thematic units of learning which contain action systems specific to general motor skills cumulated and persistent as percentage by means specific to psychomotricity. We think that these two sides present in the specific means of acting, both of general motor skills, and psychomotricity will contribute to the improvement of psychomotor capacity of the pupils from elementary schools, 3rd and 4th grades. We are going to put this statement into practice in order to be able to confirm it.

2nd stage: Final testing within the preliminary experiment but the intermediate stage 1 within the basic practical experimental process; this stage took place during the period December 17th -December 22nd, 2021. This period represents the first registration of data gathered from the tests on the two samples – experimental and control-tests which aimed both at general motor behavior, and psychomotor behavior of pupils in the research. The results will provide information relating to the impact from using the thematic units of learning that we proposed and applied. Thus, we think that we will be able to identify a gateway to the complexity of the psychomotor capacity parameters specific to the behavior of pupils in elementary school.

3rd stage: Intermediate testing 2 within the basic practical experiment, which took place during the period March 18- March 22, 2022, testing which gave the most consistent data by interpretation relating to the improvement of the psychomotor capacity parameters of pupils in the elementary school, 3rd and 4th grades.

4th stage: Final testing, which concludes the experimental practical process that took place during the period June 17th -June 21st, 2022; the results will point to the impact of the strategy to apply the thematic units of learning that we made, with a content of systems of action by psychomotor means, but also general motor means. By using the two sides comprised by the strategy of action following application of the thematic units of learning, namely general motor and psychomotor, the predominance being of the latter, we think that we will act specifically on the most important parameters of psychomotor capacity.

Evaluation design drawn-up with a view to determine the level of psychomotor capacity parameters in the pupils under research.

We decided to carry out the process of applying tests and examinations specific to general motor skills on four stages: initial, intermediate 1, intermediate 2 and final, and the tests and examinations specifically appropriate to the psychomotricity components be applied for each component separately, but in four stages as well: initial, intermediate 1, intermediate 2 and final; in the preliminary

experiment we decided to conduct only 4 tests to identify psychomotor components which correspond to the most important of them.

The drawing-up of adequate and balances thematic units of learning is necessary, in order that all pupils may participate in the activities within the physical education and sports hours in elementary school. We think that thematic units of learning should pursue both physiological and mental development of the pupils and the acquiring of sports skills, through an effective process to be effectively usable and necessary and social life.

The diverse range of thematic units of learning that we designed considered the essential modalities of learning which should express the needs of all pupils, allowing them to develop their entire potential from psychomotor point of view, implicitly to correspond to a strategy to optimize the development of the psychomotor capacity of pupils in elementary school. Starting from these conclusions drawn from the specialized literature's analysis and following the carry out of a questionnaire on the specialty teaching staff, we have selected in our scientific research matters which can point out to the structure and content of the training level of pupils in the 3rd and 4th grades, as well as the input these activities make on the psychomotor capacity's development exhibited at this age.

The process of the strategy to act so as to accomplish and apply the thematic units consisted of creating systems to act with a predominant content of psychomotor mean specifically adapted to the activity in the physical education hour, systematized to application tracks, dynamic games and relays cumulated with traditional thematic content found in the school curriculum for physical education and sports curriculum set out for the elementary school, 3rd and 4th grades.

The structure of the thematic units in terms of selection and systematization of means specific to psychomotricity, according to the specialty studies in the international literature (Scarlat, 1993) in his work: Koordinativen psychomotorischen - Schulung der koordinativen und psychomotorischen, Fähigkieten – Wie kann man die „Kopplungsfähigkeit"), recommends a complexity of ways to act specific to psychomotricity used within the didactic process specific to school physical education hours (Alecu, Botila & Cojanu, 2021). The statements of the German author are continually interacting with the reflection of psychomotricity's components, applied systematically and as means specific to the development of the psychomotor side in the physical education and sports hours in elementary school.

Actually, psychomotor means are used in all the thematic units of learning, systematized diversely for accessibility, to allow the accomplishment of operational objectives, proposed by the design of the thematic units' specific both to motor skills: basic, application utilities, specific to certain tests or sports branches, and to psychomotor qualities (SCPES, 2022).

The intervention action on the thematic units of learning was carried out by us with a view to identify a new strategy of action within physical education and sports lessons in elementary school, 3rd and 4th grades, which will act on the structure of psychomotor capacity, having formative impact over the two component sides, general motor skills and psychomotricity, by a complex system of action by specific materials and means.

Results and discussions

The experimental study has proposed to research the actual level of motor and psychomotor training in pupils within the 3rd and 4th grades reference. Thus, within the preliminary experiment, we pursued to demonstrate hypothesis number 2, which states that: *from the perspective of the strategy to act on the optimization of the psychomotor capacity, we think we will be able to improve the quality process of development of the two sets of parameters, motor and psychomotor, only if we will create thematic systems of acting with a predominant content of psychomotor means adapted to the process and provided by operational objectives measurable and noticeable (quality of the didactic process)*, fact proven correct by the results obtained following the carry out of eight general motor skills tests and four tests which capture the main components of psychomotricity. We think that this process to improve the component parameters of the general motor skills side as a support pillar and within the own practical experiment, thus laying the support base for the psychomotor capacity developed by pupils from elementary school, 3rd and 4th grades.

On the evolution of results in the 4th grade in initial testing, we notice that to the comparative analysis of significance t- test of the two samples under research (control-experimental), none of the **eight trials** making up the general ***motor skills profile*** was statistically different. (tabel no 1)

Table no 1 - R*esults in the 4th grade in initial testing*

	25 m	Standing long jump	4-cycle exercises	Agility	Hanging exercise
t calculated	1,54	1.14	1,52	1,57	1.69
p	0.12	0.259	0.134	0.122	0.09

However, we can see that ***on the evolution of results in the 4th grade in the final testing,*** the comparative analysis by the t-test of the two samples under research (control-experimental) shows that one (***Hanging exercise)*** in the **eight trials** making up the general ***motor skills profile*** was not statistically different.
(table no 2)

Table no 2 - R*esults in the 4th grade in final testing*

	25 m	Standing long jump	4-cycle exercises	Agility	Hanging exercise
t calculated	2.24	4.01	2.91	3.32	1.97
P	0.02	0.0002	0.005	0.001	0.06

In the examinations regarding the ***evolution of results in the 4th grade in the initial testing***, the comparative analysis by the t-test of the two samples under research (control-experimental) shows that none of the **four trials** making up the ***psychomotricity profile*** was statistically different. (table no 3)

Table no 3 - R*esults in the 4th grade in initial testing*

	Bourdon T.	Lalume T.	Matorin T.	Romberg T.
t calculated	1.08	0,428	0,839	0.682
P value	0.283	0.670	0.405	0.498

Hoverer, we can see that ***on the evolution of results in the 4th grade in the final testing,*** the comparative analysis by the t-test of the two samples under research (control-experimental) shows that three of the **four trials** making up the ***psychomotricity profile*** were statistically different, except for the Matorin Test.(table no 4)

Table no 4 - R*esults in the 4th grade in final testing*

	Bourdon T.	Lalume T.	Matorin T	Romberg T.
t calculated	2,08	2,43	1.53	2,14
P value	0.04	0.01	0.131	0.03

Legend: P > 0.05 Statistically, the results of the two tests are not significantly different. The null hypothesis is accepted. P <= 0.05. Statistically, the results of the two tests are significantly different, The null hypothesis is rejected.

The specific strategic directions to act in relation to the optimization of the psychomotor capacity in the pupils from elementary school, 3rd and 4th grades are:

Thus, the essence of strategic ways to act so as to optimize the psychomotor capacity of the pupils in elementary school, grades 3 and 4 are: Systems to act, made up of psychomotor means, designed and adapted specifically to the physical education and sports hours in elementary school lie at the basis of the action strategy within the didactic process of the thematic units of learning; Application of the thematic units programmes made by us within the preliminary experiment in carrying out the didactic activity specific to the physical education and sports hours in elementary school, 3rd and 4th grades on the experimental sample selected out of 50 pupils, a classroom of 25 pupils in 3rd grade and one of 25 pupils in 4th grade; Carry out of didactic activity by using thematic units made by us within the preliminary experiment consisted of a different activity of fulfilling homework, different from the classical activity, provided by the Physical Education and Sports Syllabus in that psychomotor means were accessed directly, designed in accordance/coefficient manner with the means specific to general motor skills; The application content of psychomotor means, specifically adapted to the didactic process appropriate to the carry out of physical education and sports hours in the elementary school bring a favorable input through applying during the lesson a number of variables of materials and accessories, but more than that, accent is laid

on storing the motor skills specific to the different sport branches under varied conditions.

Conclusions

We nominated the commencement structure within the design of conclusions drawn from the carry out of the preliminary experimentation stages as hypothesis no. 1: We think that if we design and make the physical education's contents for elementary school from the complex perspective of psychomotor capacity, we will then be able to determine the enhancement of the parameters to act on the appropriate readiness, both of the motor, and the psychomotor side.

Starting from this hypothesis, we have drawn the following conclusions:

Following data interpretation from a statistical point of view, resulted from the carry out of the preliminary experiment, we think that by applying the thematic units of learning, made under a specific content of psychomotor action systems, systematized and implemented into dynamic games, relay races and application tracks, applied within the physical education and sports hours in elementary school, 3rd and 4th grades, new perspectives of operational objectives' achievement will be brought forth;

To conclude, from a statistical point of view relating to the interpretations specific to our field of activity, we can confirm that by applying the thematic units of learning, carried out with a specific content of systems under psychomotor action, designed on the basic substratum of classical units, applied within the physical education and sports hours in elementary school, 3rd and 4th grades, lead the specialty didactic process to a quality and effective impact of optimization of psychomotor capacity.

Implicitly, this strategy to apply the thematic units of action carried out by us with a predominant percentage content of psychomotor means cumulated with those recommended and found nationally in the school curriculum of physical education and sports, will lead to the optimization of the achievement of school physical education's objectives in elementary school effectively, qualitatively and persistently, which is reflected over the school population positively, to changing the study level, elementary, middle school.

Finally, we think it is a modern modality to apply the thematic units of action, made by us using psychomotor means, implemented systematically in these, modality having a positive and attractive modality, synchronized with the requirements and expectations displayed by the pupils in elementary school, 3rd and 4th grades.

We can state that a teaching manner specifically designed to act on the psychomotor capacity of the content in the physical education and sport subject in elementary school will cover the requirements of the curricular reform, and the design of content starting from objectives achieved by examinations and assessment

tests from which to result the quality and effectiveness of the instructional-educational act will resize the importance of this subject.

Bibliography

1. Alecu, A., Botila, V., Cojanu, F., (2021) *Effects of Recreational Activities Nautical Sports in Leisure on the Strengthening of Motor Skills in Children of School Age*, Bulletin of the Transilvania University of Braşov. Series IX: Sciences of Human Kinetics, Vol 14., No 1, pp. 119-124, https://doi.org/10.31926/but.shk.2021.14.63.1.15

2. Catanescu, A C. (2019). *Analyze "wellness self-perception" at the level of young people for increasing the quality of life,* Bulletin of the Transilvania University of Braşov. Series IX: Sciences of Human Kinetics, Vol 12, no 2, p. 139-146, https://doi.org/10.31926/but.shk.2019.12.61.2.49

3. Colibaba, E.D, (2007) *Praxiology and curricular design in physical education and sports, Universitaria Publishing House of Craiova, pp. 124-128;*

4. Cojanu, F, & Visan, P.F., (2019) *Optimizing phases of attack with specific physical training programs with the ball*, European Proceedings of Social and Behavioural Sciences Vol. 67, 2019, pp. 2109-2116 DOI 10.15405/epsbs.2019.08.03.262 Web of Science Id WOS:000582461100262

5. Cojanu, F., & Visan, P. (2017). New Perspectives To Develop Psychomotor Capacity For Romanian Childrens From Primary School. In Education Facing Contemporary World Issues, vol 23. European Proceedings of Social and Behavioural Sciences (pp. 1423-1431). Future Academy. https://doi.org/10.15405/epsbs.2017.05.02.174

6. Dragnea, A., & Bota, A; (1999) *Theory of motor activities, Didactic and Pedagogical Publishing House, R.A.,Bucharest,1999,pp.44- 48.*

7. *School curriculum for Physical Education and Sports for high school education (SCPES, 2022), Publishing House of the Ministry of Education, Research and Innovation, (2022);*

8. Rada L., Mateescu A. C., Macri A. C., & Amzar E L., (2024) Emergent leadership: a comprehensive analysis of stages and relevance in performance sports, Journal of Physical Education and Sport 24 (5), 1059 – 1065, DOI:10.7752/jpes.2024.05121

9. Raţă, G., & Constantinescu, E., (2002) *Didactic of teaching physical education and sports, Alma Mater Publishing House, Bacău, 2002, pp. 54-68.*

10. Raţă, G., & Raţă, C-tin, B., (2006) Aptitudinile în activitatea motrică, Editura, EduSoft, Bacău, pag. 13 -17. (*Skills related to motor activity, Edu Soft Publishing House, Bacău, pp. 13-17)*

11. Rosu D., Cojanu F., Stefanica V., & Enache S., (2022) *Experimental management of work collectives through social and socialization activities*, *Journal of physical education and Sport,* Published online: July 31, DOI:10.7752/jpes.2022.07218

12. Scarlat, E., (1993) *Physical education for school-age children, Publishing House for Youth and Sports, Bucharest, pp. 24-35.*
13. Schneider, H., (2004). Koordinativen psychomotorischen - Schulung der koordinativen und psychomotorischen, Fähigkieten – Wie kann man die „Kopplungsfähigkeit", pp.15-21;
14. Stancu, M (2018) *Improving Interpersonal Relations In Students Using Specific Motric Activities*) The European Proceedings of Social & Behavioural Sciences EpSBS, e-ISSN: 2018, pp. 2357-1330, https://doi.org/10.15405/epsbs.2019.08.03.2630.0
15. Tourrette, C., & Guidetti, M., (1998) Introduction a la psychologie du development. Du bebe a l'adolescent, Editeur Armand Collin, Paris, Petit Larousse Edition, Paris, pp. 22-27.

Session Sport Performance

STUDY ON THE PREPARATION OF JUNIOR BASEBALL PLAYERS FOR PARTICIPATION IN NATIONAL COMPETITIONS

Gabriel Adumitrachioaie

School Sports Club No. 6 Bucharest, Romania

Abstract

Baseball, as a sports discipline, involves a wide range of requirements, from the development of physical strength and motor coordination, to a deep understanding of game strategies and team dynamics. The integrated approach to the training process of junior baseball players I, requires a detailed analysis of the essential components of physical, technical, tactical, theoretical and psychological preparation. Baseball, as a team sport, is distinguished by a great technical complexity, which requires the development of fundamental skills such as throwing, catching, hitting the ball and running between the bases. Throwing the ball is one of the most important technical components of the game, involving a combination of strength, precision and coordination. Players must be able to throw the ball at high speed and accurately direct it to teammates or to a specific base, depending on the game situation. Hitting the ball, another essential technical skill, involves using a bat to send the ball as far as possible, thus giving the player the opportunity to advance to the bases. In Romania, this sport is in a development stage, and the national competition system offers limited but valuable opportunities for juniors who aspire to participate in high-level competitions. In this context, the adequate preparation of junior athletes becomes a priority.

Key words: *baseball, preparation, competition,*

1. Introduction

Sport, in all its forms, represents an essential component of the physical, mental and social development of the individual, having a profound impact on the health and education of young people. In this context, baseball, although less popular in Romania compared to other sports, stands out for its technical, tactical and strategic complexity, offering unique development opportunities for junior athletes.

Playing baseball significantly contributes to the harmonious physical development of athletes, having a positive impact on overall health and motor skills. This sport involves a variety of complex movements, such as running, throwing, catching and hitting the ball, which stimulate the development of muscle strength, motor coordination and flexibility.

According to Chaddock et al. (2011, p. 978), regular physical activity, such as that involved in baseball, improves cardiovascular and respiratory functions, reduces the risk of obesity, and contributes to maintaining a healthy body weight. In addition, baseball-specific training, which includes speed, agility, and endurance exercises, helps increase physical performance and prevent injuries by strengthening muscles

and joints. Beyond the physical benefits, baseball plays a key role in developing athletes' cognitive and psychological skills, providing opportunities to improve concentration, decision-making, and stress management.

According to Hillman et al. (2008, p. 116), sports activities that involve complex strategies, such as baseball, stimulate the executive functions of the brain, including working memory, planning, and cognitive flexibility. During a match, players must quickly analyze game situations, anticipate opponents' moves, and make effective decisions, which contribute to the development of critical thinking and problem-solving skills. From a psychological point of view, baseball provides a conducive environment for the development of resilience and self-confidence.

According to Weinberg and Gould (2019, p. 145), participating in sports competitions helps athletes learn to manage pressure and face challenges, which improves their ability to overcome obstacles and maintain motivation. Baseball, being a team sport, promotes social interaction and the development of positive relationships between players, thus contributing to the formation of essential social skills. In baseball, success depends on coordination and cooperation between players, which encourages the development of a strong team spirit and a sense of belonging.

Baseball provides opportunities for leadership development, especially for players in key positions such as pitcher or team captain. According to Côté and Gilbert (2009, p. 312), team sports are an ideal environment for developing leaders because they involve decision-making, motivating teammates, and managing conflict. These skills are not only essential for success in sports, but are also transferable to other areas of life, contributing to the personal and professional development of athletes.

Playing baseball contributes to the formation of rigorous discipline and a sense of responsibility, due to the specific requirements of this sport, which involve respecting the rules, constant participation in training and assuming a commitment to the team.

Hypotheses of the work. If the particularities of the Romanian competitive system are identified and correlated with the requirements of athlete training, then a practical and applicable perspective is offered for coaches, teachers and other specialists in the field of physical education and sports.

By using research methods such as observation and document analysis, this work can contribute to identifying the most effective training strategies, adapted to the needs and specific characteristics of juniors I.

2. Material and method

The *purpose* of this research is to analyse and evaluate the training process of junior baseball players I, with a focus on identifying the most effective methods and strategies that can contribute to optimizing their performance in national

competitions. Through this work, it is aimed not only to understand in detail the physical, technical, tactical, theoretical and psychological requirements specific to this sport, but also to provide practical recommendations to support coaches and teachers in the process of training athletes.

The *objectives* of the research include:

1. Study of the specialized bibliography.
2. Theoretical analysis of baseball as a sports game, with emphasis on its specific physical, technical and tactical requirements.
3. Investigation of the competitive system in Romania and its comparison with international models, in order to identify existing strengths and challenges.
4. Evaluation of the junior I training process in Romania, by studying documents and observation protocols, in order to highlight good practices and areas that require improvement.
5. Formulation of practical recommendations for optimizing the training of junior athletes, based on the research results and the analysis of the collected data.

Research methods used: study of specialized bibliography, observation, discussions with baseball coaches.

The research was conducted within the School Sports Club no. 6 Bucharest, as well as on the rugby field in the Student Cultural Complex Tei. This location was chosen due to the available infrastructure and easy access to the athletes involved in the study. The research period was between September 2022 and August 2023, during which the training plans were developed and implemented. This duration allowed for detailed monitoring of the training process and the athletes' performances, providing a complete perspective on their evolution.

The participants in this research were the junior I athletes of the School Sports Club no. 6 Bucharest, aged between 16 and 18 years, classified in the U18 category. They do not benefit from official contracts with the club, being athletes legitimized within the school sports system. The team is made up of 16 players, each having a specific role within the team, and their experience in practicing baseball varies between 2 and 8 years.

3. Results and Discussions

The Junior I training system in Romania structured

Stages of physical training

The physical training of juniors I constitute a fundamental component in the sports training process, having as its main objective the development of motor capacities essential for performance in baseball. This training stage is characterized by a methodical and progressive approach, which aims to optimize the physical potential of the athletes, in accordance with the specific requirements of this sport.

Bompa and Carrera (2015, p. 67) emphasize that physical training must be personalized according to the age, level of development and individual

characteristics of the athletes, including exercises aimed at increasing muscle strength, reaction speed, cardiovascular endurance and joint flexibility. In Romania, the physical training of juniors I is organized in a structured way, being integrated into the weekly training program of the teams.

The development of muscular strength is a priority in the physical training of juniors I, given its importance in executing hits, throws and fast runs, which are essential in baseball. Bompa and Carrera (2015, p. 68) argue that strength exercises should be performed with moderate weights and include functional movements that imitate specific actions in the game. In Romania, strength training is integrated into the weekly program, complemented by stretching sessions and mobility exercises, which contribute to maintaining muscle balance and preventing excessive tension.

Reaction speed is another essential component of physical fitness, being crucial for performance in game situations that require quick decisions and precise movements. According to Bompa and Carrera (2015, p. 69), speed training should include sprinting exercises, rapid changes of direction, and reactions to visual or auditory stimuli.

Cardiovascular endurance is essential for maintaining an optimal level of performance throughout the entire game, which can include up to nine innings. Bompa and Carrera (2015, p. 70) emphasize that endurance training should be varied, including long runs, high-intensity intervals, and circuit exercises.

Joint flexibility is an essential component for preventing injuries and for performing the complex movements required in baseball. Bompa and Carrera (2015, p. 71) argue that flexibility exercises should be included in every training session, being performed both before and after the main activities.

Developing technical and tactical skills

Technical training is an essential component of the junior I baseball training process, aiming to develop and improve the motor skills specific to this sport. In Romania, technical training is integrated into the weekly training program, being organized in dedicated sessions, which allow athletes to practice and improve their technique under the close supervision of coaches.

Pitching, which is one of the most important technical skills in baseball, is trained through exercises that emphasize precision, speed and consistency. Pitching training includes both individual exercises and group activities, which simulate real game situations, thus contributing to the development of coordination and synchronization skills.

Hitting, another essential technical skill, is trained through a combination of exercises that target strength, precision and control. Schmidt and Wrisberg (2008, p. 94) argue that hitting training should include both static exercises, which allow athletes to focus on technique, and dynamic exercises, which simulate real competition conditions. In Romania, these exercises are performed on specially designed courts, which allow athletes to practice in conditions similar to those in

competitions, thus contributing to increasing confidence and performance.

Catches, which are essential for defence, are trained through exercises that emphasize reflexes, coordination, and positioning. Schmidt and Wrisberg (2008, p. 95) emphasize that these exercises must be varied and include situations that simulate different types of throws and ball trajectories. In Romania, catch training is organized regularly, monitored by coaches who provide constant feedback to athletes, thus contributing to improving technique and reducing errors.

Tactical training is another essential component of the training process, aiming to develop athletes' ability to understand game strategies and make quick and effective decisions during competitions. According to Schmidt and Wrisberg (2008, p. 96), tactical training must be integrated into the training program, using methods that stimulate athletes' critical thinking and adaptability. In Romania, tactical training is addressed during training sessions, being adapted to the requirements of national competitions and the level of performance of the athletes.

An important aspect of tactical training is represented by the understanding of the positioning on the field and the roles of each player. Schmidt and Wrisberg (2008, p. 97) argue that athletes must be trained to anticipate the movements of their opponents and coordinate their actions with their teammates, in order to maximize the team's efficiency. Quick decision-making, another essential element of tactical training, is trained through exercises that put athletes in pressure situations, forcing them to react quickly and choose the best option. Schmidt and Wrisberg (2008, p. 98) emphasize that these exercises must be varied and include both offensive and defensive situations, in order to develop a complete understanding of the game.

The integration of technical and tactical training into competitions is an essential stage in the training process, allowing athletes to apply the skills learned in real game conditions. According to Schmidt and Wrisberg (2008, p. 99), competitions provide a valuable opportunity to evaluate the progress of athletes and to identify areas that require improvement. In Romania, national competitions are organized in such a way as to allow athletes to practice both technical and tactical skills, thus contributing to their complete development and preparation for international competitions.

Psychological and theoretical preparation

Psychological preparation is an essential component of the training process of junior athletes, with the main goal of developing mental skills that allow them to cope with competitive pressures and maintain their performance at an optimal level. Weinberg and Gould (2019, p. 123) emphasize that psychological training should include specific techniques, such as progressive relaxation, visualization, and stress management, which are essential for improving concentration and self-confidence. In Romania, these techniques are integrated into the junior training program, being implemented by coaches in collaboration with sports psychologists, who provide specialized support for the development of athletes' mental skills.

Theoretical training plays a crucial role in the training of junior athletes,

contributing to the development of a deep understanding of the rules of the game and the basic principles of tactics. Weinberg and Gould (2019, p. 127) emphasize that theoretical training must be integrated into the training program, using interactive methods that stimulate critical thinking and active learning.

In Romania, theoretical training is organized in the form of educational sessions, which include presentations, discussions and video analysis, providing athletes with the opportunity to learn and apply theoretical knowledge in practical situations. An important aspect of theoretical training is represented by the understanding of the rules of the game, which is essential for respecting the regulations and avoiding penalties during competitions.

Weinberg and Gould (2019, p. 128) argue that athletes must be trained in detail on the specific rules of baseball, using concrete examples and simulations to facilitate learning. In Romania, these sessions are supported by coaches and referees, who provide detailed explanations and answer athletes' questions, thus contributing to increasing the level of understanding and compliance.

Theoretical training also includes learning the basic principles of tactics, which are essential for developing strategic thinking and making effective decisions during the game. Theoretical tactical training is supported by coaches, who use video analysis and group discussions to explain different game scenarios and encourage athletes to develop their own strategies.

The integration of psychological and theoretical training into competitions is an essential stage in the training process, allowing athletes to apply mental skills and theoretical knowledge in real game conditions. National competitions are organized in such a way as to provide athletes with the opportunity to practice both psychological skills and theoretical knowledge, thus contributing to their complete development and preparation for international competitions.

4. Conclusions

1. Playing baseball significantly contributes to the harmonious physical development of athletes, having a positive impact on overall health and motor skills. This sport involves a variety of complex movements, such as running, throwing, catching and hitting the ball, which stimulate the development of muscle strength, motor coordination and flexibility.
2. Baseball, as a sports discipline, involves a wide range of requirements, from the development of physical strength and motor coordination, to a deep understanding of game strategies and team dynamics. In Romania, this sport is in a stage of development, and the national competitive system offers limited but valuable opportunities for juniors who aspire to participate in high-level competitions.
3. Baseball, as a team sport, is notable for its technical complexity, requiring the development of fundamental skills such as throwing, catching, hitting the ball and

running between the bases. These skills are essential for the individual success of the players, but also for the collective performance of the team.

4. The study of the specialized literature as well as personal discussions with physical education teachers and coaches who are in charge of training juniors I in baseball, highlighted the lack of concern for training programming, highlighting only general theoretical issues.

Bibliography

1. Adair, R. K. (2002). The Physics of Baseball. Harper Perennial, p. 78. Disponibil la: https://baseball.physics.illinois.edu/Adair_PhysicsToday_May95.pdf, accesat în 20 martie 2025;
2. Bompa, T., Carrera, M. (2015). Periodization Training for Sports. Champaign: Human Kinetics. Disponibil la: https://coachezra.weebly.com/uploads/1/1/8/3/118372877/tudor_bompa_carlo_buzzichelli-periodization_training_for_sports-human_kinetics__2015_.pdf, accesat în 21 martie 2025;
3. Côté, J., Gilbert, W. (2009). An integrative definition of coaching effectiveness and expertise. International Journal of Sports Science & Coaching, 4(3), p. 312. Disponibil la: https://www.researchgate.net/publication/249883809_An_Integrative_Definition_of_Coaching_Effectiveness_and_Expertise, accesat în 24 martie 2025;
4. Faigenbaum, A. D., Myer, G. D. (2010). Resistance training among young athletes: Safety, efficacy and injury prevention effects. British Journal of Sports Medicine, 44(1), p. 162. Disponibil la: https://www.researchgate.net/publication/40039109_Resistance_training_among_young_athletes_Safety_efficacy_and_injury_prevention_effects, accesat în 1 aprilie 2025;
5. Federația Română de Baseball și Softball (FRBS). (2020). Regulamentul Campionatului Național de Baseball, categoria seniori. București: Federația Română de Baseball și Softball. Disponibil la: https://baseball-softball.ro/wp-content/uploads/2023/01/Reg.CN_bas_seniori.pdf, accesat în 2 aprlie 2025;
6. Guttmann, A. (2004). Sports: The First Five Millennia. Amherst: University of Massachusetts Press. Disponibil la: https://www.researchgate.net/publication/287684158_Sports_The_first_five_millennia, accesat în 1 aprilie 2025;
7. Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: Exercise effects on brain and cognition. Nature Reviews Neuroscience, 9(1), p. 116. Disponibil la: https://www.researchgate.net/publication/5753778_Be_Smart_Exercise_Your_Heart_Exercise_Effects_on_Brain_and_Cognition, accesat în 1 aprilie 2025;

8. Klein, A. (2016). Baseball on the Border: A Tale of Two Laredos. Princeton University Press, p. 102. Disponibil la: https://press.princeton.edu/our-authors/klein-alan-m?srsltid=AfmBOopq7BKMxbbUHP8a3oyXecdamp3WwFrHqxFfIZb6yOqyyTklzjX0, accesat în 1 aprilie 2025;
9. Morris, P. (2015). A Game of Inches: The Stories Behind the Innovations That Shaped Baseball. Ivan R. Dee, p. 134. Disponibil la: https://archive.org/details/gameofinchesstor0000morr, accesat în 1 aprilie 2025;
10. Rader, B. G. (2008). Baseball: A History of America's Game. University of Illinois Press. Disponibil la: https://books.google.com.na/books?id=LRTU0n3IcEYC&printsec=frontcover&source=gbs_vpt_read#v=onepage&q&f=false, accesat în 1 aprilie 2025;
11. WBSC. (2021). World Baseball Softball Confederation Annual Report. WBSC Publications. Disponibil la: https://static.wbsc.org/assets/cms/documents/522db522-add3-8968-4953-48e4dd052e46.pdf, accesat în 1 aprilie 2025;
12. Weinberg, R. S., Gould, D. (2019). Foundations of Sport and Exercise Psychology. Human Kinetics, p. 89. Disponibil la: https://books.google.it/books/about/Foundations_of_Sport_and_Exercise_Psycho.html?id=ACBwDwAAQBAJ&redir_esc=y, accesat în 1 aprilie 2025.

THEORETICAL AND METHODOLOGICAL PERSPECTIVES ON THE DEVELOPMENT OF MOTOR SKILLS IN FEMALE MINI-VOLLEYBALL PLAYERS

Aurelia Gabriela Ayza Berca [1], Veronica Visan [2], Vladimir Potop [3], Carmen Pârvu [4], Valentina Ștefănică [5], Ilie Mihai [6]

[1,2] *"Mircea cel Batran" Secondary School Pitesti, Romania*

[1,3] *Doctoral School of Sport Science and Physical Education, University Center Pitesti, National University of Science and Technology "Politehnica" Bucharest, Romania*

[3,5,6] *University Center Pitești, National University of Science and Technology Politehnica Bucharest, Romania*

[3]*Institute of Physical Education and Sports, Moldova State University, Chisinau, Republic of Moldova*

[4] *Faculty of Physical Education and Sports, "Dunărea de Jos" University of Galați, 47 Domnească Street, Galați, 800008, Romania*

Abstract

This study presents a systematic review conducted according to the PRISMA 2020 protocol, aiming to identify and analyze theoretical and methodological contributions related to the development of motor skills in female mini-volleyball players aged 8–12. Seven articles published between 2010 and 2025 were included, addressing strength, speed, coordination, balance and dexterity, as well as modern approaches to training and assessment. Results reflect the effectiveness of the exercises applied, small-sided games and play-based methods in improving motor performance and intrinsic motivation. Moreover, research confirms the importance of coordination and executive function development in young players, emphasizing a multidimensional approach that integrates physical, cognitive and socio-affective components. The review recommends individualized content, visual and auditory feedback and also the use of standardized tests to monitor motor progress.

Key words: *mini-volleyball, motor skills, coordination, speed, children*

1. Introduction

The initiation stage in mini-volleyball, typically encompassing ages 8 to 12, represents a crucial phase in shaping the motor, cognitive and emotional foundations that will support future performance in competitive volleyball. During this period, training focuses primarily on developing fundamental motor skills—speed, coordination, agility, balance, flexibility and strength—through playful, age-appropriate methods that ensure both physiological and psychological adaptation (Šimonek, 2014).

Recent research points out that specific small-sided volleyball games (SSGs) can significantly improve body mass index (BMI), motor performance and physiological adaptation in prepubertal children. Hari, Kurniawan and Budijanto (2024) ascertained that implementing structured mini-volleyball learning models resulted in better BMI regulation and enhanced physical fitness indicators in 8–12-year-old

children. Such findings suggest that modifying traditional training structures, by using smaller game formats, fosters motor engagement, reduces monotony and improves long-term adherence.

At neuromuscular level, the training for strength and coordination plays a fundamental role in the early years of volleyball development. Fattahi and Sadeghi (2014) highlighted that resistance and plyometric training programs conducted over short durations (8–12 weeks) could improve jump performance by up to 74% in young volleyball athletes. Similarly, Oikonomou et al. (2014) underscored that consistent volleyball training positively influenced throwing velocity and handgrip strength, two indicators closely linked to general upper-body coordination and control.

Beyond physical conditioning, the development of coordinative and executive abilities is equally relevant. Arsham (2024) demonstrated that practicing tasks with varying coordination requirements improved executive functions—such as motor inhibition and visual attention—in 9–10-year-old girls, which shows that coordination-based learning positively influences cognitive control in sports contexts. These results align with the assertion of Šimonek (2014) that rational development of coordination abilities is closely connected with the psychological and physiological maturation of young athletes.

From a psychosocial perspective, team-based conditions in mini-volleyball encourage not only motor and cognitive abilities but also interpersonal and leadership skills. Sopa and Pomohaci (2018) found that early team experiences shape leadership traits and communication abilities in young female volleyball players, reinforcing the holistic nature of mini-volleyball training.

Despite these advances, research gaps persist regarding the integrated development and assessment of motor skills among prepubertal female athletes. As Stankiewicz (2013) noted, much of the volleyball literature remains focused on adolescent or adult populations, leaving the early formative years underrepresented in empirical studies. Furthermore, as Kioumourtzoglou, Zetou and Giannousi (2022) emphasized, technological and multimedia tools—though promising for increasing motivation and engagement—are still rarely applied in mini-volleyball for children aged 8–12 years.

Consequently, this review aims to synthesize and critically analyze existing theoretical and methodological approaches related to the development and evaluation of motor skills in female mini-volleyball players during the initiation stage. Emphasis will be placed on identifying effective training modalities, age-appropriate assessment tools and multidimensional frameworks that integrate physiological, cognitive and psychosocial components.

2. Material and method

This study follows a systematic review design, developed according to the PRISMA 2020 statement (Preferred Reporting Items for Systematic Reviews and

Meta-Analyses). The aim was to identify, analyze and synthesize theoretical and methodological contributions on the development of motor skills in female mini-volleyball players aged 8–12, as well as the means and methods used to enhance and assess them.

Inclusion and exclusion criteria

Studies were included if they met the following criteria:

- published between 2010 and 2025;
- addressed motor skills such as strength, speed, coordination, balance or agility in children aged 8–12 years;
- focused on mini-volleyball, volleyball or comparable sports requiring complex coordinative actions;
- presented theoretical frameworks, methodological approaches or empirical findings relevant to motor development;
- written in English, Romanian or other languages with English abstracts.

Exclusion criteria:

- studies unrelated to motor development;
- research involving athletes older than 13 years;
- editorials, opinion papers or unpublished works.

Search Strategy

Electronic searches were carried out from August to October 2025 by means of the Google Scholar, Scopus, ResearchGate, ProQuest and Academia.edu databases. The used keywords included: "motor abilities," "motor skills," "mini-volleyball," "children 8–12 years," "physical training," "coordination," "explosive power," "balance," "skill learning," "girls."

The PRISMA process followed these stages:

1. Identification (n = 87 articles);
2. Duplicate removal (n = 15);
3. Title and abstract screening (n = 72);
4. Full-text assessment (n = 34);
5. Final inclusion (n = 7).

Data Analysis

The selected studies were qualitatively analyzed to compare research objectives, methodological designs and conclusions. The synthesis focused on identifying theoretical and applied trends in motor skills development, as well as training and assessment strategies used in the initiation stage of mini-volleyball players.

3. Results and discussions

The qualitative synthesis of the selected studies revealed a consistent research trend emphasizing the integrated development of fundamental and specific motor skills during the initiation stage in mini-volleyball. Recent findings (Hari et al., 2024; Fattahi & Sadeghi, 2014) highlight the value of applied exercises, small-sided games

and play-based training in enhancing strength, speed and coordination among 8–12-year-old children.

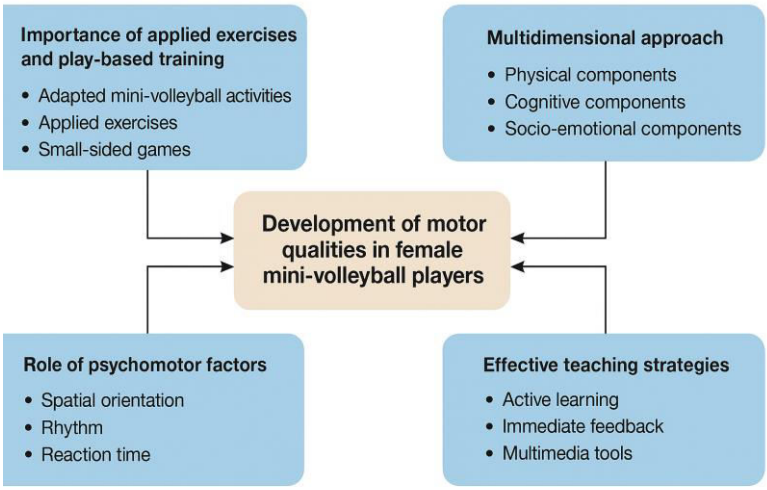


Figure 1. *Conceptual model of motor skills development in female mini-volleyball players during the initiation stage*

Figure 1 presents a conceptual model summarizing the main theoretical and methodological perspectives on motor skills development in female mini-volleyball players aged 8–12 years. At the center of the model lies the concept of motor development, understood as a multidimensional and interactive process shaped by four key factors:

- Importance of applied exercises and play-based training, which increase motivation, coordination and physical performance through age-appropriate activities and small-sided games.
- Role of psychomotor factors, including spatial orientation, rhythm and reaction time, which form the basis for accurate technical execution and game adaptability.
- Effectiveness of modern teaching strategies, emphasizing active learning, immediate feedback and the integration of multimedia tools to support motor learning and intrinsic motivation.
- Multidimensional approach that includes physical, cognitive and socio-emotional components, providing a holistic framework for motor and sport skill formation during the initiation phase.

Therefore, this model highlights that motor development in young female mini-volleyball players depends not only on physical conditioning but also on the interaction between body, cognition and social context, reflecting the principles of modern and holistic motor education.

Hari et al. (2024) underlined that using adapted mini-volleyball activities significantly improved physiological parameters and maintained a balanced body

mass index among prepubertal children. Similarly, Fattahi and Sadeghi (2014) demonstrated that combined resistance and plyometric training programs led to notable gains in explosive power and intersegmental coordination, which in turn improved technical execution.

Szabo et al. (2021) focused on eye-hand coordination and reaction speed in children aged 10–14, identifying these abilities as key predictors of motor performance in ball games such as volleyball. Stankiewicz (2013) further emphasized the role of psychomotor factors (spatial orientation, rhythm and reaction time) in the early formation of young players, while Šimonek (2014) proposed a refined taxonomy of coordination abilities and corresponding differentiated training methods.

From a methodological standpoint, the studies conducted by Kioumourtzoglou et al. (2022) and Sopa & Pomohaci (2018) confirmed the effectiveness of active learning strategies, immediate feedback and multimedia-assisted training for improving both motor performance and self-motivation. Moreover, Shaltout & Hosni (2022) showed that incorporating action games and cooperative learning models (Jigsaw) enhances attention, cooperation and movement execution among elementary school students.

Overall, the reviewed evidence suggests that the development of motor skills in female mini-volleyball players requires a multidimensional approach that integrates physical, cognitive and socio-emotional components. Such a holistic perspective ensures optimal adaptation during the sensitive developmental phase (ages 8–12) and supports the transition toward advanced levels of sports performance.

4. Conclusions

The analysis of the specialized literature published between 2010 and 2025 highlights an increasing interest in studying the development of motor skills in female mini-volleyball players during the initiation stage, as a fundamental basis for future performance. The reviewed studies indicate that this stage represents a sensitive period for the development of coordination, reaction speed, balance and explosive strength — factors that largely determine technical efficiency and adaptability to the demands of modern volleyball.

The findings confirm that playful and varied methodological approaches, such as thematic games, circuit-based exercises and age-appropriate plyometric training, contribute to the harmonious development of motor abilities and the strengthening of intrinsic motivation. Also, the use of digital tools and visual feedback has proven effective in enhancing motor learning.

From a methodological perspective, the reviewed authors recommend individualizing training content and integrating cognitive and socio-emotional components into the instructional process. Adapting motor tasks to age- and gender-

specific characteristics is an essential condition for preventing overtraining and optimizing long-term progress.

Consequently, it can be concluded that the development of motor skills in 8–12-year-old female mini-volleyball players should be achieved through an integrative approach, based on the complementarity of play, training and psychomotor education.

Practical recommendations

1. Systematically introduce small-sided games and variable coordination exercises adapted to the experience level of the players.
2. Employ combined methods (technical–motor and cognitive) to stimulate anticipation and decision-making.
3. Implement periodic monitoring of motor skills (speed, strength and balance) using standardized tests.
4. Promote the use of visual and auditory feedback to improve motor self-control.
5. Encourage continuous professional development of coaches in terms of modern methods of psychomotor development for children.

Bibliography

1. Aljedani, A. K. K. (2020). *Sports health education instructional for women at the University of Jeddah* (Doctoral dissertation, Concordia University Chicago).
2. Arsham, S. (2024). The effect of practicing skills with different coordination requirements on the executive functions of 9 to 10 year old girls. *Authorea Preprints*.
3. Fattahi, A., & Sadeghi, H. (2014). Resistance, plyometrics and combined training in children and adolescents' volleyball players: A review study. *Journal of Scientific Research and Reports*, 3(20), 2584-2610.
4. Güler, U. (2019). *Dinamik ve FIFA 11+ ısınma yöntemlerinin futbol oyuncularının esneklik, dikey sıçrama ve çeviklik performansları üzerine akut etkisi* [The acute effects of dynamic and FIFA 11+ warm-up methods on flexibility, vertical jump and agility performance in football players]. (Master's thesis, Marmara Universitesi, Turkey).
5. Hari, H. P., Kurniawan, F. T., & Budijanto, B. (2024). Effect of volleyball small side games on body mass index and physiological conditions on pre-pubertal children. *Bravo's: Journal of Physical Education and Sport Science*, 12(2), 170-192.
6. Iserbyt, P., Dehandschutter, T., & colleagues. (2022). The effect of a coaching clinic on student-coaches' behavior during a basketball Sport Education season

with preservice teachers. *Journal of Teaching in Physical Education*, 42(3), 563-572.

7. Kioumourtzoglou, J., Zetou, E., & Giannousi, M. (2022). Multimedia as an incentive for internal motivation and use of computers in sports. *European Journal of Physical Education and Sport Science,* 7(6), 58-69.
8. Ngatman, N., Hermawan, H. A., Komari, A., & Solikhin, M. N. (2024). Techniques of serving, forehand and backhand groundstroke, forehand and backhand volley based on "acentos method" for junior tennis players in Yogyakarta region. *Retos: Nuevas Tendencias en Educación Física, Deporte y Recreación*, 59, 584-594.
9. Oikonomou N., Papadopoulou S.D., Bassa E., Kaloudi M., Skoufas D. (2011). Evaluation of the effect of volleyball training on throwing velocity and handgrip strength in male children. *Aristotle University of Thessaloniki*, Greece, Department of Physical Education and Sport Science, Coaching and Sport Performance Laboratory.
10. Popek, S. (2023). *Utjecaj različitih vrsta istezanja na eksplozivnu snagu* [The effect of different stretching types on explosive power]. Doctoral dissertation, University of Zagreb. Faculty of Kinesiology.
11. Shaltout, M., & Hosni, A. (2022). The impact of Jigsaw's strategy using action games on learning some basic skills for basic education students. Assiut Journal of Sport Science and Arts. *Assiut Journal of Sport Science and Arts*, 2022(1), 110-132.
12. Šimonek, J. (2014). *Coordination abilities in volleyball*. Walter de Gruyter GmbH & Co KG.
13. Sopa, I. S., & Pomohaci, M. (2018). Discovering the leader of a volleyball team using the sociometric survey method. *Timisoara Physical Education and Rehabilitation Journal,* 11(20), 27-33.
14. Stankiewicz, B. (2013). Status, problems and future directions of research in volleyball. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 17(12), 77-81.
15. Szabo, D., Ujică, A., & Ursu, O. (2021). Testing the eye-hand coordination and reaction speed in children aged between 10–14 years old. *Geosport Soc,* 15, 110-121.

DETERMINING THE VISUAL REACTION OF LOWER LIMBS IN PERFORMANCE SAMBO ATHLETES

Gheorghe Cristian Bodîrlău [1], Vladimir Potop [2], Victor Manolachi [3], Andrii Chernozub [4], Ilie Mihai[5]

[1,2,3]*Institute of Physical Education and Sports, Moldova State University, Chisinau, Republic of Moldova*
[2,5]*University Center Pitești, National University of Science and Technology Politehnica Bucharest, Romania*
[4]*Lesya Ukrainka Volyn National University, Ukraine*

Abstract

The aim of this study was to investigate the characteristics of lower-limb visual reaction time in female Sambo athletes, identifying neuromotor particularities, functional asymmetries and intra-segmental consistency of visual-motor responses. The sample included 13 athletes aged 14–17 years, members of the "Steaua" Army Sports Club. Visual reaction time was assessed using the OptoJump platform, with two repetitions per leg. Statistical analysis performed in KyPlot showed similar mean values between limbs, with slightly faster responses in the right leg, though differences were not statistically significant ($p > 0.05$). Pearson's correlation revealed a moderate relationship between repeated trials of the same leg ($r = 0.536$) and weak inter-limb correlations, indicating functional lateralization typical of Sambo athletes. The findings emphasize the importance of integrating visual reaction assessment into training, providing a basis for the improvement of bilateral coordination and optimizing performance preparation in competitive Sambo.

Key words: *visual reaction; lower limbs; Sambo; functional lateralization; bilateral coordination*

1. Introduction

The speed with which an athlete perceives a visual stimulus and transforms it into an appropriate motor response is a critical determinant of competitive success in high-performance combat sports. Sambo, a complex discipline that combines elements of judo, freestyle wrestling and self-defense techniques, has exceptional requirements in terms of rapidity and precision of neuromotor responses. The lower limbs play a strategic role: they initiate movement, control balance and generate the force needed for throws and counterattacks-adaptations supported by specific neuromotor and muscular training programs (Wang et al., 2023).

Recent studies confirm that the Sambo athletes exhibit superior visual–motor reaction times compared with practitioners of other martial arts (Bocharin et al., 2024a) and that adolescents engaged in this sport have significantly faster psychophysiological responses (Vedernikova et al., 2023). In direct combat, opponents continually change their positioning and tactical intentions. So, the ability

to promptly process visual information (movement direction, initiation of an attack) and convert it into an efficient motor action is decisive for achieving good results (Bocharin et al., 2024a; Bajkowski & Cynarski, 2024). The stability of visual response and lower-limb motor execution has proven essential for the successful performance of throwing and counterattacking techniques (Tron et al., 2018; Chen et al., 2017). The individualized training based on these reactions is recommended to optimize performance (Bocharin et al., 2024b).

Lower-limb visual reaction is closely linked to key motor abilities such as execution speed, intersegmental coordination and dynamic balance—variables critical to combat sports. Investigating these relationships provides coaches and researchers with valuable data for refining training programs (Niederer et al., 2019; Szabo et al., 2021). Objective assessment of reaction time using modern technologies—force platforms, photocell systems, computer applications—enables progress monitoring and the personalization of exercises aimed at reducing motor response latency (Wilke & Vogel, 2020; Badau et al., 2025; Ersoy & Hocaoglu, 2023).

Rigorous research requires the clear definition of analytical parameters—visual–motor latency, execution accuracy and response consistency—and also the selection of scientifically validated testing instruments integrated into the specific context of Sambo training. Recent studies highlight the usefulness of measuring these variables with reliable technologies to evaluate the accuracy and stability of visual–motor responses (Luo et al., 2025; Burris et al., 2020). Visual-training programs can enhance reaction speed and execution precision, even in athletes with different levels of experience (Guo et al., 2024; Erickson, 2021). Correlating the results with factors such as age, weight category, training volume and competitive experience is crucial for individualized interventions (Ramyarangsi et al., 2024).

This study aims to analyze the characteristics of lower-limb visual reaction time in female Sambo athletes, for identifying neuromotor particularities, functional asymmetries and the intra-segmental consistency of visual-motor responses. Through descriptive, comparative and correlation analysis, the research seeks to provide a scientific basis for optimizing sport-specific training and enhancing reaction speed and bilateral coordination abilities in high-performance Sambo.

2. Material and method

The research group consisted of 13 athletes aged between 14 and 17 years, all registered members of the "Steaua" Army Sports Club. The participants were selected and evaluated in accordance with the ethical and deontological principles approved within the doctoral program of the Institute of Physical Education and Sports, Moldova State University, in collaboration with the Human Performance Research Center (CCPU) of the University Center of Pitești.

To assess the visual reaction speed of the lower limbs, the OptoJump platform was used. This allows for precise measurement of reaction time expressed in seconds. Each participant performed two trials for each leg, with the best performance being recorded for analysis.

Statistical analysis of the data was conducted by means of the KyPlot software, employing both descriptive indicators (mean, standard deviation (S.D.), coefficient of variation (CV%), minimum, maximum, Skewness, Kurtosis, Mean Deviation, Confidence Level of Mean (0.95) (CLM (0.95); Mean of Differences, S.E. of Differences, t- test Paired Comparison for Means, P - significance level) and the Pearson correlation coefficient to identify relationships between the investigated variables.

3. Results and Discussions

The analysis of the results aimed to highlight neuromotor characteristics and possible functional differences between the lower limbs, based on descriptive, comparative and correlational parameters of visual reaction time in female Sambo athletes.

Table 1. *Descriptive and comparative analysis of lower-limb visual reaction in female Sambo athletes*

Parameters	L-r1 (sec)	L-r2 (sec)	R-r1 (sec)	R-r2 (sec)
Mean	0.462	0.580	0.470	0.503
S.D.	0.09	0.28	0.08	0.13
Coeff. Var. (%)	19.43	49.04	17.86	26.79
Min	0.348	0.4	0.367	0.356
Max	0.633	1.233	0.608	0.787
Skewness	0.76	1.70	0.47	0.93
Kurtosis	-0.23	1.22	-1.19	-0.32
Mean Deviation	0.072	0.218	0.078	0.111
CLM (0.95)	0.05	0.17	0.05	0.08
Mean of Differences	-0.119		-0.033	
S.E. of Differences	0.08		0.05	
t	-1.43		-0.69	
P	0.178		0.503	

Note. Confidence Level of Mean (0.95); L – left leg, R – right leg; r - trial

Table 1 presents the descriptive and comparative statistical parameters of the lower limbs visual reaction time in female Sambo athletes, assessed using the OptoJump platform. Two trials were carried out for each leg (L–r1, L–r2 for the left leg; R–r1, R–r2 for the right leg), with results expressed in seconds.

The descriptive analysis of the visual reaction times in Sambo athletes revealed relatively similar values between the two lower limbs, with slight differences

favoring the right leg. The mean reaction time for the left leg was 0.462 s in the first trial (L–r1) and 0.580 s in the second trial (L–r2), while the mean values for the right leg were 0.470 s (R–r1) and 0.503 s (R–r2).

These data show a slight increase in reaction time in the second attempt, more pronounced in the left leg, suggesting a minor decrease in focus or neuromotor stability upon task repetition.

Performance variability, expressed through the coefficient of variation (CV), was considerably higher in the left leg (19.43–49.04%) compared to the right leg (17.86–26.79%), which reflects less consistent motor responses for the non-dominant limb. This tendency is further supported by the standard deviation values (S.D. = 0.28 s for L–r2 vs. 0.13 s for R–r2), indicating greater dispersion in left-leg performance.

The skewness and kurtosis parameters showed slightly positive asymmetry across all trials, with higher skewness in L–r2 (1.70), sign of a concentration of slower responses for the left limb in some participants.

Comparatively, the mean differences between the lower limbs were –0.119 s in the first trial and –0.033 s in the second, the negative sign indicating slightly faster responses in the right leg.

The paired t-test confirmed that these differences were not statistically significant ($t = –1.43$, $p = 0.178$ for the first trial; $t = –0.69$, $p = 0.503$ for the second trial). However, the descriptive results suggest a functional tendency favoring the right leg, likely associated with motor dominance and its more frequent involvement in sport-specific motor actions.

These findings align with previous research highlighting the presence of moderate functional asymmetries between the lower limbs. This fact points out neuromotor adaptation patterns characteristic of high-performance athletes in combat sports. The slight asymmetries identified in Table 1 are consistent with broader evidence proving that inter-limb functional disparities tend to develop in the sport disciplines where one limb is preferentially involved in forceful or reactive motor tasks (Bishop, 2018; D'Hondt et al., 2024). Recent studies further emphasize that the extent and nature of these asymmetries can influence both performance efficiency and injury susceptibility, depending on their magnitude, context and sport-specific demands (Guan et al., 2022).

The observed inter-limb differences in visual reaction time among Sambo athletes are in line with previous evidence reflecting that asymmetries in motor control and visuomotor responses may arise as adaptive outcomes of repetitive sport-specific motor demands (Duarte & Almeida, 2007). Moreover, neurophysiological studies have emphasized the role of inter-hemispheric communication in processing visual information and coordinating bilateral motor actions, which can influence the degree of lateralization in skilled athletes (Celeghin, Bendini, & Marzi, 2013; Calluso, Tosoni, Pezzulo & Committeri, 2014). These studies support the notion that

combat sports such as Sambo, characterized by asymmetric attack and defense actions, may foster functional specialization of the limbs as part of a broader neuromotor adaptation process (Czerwińska Pawluk & Zukow, 2011).

The intrasegmental correlation analysis of visual reaction times in Sambo athletes (Figure 1) revealed low Pearson correlation coefficients, indicating a weak dependence between successive trials and between homologous segments (left vs. right leg).

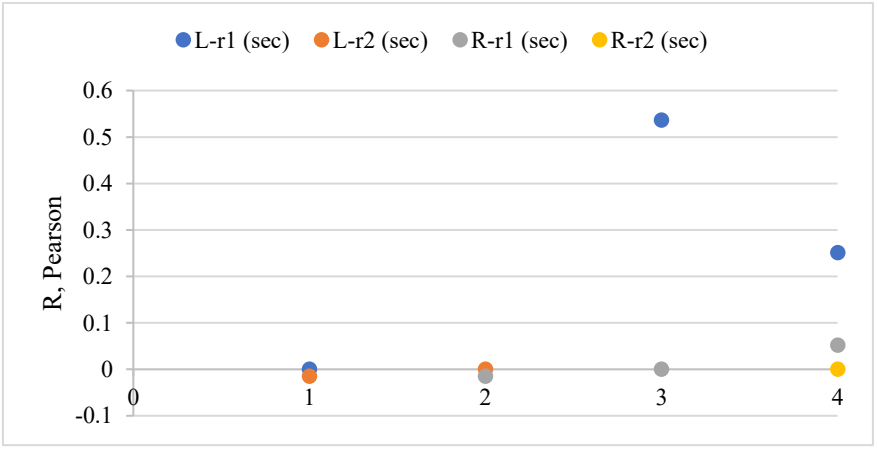


Figure 1. *Intrasegmental correlation analysis of visual reaction in the lower limbs of Sambo athletes*

The strongest association was observed between the left leg trials (L–r1 and L–r2), with a correlation coefficient of r = 0.536, suggesting a moderate relationship and a partial consistency of the visual-motor response within the same limb.

Other correlations were notably low: r = 0.251 between L–r1 and R–r1, and r = 0.052 between R–r1 and R–r2. The small negative coefficients (r = –0.015) indicate the absence of functional interdependence between certain reaction series.

These findings prove that, while visual reaction shows some degree of intra-limb stability, the inter-limb consistency remains low, reflecting functional lateralization typical for combat athletes, where each leg plays a distinct biomechanical role (support, attack or balance).

The weak correlations may be attributed to the acyclic nature of movement in Sambo, where visual reactions are highly context-dependent and rely more on rapid adaptive responses rather than repetitive motor patterns.

The results illustrated in Figure 2 confirm the presence of moderate functional lateralization of visual reaction in female Sambo athletes, a phenomenon also highlighted in previous studies on high-performance athletes, where inter-limb asymmetries are linked to neuromotor adaptations typical of combat sports (Duarte & Almeida, 2007; Celeghin, Bendini & Marzi, 2013; Calluso, Tosoni, Pezzulo, &

Committeri, 2014). The results confirm that the asymmetric training patterns inherent to Sambo may influence visual-motor balance and interhemispheric visual processing mechanisms. Thus, the need for differentiated approaches in designing coordination and reaction training exercises is emphasized.

4. Conclusions

This study underscores the relevance of lower-limb visual reaction as a determinant of neuromotor efficiency in high-performance Sambo. The results obtained highlight both intra-limb consistency and inter-limb asymmetry, with slightly superior performance in the right leg—most likely reflecting functional lateralization and sport-specific motor dominance.

Although the statistical analysis did not reveal significant differences between the limbs, the descriptive indicators (mean values, variability coefficients and asymmetry indices) demonstrate the necessity of individualized monitoring of visual reaction performance. The moderate correlation within the same limb ($r = 0.536$ for L–r1 and L–r2) indicates a partial stability of visual-motor control, whereas the weak inter-limb correlations suggest that bilateral coordination and reaction balance should represent a target in technical and physical training.

Consequently, this paper highlights the importance of integrating visual reaction assessment into the training process for Sambo athletes, both for diagnostic and developmental purposes. The use of precise evaluation tools, such as the OptoJump system, can support coaches and sport scientists in creating evidence-based training strategies focused on improving reaction speed, coordination symmetry and neuromotor adaptation.

These findings are expected to contribute to the optimization of athlete selection and performance enhancement, as an important basis of the effective training for national and international competitions in Sambo.

Bibliography

1. Badau, D., Steff, N., Badau, A., & Stoica, M. (2025). Enhancing Lower-Limb Simple and Choice Reaction Time and Spatial Orientation in Junior Basketball Players by Implementing Fitlight Technology in Sports Training. Perceptual and Motor Skills, 00315125251347793.
2. Bajkowski, D. S., & Cynarski, W. J. (2024). Testing factors influencing handgrip strength and reaction time to visual stimulus in selected martial arts. Journal of Kinesiology and Exercise Sciences, 34(105), 46-59.
3. Bishop, C., Turner, A., & Read, P. (2018). Effects of inter-limb asymmetries on physical and sports performance: A systematic review. Journal of sports sciences, 36(10), 1135-1144.
4. Bocharin, I., Guryanov, M., Suldin, P., Kolokoltsev, M., Vorozheikin, A., Kraynik, V., ... & Morozova, O. (2024a). Distinguishing sensorimotor reactions

among students with varied forms of physical education training organization in sports sambo. Journal of Physical Education and Sport, 24(3), 614-620.
5. Bocharin, I., Guryanov, M., Vorozheikin, A., Kraynik, V., Romanova, E., Ryzhkova, L., ... & Kovalchuk, A. (2024b). Individualization of martial arts training based on sensorimotor reaction analysis in students. Journal of Physical Education & Sport, 24(6), 373- 1379.
6. Burris, K., Liu, S., & Appelbaum, L. (2020). Visual-motor expertise in athletes: Insights from semiparametric modelling of 2317 athletes tested on the Nike SPARQ Sensory Station. Journal of sports sciences, 38(3), 320-329.
7. Calluso, C., Tosoni, A., Pezzulo, G., & Committeri, G. (2014). Interindividual variability in functional connectivity predicts discounting behavior during intertemporal choice. Editors in-Chief: Michela Balconi Salvatore Campanella Carlo Miniussi. Neuropsychological Trends, 64-65.
8. Celeghin, A., Bendini, M., & Marzi, C. A. (2013). Inter-hemispheric transmission of visual information between the intact and the lesioned hemisphere. Neuropsychological trends, 71-71.
9. Chen, W. Y., Wu, S. K., Song, T. F., Chou, K. M., Wang, K. Y., Chang, Y. C., & Goodbourn, P. T. (2017). Perceptual and motor performance of combat-sport athletes differs according to specific demands of the discipline. Perceptual and motor skills, 124(1), 293-313.
10. D'Hondt, J., Chapelle, L., Bishop, C., Aerenhouts, D., De Pauw, K., Clarys, P., & D'Hondt, E. (2024). Association between inter-limb asymmetry and determinants of middle-and long-distance running performance in healthy populations: a systematic review. Sports medicine-open, 10(1), 127.
11. Erickson, G. B. (2021). Visual performance assessments for sport. Optometry and Vision Science, 98(7), 672-680.
12. Ersoy, T., & Hocaoglu, E. (2023). A 3-DoF robotic platform for the rehabilitation and assessment of reaction time and balance skills of MS patients. Plos one, 18(2), e0280505.
13. Guan, Y., Bredin, S. S., Taunton, J., Jiang, Q., Wu, N., & Warburton, D. E. (2022). Association between inter-limb asymmetries in lower-limb functional performance and sport injury: a systematic review of prospective cohort studies. Journal of clinical medicine, 11(2), 360.
14. Guo, Y., Yuan, T., Peng, J., Deng, L., & Chen, C. (2024). Impact of sports vision training on visuomotor skills and shooting performance in elite skeet shooters. Frontiers in Human Neuroscience, 18, 1476649.
15. Czerwińska Pawluk, I., & Zukow, W. (ed.). (2011). Humanities dimension of physiotherapy, rehabilitation, nursing and public health. https://books.google.ro/
16. Duarte, M., & Almeida, G. L. (2007). The Official Journal of the International Society of Motor Control, 11 suppl.
17. Luo, Y., Cao, Y., Pan, X., Li, S., Koh, D., & Shi, Y. (2025). Effects of

stroboscopic visual training on reaction time and movement accuracy in collegiate athletes: a systematic review and meta-analysis. Scientific Reports, 15(1), 25151.

18. Niederer, D., Plaumann, U., Seitz, T., Wallner, F., Wilke, J., Engeroff, T., ... & Banzer, W. (2019). How does a 4-week motor–cognitive training affect choice reaction, dynamic balance and cognitive performance ability? A randomized controlled trial in well-trained, young, healthy participants. SAGE open medicine, 7, 2050312119870020.
19. Ramyarangsi, P., Bennett, S. J., Siripornpanich, V., Nanbancha, A., Pokaisasawan, A., Noppongsakit, P., & Ajjimaporn, A. (2024). Distinct Visual Processing Patterns in Female Elite Athletes: A Comparative Study of Gymnastics, Soccer, and Esports Using Visual P300 Event-Related Potentials. International Journal of Exercise Science, 17(5), 1595.
20. Szabo, D. A., Neagu, N., Teodorescu, S., Panait, C. M., & Sopa, I. S. (2021). Study on the influence of proprioceptive control versus visual control on reaction speed, hand coordination, and lower limb balance in young students 14–15 years old. International Journal of Environmental Research and Public Health, 18(19), 10356.
21. Tron, R., Hruzevych, I., Salnykova, S., Kormiltsev, V., Sarafynyuk, P., Kyrychenko, Y., ... & Kropta, R. (2018). Psychophysiological conditions and competition in highly qualified combat sambo wrestlers. Journal of Physical Education and Sport, 18(2), 600 – 605.
22. Vedernikova, E. V., Morozova, M. A., Shushkanova, E. G., & Krotova, M. N. (2023). Psychophysiological peculiarities of adolescent athletes of different sports specialization. Theory and Practice of Physical Culture, (2), 54-57.
23. Wang, X., Soh, K. G., Samsudin, S., Deng, N., Liu, X., Zhao, Y., & Akbar, S. (2023). Effects of high-intensity functional training on physical fitness and sport-specific performance among the athletes: A systematic review with meta-analysis. Plos one, 18(12), e0295531.
24. Wilke, J., & Vogel, O. (2020). Computerized cognitive training with minimal motor component improves lower limb Choice-Reaction time. Journal of Sports Science & Medicine, 19(3), 529.

MODEL INDICATORS OF COMPETITIVE ACTIVITY OF HIGHLY QUALIFIED PLAYERS AS THE MAIN SELECTION CRITERION IN VOLLEYBALL

Olha Borysova [1], Olha Shlonska [2]
[1,2] *National University of Ukraine on Physical Education and Sport, Ukraine*
1, Fizkultury str., Kyiv-150, Ukraine, 03150

Abstract

One of the most important directions of the training process of highly skilled athletes in team game sports is to improve the quality of management based on the laws of formation of sportsmanship and objective knowledge about the structure of competitive activity, taking into account global trends. **The aim** is to determine the model indicators of competitive activity of highly skilled volleyball players of different roles as the main criteria for selection to the national teams. **Material and methods of the research**. The analysis of competitive activity of highly skilled volleyball players of different roles of the leading national teams of the world on the results of their performance in the Women's Volleyball Nations League 2022 is carried out on the basis of video viewing and the model indicators of competitive activity are defined. **Results.** On the basis of indicators of competitive activity of highly skilled volleyball players the generalized and group models of athletes of different game roles with the definition of average, maximum and minimum permissible characteristics are developed. It is determined that the main criteria of preparedness of pre-players are a high level of efficiency of attack (41.5 %) and defensive actions (67.7 %), for middle blockers - attack (53.9 %) and blocking (19.3 %), for setters - ball passes (24.1 %), which is confirmed by the peculiarities of the structure of their competitive activity. **Conclusions.** The maximum model indicators of the competitive activity of highly qualified volleyball players of different roles should be an important benchmark for predicting the success of performance in the most important international competitions, the average ones − as a necessary criterion for selecting players for national teams and the presence of certain abilities to universalize game actions.

Key words: *national teams, training system, model, indicators, volleyball*

1. Introduction

The results of the performances of high-class athletes of various team sports in the XXXIII Olympic Games show that the success of competitive activity depends not only on the level of sports training, where the key is technical and tactical, physical and psychological fitness. More and more attention in international scientific research is paid to the definition of refined model characteristics of players as the main criterion for selecting players for national teams [6]. Modeling is an active tool for managing the training of athletes and allows us to better understand the dynamics of the game, modern ways of forming strategic decisions that affect the effectiveness of players' actions, optimize the rational composition of the team, taking into account the technical and tactical actions of players of different roles [4].

The results of the analysis of the modern international bibliography show that one of the most informative indicators in building models is statistical, which reflects the individual performance of players and their activity during the match, which becomes an integral tool for predicting sports results in high-performance sports [2, 7]. However, the analysis of official protocols will not always determine the existing trends that are inherent in a particular sport [3]. With the development of modern information technologies, it becomes possible to analyze competitive activity on the basis of video viewing of matches using stops and replays, which provides a comprehensive analysis of competitive activity based on the use of technical and tactical actions by players of different roles in attack and defense, identifying key factors that ensure the effectiveness of competitive activity during the game. Today, mathematical modeling methods are widely used in team sports, volleyball in particular, where regression models are the main link [1], which allows to analyze the dynamics of the game in terms of physiological, biomechanical and psychological aspects of competitive activity. Modern advanced technologies and the use of artificial intelligence make it possible to use network programs for a detailed analysis of games and the impact of tactical actions on the effectiveness of competitive activity [5].

At the same time, issues related to the peculiarities of selecting players for national teams based on the criteria of their preparedness remain insufficiently studied. Along with this, it becomes especially important not only to quantify the technical and tactical actions performed by players, but also their effectiveness and analysis of the conditions that contributed to their victory. In view of this, the definition of model indicators of highly skilled players in volleyball will allow to substantiate the trends that are inherent in the selection of athletes in national teams as a necessary criterion of their preparedness, which increases the significance of our study.

The aim is to determine the model indicators of competitive activity of highly skilled volleyball players of different roles as the main criteria for selection to national teams.

2. Material and method

The hypothesis of the research is that the efficiency of competitive activity of highly skilled volleyball players in the international system of competitions depends on features of technical and tactical preparedness of players of different amplitude and compliance with model characteristics that is a prerequisite for universalization of game actions.

The analysis of the competitive activity was carried out according to the results of the video review of the Nation League 2024 of the 8 strongest national teams of the tournament according to their rating (63 highly qualified volleyball players) by the main quantitative indicators (the number of technical and tactical

actions performed during the game) and qualitative (efficiency): serving, passing, attacking, blocking, receiving service and defensive actions.

The data obtained were processed using standard statistical methods included in the Statistics 7.0 software package. The method of averages with the determination of the mean value and standard deviation was used to describe the indicators of competitive activity. The statistical reliability of the data was determined using the critically acceptable value (t).

3. Results and Discussions

The improvement of the system of training of qualified sportsmen is based on the objectification of knowledge about the features and structure of competitive activity, orientation to the model characteristics of competitive activity and preparedness of sportsmen, the use of which is the main factor in predicting success in the long-term process of sports improvement. The use of interactive technologies for the management of competitive activity constitutes the prerequisites for the use of modeling and the development of individual, group and generalized models, which is currently one of the reserves for improving the training process.

When forming models of competitive activity, its most essential characteristics are distinguished. For team game sports, the most significant components in the construction of these models are the effectiveness of technical and tactical actions in attack and defense. To develop model indicators of the competitive activity of highly skilled volleyball players, a scientific and methodological approach was chosen, which is based on the definition of maximum and average indicators of the effectiveness of technical and tactical actions and their quantitative performance by players of different roles based on the results of their participation in the most significant international competitions. Table 1, for example, presents a generalized model of the competitive activity of a pre-player in volleyball.

Table 1. *Generalized models of competitive activity of highly qualified volleyball players based on the results of their performance in the Women's Volleyball Nations League 2022 (n=19)*

Parameters	Model values		
	Maximal	middle	minimal
Total number of actions	135	115	95
Total number of attacks, number of times	45	27	21
Total number of defensive actions, number	18	12	9
Attack effectiveness, %.	60	41.5	23.1
Efficiency of defense, %.	77.6	67.7	56.2
Efficiency of competitive activity, %.	43.8	34.2	25.7
Efficiency of competitive of competitive activity, %.	33.4	23.4	12.9
Defects, %	16.1	10.7	4.4

The pedagogical analysis of indicators of competitive activity of highly skilled volleyball players of different game roles allows to emphasize that for attacking players one of the most important criteria of their preparedness should be the efficiency of attacking and defensive actions (the maximum model indicators are 60,0 and 77,6 %). Today, in the training of high-class athletes, there is a tendency to complete teams with players with different indicators of the effectiveness of attacking actions, where only one attacking player of a certain role is dominant. Thus, in the national team of Italy, the effectiveness of attacking actions of two additional players of the main composition have significant differences (Bosetti − 60.0%, Silla − 30.2%), which indicates a different level of technical and tactical preparedness.

However, it should be noted that the effectiveness of managing competitive activity also depends on the peculiarities of the strategy based on the organization of group tactical actions by players of different roles. Thus, in modern practice, blocking is considered to be the most effective defensive action in volleyball. However, competitive conditions (high speed of the ball transfer and its trajectory, anticipation of the actions of the connecting player) do not allow performing this technical and tactical action with a high level of efficiency. Therefore, the most important thing in this aspect is not the attacking actions of the player but the tactically correct execution of blocking, where the key task should be to "block" a separate area of the playing field. This can also be seen in the attack − the effectiveness of the player's attack can be at the level of the minimum acceptable model values, and the defensive actions are performed steadily, which ensures the "line efficiency."

The specificity of competitive activity significantly affects the performance of certain technical and tactical actions by players of different roles, which determines the differences in the criteria of their preparedness. Preliminary selection of players for the national teams should be carried out on the basis of the analysis of the effectiveness of indicators of their competitive activity, which is a model benchmark in team sports, in particular in volleyball. Figure 1 shows group models of the effectiveness of the performance of technical and tactical actions of players of different roles on the example of a middle blocker and a setter.

The analysis of the data allows us to emphasize that the maximum model indicators of the central blocking players were noted when performing attacking strokes (74.6 %), which is explained by the participation of these players in the group tactics of attack. The model indicators of blocking efficiency are quite natural (19.3% − average values; 23.1% − maximum), which determines the structure of competitive activity of players of this role. The basis of the competitive activity of linking players is the effective execution of ball passes, which is the maximum model value of 30.4 % for the German volleyball player Kästner. Increasingly, in the international arena, the tendency to perform attacking actions by connecting players is increasing (average value − 58.2%, maximum − 78.9%). However, the execution

of attacking shots should not be the leading technical and tactical action, due to the small number of their executions (on average 2-3 times during one game). Also, the model indicators of the effectiveness of defensive actions (56.6 and 73.4%, respectively) are of great importance for linking players.

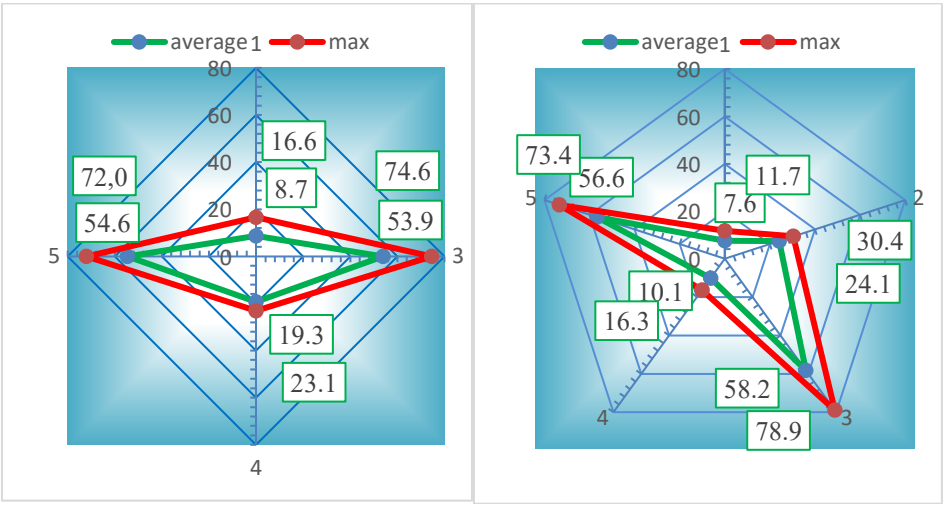


Figure 1. *Group models of competitive activity of players of different roles: a) central blocker; b) linker; 1 - serving; 2 - passing; 3 - attacking shot; 4 - block; 5 - defensive actions*

Thus, the established average model indicators of competitive activity became a scientific basis for the development of an effective system for the selection of players of different roles in volleyball. It is the correspondence to the model indicators of a separate game role that constitutes the prerequisites for the universalization of game actions.

Conclusions

1. The modern system of training highly skilled athletes in team game sports, volleyball in particular, should be based on the search for rational ways to improve the efficiency of the training process, where the central place is occupied by modeling methods as the basis for effective management of athletes' training for successful performance in the most significant international competitions.

2. Model characteristics of the efficiency of competitive activity of highly skilled players of different roles can act as guidelines for the selection of athletes to national teams, which will contribute to the effective management and forecasting of sports results.

3. The obtained model indicators of highly skilled volleyball players of different roles on the basis of generalized and group models of competitive activity

make a scientific and methodological basis for substantiation of scientific approaches in training of players of different roles, namely the ability to universalize game actions, which will help to improve sports results. This approach can be used in other team sports.

Bibliography

1. Araújo R., Hastie P., Mesquita I., Lohse K. R., Bessa C. (2017) The long-term development of volleyball game play performance using Sport Education and the Step-Game-Approach model. European Physical Education Review, 25(2). https://doi.org/10.1177/1356336X17730307.

2. Boichuk R, Strelnykova Y, Wnorowski K. Analysis of volleyball matches based on normalized indicators of competitive activity. *Pedagogy of Health*. 2025;4(1): 57-69. doi:10.15561/health.2025.0104.

3. Borysova O., Shlonska O. (2024) Modern approaches to the formation of national teams by players of different game roles in volleyball. *Sport Spectrum*, 3: 16-24. doi:10.15561/health.2025.0104.

4. Iermakov S., Yermakova T., Prusik K. (2023) Modeling the gameplay actions of elite volleyball players and teams based on statistical match reports. *Pedagogy of Health, 50-64.* doi:10.15561/health.2023.0202.

5. López-Serrano C., Zakynthinaki M., Martín J. J. M. (2023) Contextualizing Evaluation of Performance in Volleyball: Introducing Contextual Individual Contribution Coefficients to Assess Technical Actions. Perceptual and Motor Skills, 130(6). https://doi.org/10.1177/00315125231212592. doi:10.15561/health.2025.0104.

6. Mireille, M., Johan P., Matthieu, L., & Pieter, V. (2022). A retrospective analysis of the national youth teams in volleyball: Were they always faster, taller and stronger? Journal Strength Cond Res, 36(9): 2615–2621. DOI: 10.1519/JSC.0000000000003847.

7. Nelson K. M. J. (2021) Match Analysis for Elaborate the Volleyball Training: A Review. *Journal of Sports and Games,* 3(1): 1-7. https://doi.org/10.22259/2642-8466.0301001.

ASSESSMENT OF STATIC BALANCE IN 6-8-YEAR-OLD CHILD DANCERS

Diana Chilom [1], Vladimir Potop [2], Cristina Ionescu [3], Maria Florica Grigore [4], Dmytro Strelnyk [5], Carolina Moga [6]

[1] *Doctoral School of Sport Science and Physical Education, University Center Pitesti, National University of Science and Technology "Politehnica" Bucharest, Romania*
[2] *Department of Physical Education and Sport, National University of Science and Technology "Politehnica" Bucharest, University Center Pitesti, Romania*
[2,6] *Institute of Physical Education and Sports, Moldova State University, Chisinau, Republic of Moldova*
[3] *National Children's Palace, Bucharest, Romania*
[4] *Faculty of Physical Education and Sport, Ecological University of Bucharest, Romania*
[5] *ACS "Bravo", Bucharest, Romania*

Abstract

The aim of this study is to analyze the level of static balance in child dancers aged between six and eight years, highlighting the impact of choreographic exercises on postural control and body stability. The research was conducted on a group of twenty children. The evaluation was performed using the SensaMove Mini Board platform. The analyzed parameters included overall performance and mean anterior–posterior and medio–lateral deviations. Results showed an average performance level of 56.50%, with moderate variability among participants. Correlation analysis revealed a significant negative relationship between balance performance and lateral deviations, suggesting that better lateral stability is associated with higher postural performance. These findings confirm the role of dance in developing efficient balance maintenance strategies through the integration of visual, vestibular and proprioceptive mechanisms. The study emphasizes the importance of early dance practice for fostering harmonious motor development and strengthening postural control capacity.

Key words: *static balance, child dancers, postural control, psychomotor development, sensorimotor coordination*

1. Introduction

Balance represents one of the fundamental components of psychomotor development in children, contributing to the creation of a solid foundation for learning and perfecting movement. The ability to maintain body stability, both in static and dynamic positions, is very important for postural control and for coordinating movements in daily and sports activities (Chatzopoulos, 2019). During childhood, particularly between the ages of 6 and 8, significant progress occurs in balance control due to the maturation of the nervous system and the development of fundamental motor skills (Fotiadou et al., 2017).

Dance, as an expressive and educational motor activity, provides an ideal framework for stimulating both static and dynamic balance. Through rhythmic movements, postural maintenance and segmental control, dance helps to improve the postural stability, body awareness and intersegmental coordination (Marinkovic et al., 2022). Studies have shown that practicing modern or classical dance promotes the development of postural control and sensorimotor synchronization, which are essential for the precise execution of choreographic movements (Chatzihidiroglou et al., 2018; Chatzopoulos et al., 2019).

The ability to maintain body stability is closely related to the maturation of sensory systems, neuromuscular coordination and postural control. During early childhood, from 6 to 8 years old, significant progress occurs in balance control as a result of central nervous system development and increased body awareness. The maturation of the visual, vestibular and proprioceptive systems contributes to the optimization of postural control strategies (de Sá et al., 2018; Norasteh et al., 2020). At this stage, neuromuscular coordination plays a crucial role in integrating sensory information and regulating muscle tone required for maintaining balance (Ludwig et al., 2020; Fong et al., 2018).

Dance, as a complex form of expressive motor activity, provides a valuable environment for developing static balance and general coordination. Practicing dance enhances postural control under both static and dynamic conditions by engaging sensorimotor mechanisms and fine adjustments of body movements (Marinkovic et al., 2022; Stawicki et al., 2021). Child dancers develop an increased ability to control their center of gravity and adjust their movements according to spatial requirements, thereby improving overall body stability (Chatzopoulos et al., 2019; Limanskaya et al., 2021).

The evaluation of static balance in child dancers aged 6–8 years enables the understanding of the motor development level specific to this age group, as well as the identification of particularities generated by dance practice as for postural control.

2. Material and method

The purpose of the present study is to analyze the performance of static balance in children practicing dance, focusing on how specific exercises influence postural stability and the ability to maintain position under controlled conditions.

Study hypothesis. Systematic dance practice during early childhood leads to the development of efficient postural control strategies through the coordinated integration of visual, vestibular and proprioceptive mechanisms. Thus, balanced and expressive motor skills are shaped.

A group of 20 children of 6 - 8 years old participated in this research (girls: n = 14; boys: n = 6). They were involved in sports activities carried out at the National Children's Palace in Bucharest. Prior to the start of the study, informed parental

consent was obtained and signed in accordance with the principles of the Declaration of Helsinki. The research protocol was approved by the Ethics Committee of the Doctoral School of Physical Education and Sports Science (ID:06/22.07.2023), University Center of Pitești, Romania.

The assessment of static balance was performed using the SensaMove Mini Board platform. The following parameters were analyzed: performance (%), mean anterior–posterior deviations (degrees) and mean medio–lateral deviations (degrees).

Statistical analysis was conducted using KyPlot software, version 6.0, calculating standard descriptive indicators: arithmetic mean, standard deviation (SD), coefficient of variation (CV%), skewness, kurtosis, mean deviation and confidence level of the mean (CLM 0.95). The relations among the static balance parameters were examined using the Pearson linear correlation coefficient (r).

3. Results and discussions

Analyzing the results obtained from the static balance testing of 6-8-year-old dancers underscores significant particularities regarding postural control specific to this stage of development. Data in the tables below present the descriptive values of the analyzed parameters, as well as the correlation between overall performance and the average anterior–posterior and medio–lateral deviations, providing a clear picture of how dance practice influences body stability.

Table 1. *Descriptive analysis of static balance parameters in child dancers*

Parameters	Age	Performance (%)	Front, avg, dev. (degrees)	Back, avg, dev. (degrees)	Left, avg, dev. (degrees)	Right, avg, dev. (degrees)
mean	6.80	56.50	1.93	-2.41	-2.24	3.01
SD	0.89	19.85	1.14	1.51	1.31	1.97
CV(%)	13.2	35.1	59.3	62.4	58.7	65.5
Skewness	0.40	-0.59	0.47	-1.03	-0.44	1.36
Kurtosis	-1.57	-0.44	-0.21	0.84	-0.74	1.78
Mean Deviation	0.84	17.42	0.92	1.24	1.09	1.55
CLM(0.95)	0.42	9.29	0.54	0.70	0.61	0.92

Note: Confidence Level of Mean (0.95); F, n=14, M, n=6

The descriptive analysis of the data (Table 1) indicates an average performance level of 56.50%, with a standard deviation of 19.85%, reflecting a moderate variability of results within the group of child dancers. The variation coefficient of 35.1% confirms the existence of inter-individual differences in postural stability. It is a common characteristic at this age, when neuromotor maturation processes are still in progress.

Regarding the mean deviations in the sagittal plane, the obtained values show a slight tendency toward backward oscillation (−2.41°) compared to forward deviation (1.93°). This fact may be explained by the biomechanical characteristics of the position adopted on the platform and by the postural musculature tonic control. Furthermore, the mean deviations in the frontal plane (left −2.24°, right 3.01°) reflect better balance control on the left side, although the high variability (CV ranging from 58.7% to 65.5%) shows significant differences among participants.

The skewness and kurtosis indicators describe a relatively balanced distribution, with slight asymmetries but without extreme values, confirming a normal distribution of performance within the sample.

Table 2. *Correlation analysis between static balance parameters*

Parameters/ R, Pearson	Perf. (%)	Front, avg. dev. (degrees)	Back, avg. dev. (degrees)	Left, avg. dev. (degrees)	Right, avg. dev. (degrees)
Performance (%)			0.418		
Front, avg. dev. (degrees)	-0.390		0.203		0.377
Back, avg. dev. (grade)				0.323	
Left, avg. dev. (degrees)		-0.619**			
Right, avg. dev. (degrees)	-0.815***		-0.023	-0.063	

Note: ***p<0.001; **p<0.01

The correlation analysis (Table 2) reveals significant relations between overall performance and lateral deviations, particularly a strong negative correlation between performance and rightward deviation ($r = -0.815$, $p < 0.001$), indicating that better lateral stability is associated with higher overall performance. Additionally, a moderate negative correlation was observed between performance and leftward deviation ($r = -0.619$, $p < 0.01$), which underlines the importance of bilateral balance in postural control.

These results suggest that efficient postural control of child dancers depends both on a balanced distribution of body weight between the two lateral sides and on the ability to maintain stability in the frontal plane. The absence of significant correlations between performance and anterior-posterior deviations indicates a dance-specific adaptation, where biomechanical emphasis is placed more on lateral and rotational body control rather than on anteroposterior oscillations.

The findings are consistent with previous research demonstrating that dance contributes to the development of static balance and increased postural stability through intersegmental coordination mechanisms and sensorimotor control (Marinkovic et al., 2022; Stawicki et al., 2021; Costa et al., 2013). These data prove that early engagement in dance facilitates the consolidation of postural regulation mechanisms and the development of balanced motor skills, with beneficial implications for future performance and physical health (Andrieieva et al., 2021; Michalska et al., 2018).

In this context, the analysis demonstrates that dance provides an optimal framework for developing static balance in 6–8-year-old children, encouraging an efficient postural control and enhancing the ability of the body to stabilize in various positions specific to motor and expressive activities.

4. Conclusions

The average level of static balance performance among child dancers aged 6–8 years indicates a good level of postural stability development specific to this age group, suggesting a positive influence of dance practice on postural control and sensorimotor coordination.

The high coefficients of variation (CV%) observed for anterior and lateral deviation parameters reflect notable individual differences among participants, likely determined by varying levels of choreographic experience, degrees of neuromotor maturation and specific characteristics of movement control.

Correlation analysis highlights a strong negative association between balance performance and lateral deviations, both right and left, confirming that superior postural stability is linked to more precise control of body oscillations and a more efficient positioning of the center of gravity.

The results support the hypothesis that early dance practice significantly contributes to the development of effective balance-maintenance strategies through the simultaneous activation of visual, vestibular and proprioceptive mechanisms. Thus, dance strengthens the foundation for harmonious and expressive motor skills.

Bibliography

1. Andrieieva, O., Kashuba, V., Yarmak, O., Cheverda, A., Dobrodub, E., & Zakharina, A. (2021). Efficiency of children's fitness training program with elements of sport dances in improving balance, strength and posture. *Journal of Physical Education and Sport*, 21, 2872-2879.
2. Chatzihidiroglou, P., Chatzopoulos, D., Lykesas, G., & Doganis, G. (2018). Dancing effects on preschoolers' sensorimotor synchronization, balance, and movement reaction time. *Perceptual and motor skills*, 125(3), 463-477.
3. Chatzopoulos, D. (2019). Effects of Ballet Training on Proprioception, Balance, and Rhythmic Synchronization of Young Children. *Journal of Exercise*

Physiology online, 22(2), 26-37.
4. Chatzopoulos, D., Doganis, G., & Kollias, I. (2019). Effects of creative dance on proprioception, rhythm and balance of preschool children. *Early Child Development and Care*, https://doi.org/10.1080/03004430.2017.1423484
5. Chilom, D., Potop, V., Mihăilă, I., Mihaiu, C., & Mihai, I. (2024). Influence of dancesport on segmental coordination development in 6–8-year-old children. *Pedagogy of Physical Culture and Sports*, 28(2), 117–125.
6. Costa, M. S. D. S., Ferreira, A. D. S., & Felicio, L. R. (2013). Equilíbrio estático e dinâmico em bailarinos: revisão da literatura. *Fisioterapia e Pesquisa*, 20, 299-305.
7. de Sá, C. D. S. C., Boffino, C. C., Ramos, R. T., & Tanaka, C. (2018). Development of postural control and maturation of sensory systems in children of different ages a cross-sectional study. *Brazilian journal of physical therapy*, 22(1), 70-76.
8. Fong, S. S., Chung, L. M., Bae, Y. H., Vackova, D., Ma, A. W., & Liu, K. P. (2018). Neuromuscular processes in the control of posture in children with developmental coordination disorder: Current evidence and future research directions. *Current Developmental Disorders Reports*, 5(1), 43-48.
9. Fotiadou, E. G., Neofotistou, K. H., Giagazoglou, P. F., & Tsimaras, V. K. (2017). The effect of a psychomotor education program on the static balance of children with intellectual disability. *The Journal of Strength & Conditioning Research,* 31(6), 1702-1708.
10. Limanskaya, O. V., Yefimova, O. V., Kriventsova, I. V., Wnorowski, K., & Bensbaa, A. (2021). The coordination abilities development in female students based on dance exercises. *Physical education of students*, 25(4), 249-256.
11. Ludwig, O., Kelm, J., Hammes, A., Schmitt, E., & Fröhlich, M. (2020). Neuromuscular performance of balance and posture control in childhood and adolescence. *Heliyon*, 6(7).
12. Marinkovic, D., Belic, A., Marijanac, A., Martin-Wylie, E., Madic, D., & Obradovic, B. (2022). Static and dynamic postural stability of children girls engaged in modern dance. *European Journal of Sport Science*, 22(3), 354-359.
13. Michalska, J., Kamieniarz, A., Fredyk, A., Bacik, B., Juras, G., & Słomka, K. J. (2018). Effect of expertise in ballet dance on static and functional balance. *Gait & posture*, 64, 68-74.
14. Norasteh, A. A., Zarei, H., & Mollazadeh, M. (2020). Organization of sensory systems in postural control of children: A review of literature. *The Scientific Journal of Rehabilitation Medicine*, 9(4), 298-307.
15. Stawicki, P., Wareńczak, A., & Lisiński, P. (2021). Does regular dancing improve static balance?. *International journal of environmental research and public health*, 18(10), 5056.

International Scientific Conference
„ Actualities and Perspectives of Physical Education and Sport Sciences", 2025

RESEARCH ON FACTORS INFLUENCING THE SPECIFIC PHYSICAL TRAINING OF JUNIOR HANDBALL TEAMS

Marius Dănuleț [1], Ion Mihaila [2], Alexandru Acsinte [3], Daniela Corina Popescu [4], Ilie Mihai [5], Maura Stancu [6]

[1,2] *Doctoral School of Sport Science and Physical Education, University Center Pitesti, National University of Science and Technology "Politehnica" Bucharest, Romania*
[4,5,6] *University Center Pitești, National University of Science and Technology Politehnica Bucharest, Romania*
[3] *"Vasile Alecsandri" University of Bacău, Romania*

Abstract

This study intended to identify the main factors influencing the process of specific physical training in Junior Three handball female teams, providing the foundation for a subsequent applied experimental study. A survey was conducted with forty coaches from across Romania during a professional development course organized by the Romanian Handball Federation. The questionnaire explored coaches' perceptions of the current level of youth female handball, the organization of specific physical preparation, priority motor abilities, training frequency and load, position-specific specialization and monitoring practices. Results show that the level of physical preparation is generally perceived as medium to high, with particular emphasis on coordination, speed and multilateral development. Coaches highlight the importance of structured periodization, early specialization adapted to playing positions and integration of physical and technical training. Areas pinpointed for improvement include enhancing speed and endurance, individualizing training programs and modernizing performance assessment methods. Findings are consistent with recent literature emphasizing the benefits of differential learning, neuromuscular training and position-specific conditioning meant to optimize the physical and technical skills of young athletes. Overall, a systematic, individualized and integrated approach combining physical, technical and tactical components is recommended to support sustainable performance development in youth female handball.

Key words: *youth handball, female athletes, specific physical preparation, training organization, motor skills, periodization, position-specific conditioning*

1. Introduction

Optimizing physical performance in youth female handball represents a central concern of current research in sports science, given the need to align the training process with the specific demands of modern gameplay. The athletic development of young players must be correlated with the biological, motor and psychological characteristics of each growth stage, by applying methods that promote long-term progress. According to recent studies, the success of training depends on synchronizing the preparation phases with stages of athletic maturation and using innovative technologies for workload monitoring and individualized effort

(Wedman, 2024; Mircea & Ionel, 2024; Nagorna et al., 2024).

Modern models of athletic development, such as those proposed by Kraemer, Ratamess and Newman (2024) or Amangeldiyevich (2025), support a multidimensional approach that combines physical, technical and mental training, providing a solid foundation for sustainable performance. Similarly, the specialized literature emphasizes the importance of staged sports development, periodic performance monitoring and proper management of training load to prevent overtraining and optimize efficiency (Bjørndal et al., 2021; Haugen et al., 2025).

Moreover, in the context of youth handball, emphasis is increasingly placed on a holistic view of sports training, which integrates physical, technical-tactical and psychological dimensions. Recent studies indicate that integrated programs contribute to the development of tactical behavior, psychological balance and effective adaptation to competitive demands (Tassi et al., 2024; Kusuma et al., 2024; Espoz-Lazo & Hinojosa-Torres, 2025). This integrated perspective is also reflected in current trends toward multifactorial periodization, designed to ensure an optimal transition between general and specific training phases while maintaining long-term performance (Kniubaitė, 2020).

2. Material and method

Purpose of the preliminary research

Preliminary research had the purpose to identify the main factors influencing the process of specific physical preparation in youth female handball teams at the Junior III level, in order to lay the groundwork for a subsequent applied experimental study. The survey aimed to evaluate the current level of physical training, the coaches' perspectives concerning its organization, as well as the challenges encountered in planning and conducting the training process.

Participants

The research was conducted in the framework of the coaching certification and professional development course for handball coaches in Romania, organized by the Romanian Handball Federation on September 7–8, 2023.

A total of 40 coaches actively working with children and youth teams (Junior III category) from clubs across the country participated in the survey. Participation was voluntary and anonymous. Respondents completed the questionnaire at the end of the course.

Research instrument

Data were collected using a questionnaire developed by the author, designed to assess the opinions of coaches regarding the level and organization of specific physical preparation at the Junior III level.

The questionnaire included 15 closed and open-ended items, structured along the following dimensions:

• Perception of the overall level of youth female handball in Romania;

• Evaluation of the level and importance of specific physical preparation;
• Identification of priorities for developing motor skills;
• Assessment of the proportion and frequency of specific physical preparation across different periods of the annual plan (preparatory, pre-competition, competition);
• Opinions about early specialization by position and adaptation of training methods to the specific requirements;
• Identification of the main means and tests used to monitor specific physical preparation;
• Suggestions for improving the training process.

Items were formulated clearly and concisely, including both five-point Likert scales and open-ended questions to capture qualitative information.

Procedure

The questionnaires were distributed in printed format at the end of the course session and completed individually without strict time constraints. Responses were collected by the course organizers and forwarded to the researcher for processing. To ensure validity, the instrument was pretested on a small sample of five coaches to check the clarity and relevance of the items. Minor corrections addressed the phrasing of certain open-ended questions and the logical sequence of sections.

Data processing and analysis methods

Collected data were centralized and analyzed using:
• Descriptive analysis (frequencies, percentages) for closed-ended items;
• Content analysis for open-ended responses to identify thematic trends and common issues;
• Graphical representation of dominant responses to highlight the distribution of opinions.

The analysis tried to reveal the present level of knowledge and application of specific physical preparation principles, as well as to identify potential discrepancies between training periods and the real requirements of modern handball.

Participation in the study complied with the principles of research ethics and was approved by the Ethics Committee of the Doctoral School in Physical Education and Sports Science at the University Center Pitești (ID:29/21.02.2025), National University of Science and Technology Politehnica Bucharest. All participants were informed about the purpose of the survey and the confidentiality of their responses, which were used exclusively for academic and statistical purposes.

3. Results and discussions

This analysis is based on the data obtained from the applied survey and their correlation with trends identified in the specialized literature. The aim is to interpret the current level of youth female handball in Romania through the lens of coaches' perceptions, the structure of specific physical preparation and modern directions for

performance optimization. The analysis also highlights the convergences and discrepancies between training practice and contemporary research recommendations.

Table 1. *Summary of survey results on the level of youth female handball and specific physical training (Junior 3 category, n = 40 coaches)*

Research direction	Analyzed aspects	Main results (%)	Interpretation / Summary conclusions
1. General level of youth female handball	Coaches' perception of performance level	40% medium, 40% high, 10% very high, 10% low	Competitive level is good but improvable; international results confirm a solid development base.
2. Level of specific physical preparation (S.P.P.) in Junior 3	Current evaluation of S.P.P.	80% good, 20% medium	Correlated with cadet performance; coaches acknowledge the importance of continuity in physical development.
3. Importance of S.P.P. at ages 12–14	Perception of the role of physical training	70% very high, 20% high, 10% medium	P.F.S. is considered crucial for technical learning and neuromotor adaptation.
4. Priority motor skills	Coordination, speed, strength, endurance	35% coordination, 30% speed, 35% all	Emphasis on coordination and speed, maintaining a balanced and multilateral development approach.
5. Frequency of S.P.P. sessions	Number of sessions per week	4 in preparatory period (70%), 2–3 in pre-competition (100%), 1 in competition (55%)	Rational planning correlated with the goals of each training stage.
6. S.P.P. share in total training	Distribution by period	30–50% preparatory, 50–70% pre-competition, 20–30% competition	Respecting periodization principles and transition toward technical-tactical components.
7. Specialization by position	Need for early specialization	80% largely necessary	Reflects latest trends but requires balance between specialization and general development.
8. Importance of training factors	Technical, physical, tactical, psychological, theoretical	Technical – 70%, Physical – 62.5%, Tactical – 65%, Psychological – 40%, Theoretical – 57.5%	Priority is maintained on technical and physical training at this age.
9. Share of training factors in the annual cycle	Depending on the period	Physical 40–60% (preparatory), 60–80% (pre-comp.), Technical-tactical 60–70% (competition)	Coherent application of periodization principles; high methodological competence.

10. Means used in S.P.P.	Types of exercises	Integrated, applied, technical exercises under effort	Promotes integration of S.P.P. within the technical-tactical context of the game.
11. Adaptation of means to position	Individualization according to player role	82.5% largely necessary	Confirms focus on differentiated and position-specific training.
12. Tests used and recommended	Types of evaluations	Traditional tests (30-15 IFT, SEBT, Illinois, etc.)	Highlights the need for modernized and digitalized performance assessment.
13. Testing periods	Timing of tests	55% pre-competition, 32.5% preparatory, 12.5% competition	Testing is seen more as verification than continuous monitoring.
14. Improvement directions	Priority areas	General foundation, speed, endurance, individualization	Recommendation to modernize tools and extend continuous monitoring.

I have synthesized the analysis of the results, structuring it into seven research directions, according to the main topics addressed in Table 1:

1. *General level of youth female handball in Romania:*

- The majority of coaches (80%) consider the level of female handball at the junior III category as medium (40%) or high (40%), with only 10% rating it as very high and 10% as low.
- The results of national teams in international competitions (3rd–5th place at youth level, 12th–14th place at senior and junior levels) confirm this general perception: a good competitive level, but with room for improvement, particularly at younger age categories.

2. *Specific physical preparation at junior III level:*

- 80% of coaches evaluated the specific physical preparation as "good" and 20% as "average."
- The performance of the national cadet team (1st–2nd place in international competitions) reflects the effectiveness of physical preparation.
- The importance of continuity in developing physical abilities is emphasized; this continuity supports technical skills and competitive adaptation.

3. *Importance and prioritization of specific physical preparation:*

- 70% of coaches consider specific physical preparation "very important" and 20% "important."
- The characteristics of the 12–14 age group require the simultaneous development of strength, speed and coordination to consolidate technical procedures.
- Priority motor skills: coordination (35%) and speed (30%), while 35% recommend developing all motor skills equally.

4. *Organization and frequency of specific physical preparation sessions:*

- All coaches recommend exclusive specific physical preparation sessions, with frequency adapted to the training periods:
- Preparatory period: 3–5 sessions/week (most commonly 4)
- Pre-competition period: 2–3 sessions/week
- Competition period: 1 session/week
- Proportion of specific physical preparation within total training: 30–50% (preparatory), 50–70% (pre-competition), 20–30% (competition).

5. Position specialization and adaptation of training:

- 80% of coaches consider position specialization "to a large extent" necessary.
- 82.5% recommend adapting specific physical training methods to the requirements of each position (wing, pivot, back, goalkeeper).

The modern orientation toward individualization supports the development of players according to the actual demands of the game.

6. Factors of sports training and monitoring:

- Ranking of training factors at junior III: technical preparation (70%), tactical preparation (65%), physical preparation (62.5%), theoretical preparation (57.5%), psychological preparation (40%).
- Recommended weighting by period: emphasis on physical and technical preparation in preparatory and pre-competition phases; focus on technical-tactical aspects in competitions; recovery and maintenance in the transition period.
- Tests used: traditional (30-15 IFT, Illinois, SEBT, dribbling, throwing); testing is conducted mainly in the pre-competition (55%) and preparatory (32.5%) phases, indicating punctual rather than continuous monitoring.

7. Directions for improving specific physical preparation:

- Strengthening general physical preparation;
- Improving technical execution under speed conditions;
- Developing specific endurance;
- Individualization and continuous monitoring of training;
- Need to modernize assessment tools and implement continuous monitoring to ensure progress and training efficiency.

The survey results indicate a general perception of a medium-to-high level of specific physical preparation in youth female handball, while also underscoring the importance of a more systematic approach to developing strength, speed and endurance in accordance with the current demands of the game. Recent research confirms a direct correlation between early adaptation to sport-specific requirements and athletic performance (Gaamouri et al., 2023), as well as the effectiveness of small-sided game methods for the simultaneous development of physical and tactical abilities (Mikalonytė et al., 2022). Additionally, the rational management of training load throughout the competitive season contributes to maintaining functional balance and optimizing performance (Bjørndal et al., 2021).

The importance of differentiated approaches and neuromuscular training

programs is emphasized by studies showing that the application of a differential learning model stimulates neuromotor adaptations and enhances coordination performance in players aged 11–13 years (Çakıt et al., 2022). Similarly, CoBAgi training contributes to improvements in dynamic balance, agility and movement control, pointing out movement variability and game-specific tasks (Mohamad Puzi & Choo, 2021). Other studies (Spieszny et al., 2024; Gaamouri et al., 2023) confirm the positive effects of coordinative and plyometric training on speed, explosive strength and reaction capacity — essential parameters for handball performance.

Recent systematic analyses (Barahona-Fuentes et al., 2025) show that late childhood and early adolescence represent a critical window for enhancing neuromuscular performance and fundamental motor skills, which can be maximized through individualized training planning.

At the same time, analyses of positional demands in elite handball reveal significant differences in physical and physiological requirements depending on the playing position. Thus, individualized adaptation of training programs is needed (Lefèvre et al., 2023; Haksever et al., 2021). Recent research confirms that individualized training based on positional data and neuromuscular task analysis optimizes performance and reduces injury risk (Herbert et al., 2025; McShane, 2025). In this context, the application of position-specific conditioning principles leads to the differentiated and effective development of motor skills (Bøgild et al., 2020).

Furthermore, the use of sport-specific performance tests provides a more accurate perspective on the functional demands of handball. Latest studies emphasize the central role of specific strength, execution speed and reaction capacity in differentiating competitive levels among young athletes (Chirosa-Ríos et al., 2023; Hammami et al., 2019; Wagner et al., 2019). Correlating these tests with anthropometric and physiological indicators allows for an integrated assessment of performance potential, reinforcing the need for testing batteries adapted to the specific characteristics of handball (Schwesig et al., 2016; Michalsik et al., 2015).

In conclusion, a modern approach to training in youth female handball must be systemic and individualized, based on the integration of physical, technical-tactical and psychological dimensions. Synchronizing developmental stages with training planning, applying differentiated methods, and using innovative monitoring technologies can ensure sustainable performance and coherent progression of young athletes.

4. Conclusions

The level of youth female handball in Romania is perceived by coaches as medium to high, indicating the existence of a solid competitive foundation, yet with potential for further development, particularly in younger age categories.

Specific physical preparation in U13 players is evaluated as good, highlighting

the importance of continuous development of motor abilities to support technical-tactical performance.

Coordination and speed are identified as the priority motor abilities; however, a comprehensive approach that also includes strength and endurance is recommended, adapted to the characteristics of the age group 12–14 and the specific demands of playing positions.

Individualization of training and adaptation of specific physical preparation to positional requirements contribute to optimizing athletic performance and reducing injury risk.

Modernization of assessment tools and implementation of continuous monitoring, combined with differentiated methods and integration of physical, technical-tactical and psychological components, ensure sustainable and coherent development of young athletes.

Bibliography

1. Amangeldiyevich, B. P. (2025). Ways to establish the physical fitness of qualified handball players by professionals. *Western European Journal of Linguistics and Education*, 3(03), 152-154.
2. Barahona-Fuentes, G., Hinojosa-Torres, C., Espoz-Lazo, S., Zavala-Crichton, J. P., Cortés-Roco, G., Yáñez-Sepúlveda, R., & Alacid, F. (2025). Impact of Training Interventions on Physical Fitness in Children and Adolescent Handball Players: A Systematic Review and Meta-Analysis. *Applied Sciences,* 15(11), 6208.
3. Bjørndal, C. T., Bache-Mathiesen, L. K., Gjesdal, S., Moseid, C. H., Myklebust, G., & Luteberget, L. S. (2021). An examination of training load, match activities, and health problems in Norwegian youth elite handball players over one competitive season. *Frontiers in Sports and Active Living,* 3, 635103.
4. Bøgild, P., Jensen, K., & Kvorning, T. (2020). Physiological performance characteristics of Danish national team handball players 1990–2016: Implications on position-specific strength and conditioning training. *The Journal of Strength & Conditioning Research*, 34(6), 1555-1563.
5. Çakıt, İ., Çamlıgüney, F., & Erdil, G. (2022). The Impact of Differential Learning Model on Motor Skills and Handball-Specific Coordination Performance in 11-13-Year-Old Beginners in Handball. *International Journal of Sport Exercise and Training Sciences*, 8(4), 152-160.
6. Chirosa-Ríos, L. J., Chirosa-Ríos, I. J., Martínez-Marín, I., Román-Montoya, Y., & Vera-Vera, J. F. (2023). The role of the specific strength test in handball performance: exploring differences across competitive levels and age groups. *Sensors,* 23(11), 5178.
7. Espoz-Lazo, S., & Hinojosa-Torres, C. (2025). Modern Handball: A Dynamic System, Orderly Chaotic. *Applied Sciences,* 15(7), 3541.

8. Gaamouri, N., Hammami, M., Cherni, Y., Rosemann, T., Knechtle, B., Chelly, M. S., & van den Tillaar, R. (2023). The effects of 10-week plyometric training program on athletic performance in youth female handball players. *Frontiers in sports and active living*, 5, 1193026.
9. Haksever, B., Soylu, C., Micoogullari, M., & Baltaci, G. (2021). The physical characteristics and performance profiles of female handball players: influence of playing position. *European Journal of Human Movement*, (46), 37-49.
10. Hammami, M., Hermassi, S., Gaamouri, N., Aloui, G., Comfort, P., Shephard, R. J., & Chelly, M. S. (2019). Field tests of performance and their relationship to age and anthropometric parameters in adolescent handball players. *Frontiers in physiology,* 10, 1124.
11. Haugen, T., Bucher Sandbakk, S., Sandbakk, Ø., & Tønnessen, E. (2025). The training and development process for a world-class female handball player: A longitudinal and retrospective case study. *Frontiers in Sports and Active Living,* 7, 1655916.
12. Herbert, W., Vanja, R., & Matthias, H. (2025). Effectiveness of Specific Professional Training in Male Elite Adolescent Team Handball Players. *Sports,* 13(6), 193.
13. Kniubaitė, A. (2020). *Modeling of coaching in high-performance female handball player* (Doctoral dissertation, Lietuvos sporto universitetas.).
14. Kraemer, W. J., Ratamess, N. A., & Newman, T. (2024). *Developing the athlete: an applied sport science roadmap for optimizing performance*. Human Kinetics.
15. Kusuma, I. D. M. A. W., Kusnanik, N. W., Lumintuarso, R., & Phanpheng, Y. (2024). The holistic and partial approach in soccer training: Integrating physical, technical, tactical, and mental components: A systematic review. *Retos: nuevas tendencias en educación física, deporte y recreación,* (54), 328-337.
16. Lefèvre, T., Guignard, B., Karcher, C., Reche, X., Font, R., & Komar, J. (2023). A deep dive into the use of local positioning system in professional handball: Automatic detection of players' orientation, position and game phases to analyse specific physical demands. *PLoS One,* 18(8), e0289752.
17. McShane, H. A. (2025). *Coaches' perception and utility of load monitoring for the Icelandic national handball team: preparation for the European Women's Handball Championships 2024* (Doctoral dissertation).
18. Michalsik, L. B., Madsen, K., & Aagaard, P. (2015). Physiological capacity and physical testing in male elite team handball. *J Sports Med Phys Fitness,* 55(5), 415-429.
19. Mikalonytė, R., Paulauskas, R., Abade, E., & Figueira, B. (2022). Effects of small-sided games vs. simulated match training on physical performance of youth female handball players. *Plos one,* 17(9), e0273574.
20. Olar, V.M., & Melenco, I. (2024). Optimization of physical performance of senior handball players through the implementation of the innovative digital

wall. *Ovidius University Annals, Series Physical Education and Sport / Science, Movement and Health*, 24 (2): 291-294

21. Nagorna, V., Mytko, A., Borysova, O., Potop, V., Petrenko, H., Zhyhailova, L., ... & Lorenzetti, S. (2024). Innovative technologies in sports games: A comprehensive investigation of theory and practice. *Journal of Physical Education and Sport,* 24(3), 585-596.
22. Mohamad Puzi, M.H.B., & Choo, L.A. (2021). The effect of six weeks CoBAgi training on coordination, dynamic balance & agility of adolescent handball players. *Pedagogy of Physical Culture and Sports,* 25(1),1-8. https://doi.org/10.15561/26649837.2021.0105.
23. Schwesig, R., Koke, A., Fischer, D., Fieseler, G., Jungermann, P., Delank, K. S., & Hermassi, S. (2016). Validity and reliability of the new handball-specific complex test. The Journal of Strength & Conditioning Research, 30(2), 476-486.
24. Spieszny, M., Kamys, Z., Kasicki, K., Wąsacz, W., Ambroży, T., Jaszczur-Nowicki, J., & Rydzik, Ł. (2024). The impact of coordination training on psychomotor abilities in adolescent handball players: a randomized controlled trial. *Applied Sciences*, 14(17), 7974.
25. Tassi, J. M., Nobari, H., García, J. D., Rubio, A., Gajardo, M. Á. L., Manzano, D., & García-Calvo, T. (2024). Exploring a holistic training program on tactical behavior and psychological components of elite soccer players throughout competition season: a pilot study. *BMC Sports Science, Medicine and Rehabilitation,* 16(1), 27.
26. Wagner, H., Sperl, B., Bell, J. W., & Von Duvillard, S. P. (2019). Testing specific physical performance in male team handball players and the relationship to general tests in team sports. *The Journal of Strength & Conditioning Research,* 33(4), 1056-1064.
27. Wedman, J. (2024). *Holistic Youth Athletic Development: An evidence-based handbook.*

METHOD FOR DETERMINING "HANDICAP" IN RELAY RUN

Ivan Derkachenko
Republic of Moldova Tiraspol, 3300, Odesskaya st. 76/2, apt. 69
Institute of Physical Education and Sports, Moldova State University, Republic of Moldova

Abstract
One of the most spectacular, emotional and most difficult types of track and field is relay racing. The entire complexity of relay racing technique lies in passing the baton at high speed and thereby achieving a comfortable handicap over rivals. The study proposed in the article makes it possible to determine the relay handicap quite accurately and in a short time using a special table.

Keywords: *relay race, maximum speed, handicap, changeover, special table*

One of the most spectacular, emotional and most difficult types of athletics is relay running. The entire complexity of relay running technique lies in passing the baton at high speed says that each athlete runs his leg in an average of 928 seconds, and the world record in the 100m is only 9.69 seconds in a limited (20-meter) zone, which begins 10 meters before the end of one leg and continues 10 meters ahead of the start of the next. According to the rules of the competition, the baton receiver has the right to start the run 10 m before the start of the transfer zone, which allows him to reach a higher speed at the moment of receiving the baton. Athletes running legs 2, 3 and 4 use the run-up (10m) and changeover (20m) zones to receive the baton at maximum speed and run their leg on the move. Moreover, the runner's speed at the stages of the sprint relay must be maximum, it cannot be reduced in the transfer zones. The indicator characterizing the efficiency of the technique can be the time it takes the runner with the relay folder to pass the 20-meter transfer zone.

According to some experts (Bondarchuk, 2007; Derkachenko, 2019; Derkachenko & Mytsykov, 2019; Nikitushkin& Germanov, 2007; Chesnokov & Nikitushkin, 2010), highly qualified male sprinters cover this distance in 2.0 seconds or less, while women cover it in 2.2 seconds or less. Therefore, the starting runner needs to use almost the entire 30-meter distance to reach the highest speed. It is best if the speed of the runners at the moment of the baton change is the same.

For the accuracy of the relay pass, it is important to determine the moment the receiver starts running. To do this, a mark is made at some distance before the run-up line.

The distance to the mark ("handicap") should be such that the relay runner catches up with the receiver exactly at the place designated for the transfer (4–5 m before the end of the zone). At the moment when the runner passing the baton reaches

this mark, the receiver quickly starts running, trying to develop as much speed as possible.

Some experts propose to determine this distance as follows: first, the place of the relay transfer is specified (S = 25 m) and the running time is determined 25 m in the starting run of the baton receiver from a high start with support on one hand (for example, 4 = 3.35 s) and the last 25 m in the 100 m run (segment 75 - 100 m) of the baton receiver (tX = 2.25 s). Next, we should calculate the difference in the time it takes the transmitter and receiver to run 25 m - 1 s (3.25 - 2.25 = 1.00 s), then calculate the average running speed of the transmitter (25 m: 2.25 s = 11.11 m/s) and the distance he runs in time t (11.11 m/s x 1.00 s = 11.11 m). This distance, according to some authors, will be the optimal value of the "head start" between the receiver and the transmitter, without taking into account the reaction to the moving object (on average, the delayed reaction of the receiver of the baton is 0.2 s [3,4,5].

The total value of the "handicap" must also include an adjustment for the length of the segment covered by the transmitter, due to the delayed reaction time of the receiver.

However, there is one important detail here, which, in our opinion, plays a significant role in calculating the optimal length of the "handicap". The fact is that the participants of the 4 x 100 m relay run unequal segments: from 110 m. - on the first, 120 m - on the fourth and up to 130 m. - on the second and third stages of the distance, i.e. the length of the run segment increases from 10 to 30, which leads to a decrease in speed in the last 30 meters of the distance (table 1). And this is already a window to make certain adjustments to the method for determining the length of the "handicap" - take into account the time of running the last 30 m, and not 25 m, and not on the 100-meter, and on the 130-meter distance cut, since with increasing distance the running speed in the last meters will be lower. Transferring the relay folder from hand to hand takes some time, and the athletes run a certain distance (from 2 to 3 meters) side by side, which should also be taken into account.

Table 1. *Length of the distance segments (in m.) at various stages in the 4 x 100-meter relay race*

Stage	S_1 (m.)	S_2, S_3 (m.)	Sp (m.)	S_4 (m.)	S (m.)	Increasing distance %
1 Stage	80		27-30		107-110	6-9
2 Stage		100	27-30		127-130	26-29
3 Stage		100	27-30		127-130	26-29
4 Stage			27-30	120	120	20

Note: S, is the length of the segment (in meters) from the starting point to the receiver's start line on the 2nd stage, S2, S3; is the length of the segment from the starting point to the receiver's start line on the 2nd and 3rd stages, Sp is the length of the segment from the start line to the relay exchange

point, S4 is the length of the segment from the start line to the finish line on the 4th stage, S is the actual length of the stage.

Therefore, in our opinion, it is necessary to determine the distance from the control mark not to the start of the relay transfer zone, as suggested by the above-mentioned authors, but to the place of its transfer (approximately at the 27th meter of the distance segment from the start line of the athlete receiving the relay).

In connection with the above, we consider it possible to propose our own slightly different method for determining the "handicap", which can be calculated using the following formula:

$$Si = \frac{T1}{T2} \cdot 27{,}5 - 27,$$

where Si is the length of the "handicap", T1 is the time it takes to run the 30-meter segment from the start by the baton receiver, T2 is the time it takes to run the last 30 meters of the 130-meter distance by the baton receiver.

In relay races, where the ratio of the running speed of the receiving and passing runners is somewhat different (for example, 4 to 400 m), appropriate adjustments should be made. Naturally, the slower the runner finishes his distance (leg), the shorter the distance from the checkpoint to the beginning of the transfer zone should be.

Table 2 Calculating Handicap in Relay Race

T_1 / T_2	**2,90**	**3,00**	**3,10**	**3,20**	**3,30**	**3,40**	**3,50**	**3,60**	**3,70**	**3,80**	**3,90**	**4,00**	**4,10**	**4,20**
2,50	4,80	6,00	7,9	8,20	9,30	10,40	11,5	12,6	13,7	14,8	15,9	17,00	18,10	19,20
2,60	3,57	4,63	5,59	6,85	7,90	8,96	10,02	11,08	12,13	13,19	14,25	15,31	16,37	17,42
2,70	2,44	3,46	4,50	5,59	6,61	7,63	8,65	9,67	10,69	11,70	12,72	13,74	14,76	15,78
2,80	1,38	2,36	3,37	4,43	5,41	6,39	7,38	8,36	9,34	10,32	11,30	12,29	13,27	127,96
2,90	0,50	1,35	2,35	3,34	4,29	5,24	6,19	7,14	8,09	9,03	9,98	10,93	11,88	12,83
3,00		0,49	1,40	2,33	3,25	4,17	5,08	6,00	6,92	7,83	8,75	9,67	10,58	11,50
3,10			0,50	1,38	2,26	3,15	4,05	4,93	5,81	6,70	7,60	8,48	9,37	10,26
3,20				0,50	1,36	2,22	3,08	3,94	4,80	5,66	6,52	7,38	8,23	9,09
3,30					0,50	1,33	2,17	3,00	3,82	4,67	5,50	6,33	7,17	8,00
3,40						0,50	1,31	2,12	2,93	3,74	4,53	5,35	6,15	6,97
3,50							0,50	1,29	2,07	2,86	3,64	4,43	5,21	6,00
3,60								0,50	1,26	2,03	2,79	3,56	4,32	5,07
3,70									0,50	1,24	1,99	2,73	3,47	4,22
3,80										0,50	1,22	1,94	2,67	3,39
3,90											0,50	1,21	1,91	2,62
4,00												0,50	1,19	1,88
4,10													0,50	1,17

Considering the fact that the calculation process takes a considerable amount of time and creates certain inconveniences, we have developed a special table (table 2), with the help of which in a matter of seconds you can determine the "handicap" for several athletes participating in the relay race, sequentially from stage to stage. For this you only need to know the time it takes to run the first and last 30-meter sections of the 130-meter distance.

The table we offer is simple and easy to use. Since the calculations took into account various combinations of run time indicators for the control sections of the distance, it contains a large number of discrete values in a wide range with an accuracy of up to 0.05 m.

The algorithm for determining "forms" and using the table is as follows:

1. From a high start position with support on one hand (for the runner of the first stage - from a low start), the athletes run a distance of 130 meters in turn, recording the time for the first and last 30 meters of the distance (for the runner of the first stage - only the last 30 meters of the 110-meter distance).

2. Depending on the placement of athletes in the stages, the indicators of the relay passer (on the vertical scale) and the relay receiver (on the horizontal scale) are compared.

3. At the intersection of the two values, we mark the length of the "handicap".

Bibliography

1. Bondarchuk A.P. Management of the training process of high-class athletes / A.P. Bondarchuk.-M.: Olimpia press, 2007.-272 p.
2. Derkachenko I.V. "Features of electrical activity of the main muscle groups during high jumps with a run-up". International scientific conference April 23, 2019 "Modern trends in the development of professional education in the field of physical education and sports" Tiraspol, publishing house of PSU, 2019. - P. 91-97 "
3. Derkachenko I.V., Mytsykov N.V. "Comparative analysis of steeplechase technique, using the example of highly qualified track and field athletes specializing in steeplechase." Newsletter of Kamyanets-Podilskyi National University named after Ivan Ogienko. Physical training, sports and human health / [editor: Edinak G. A. (ed.) and in]. Kamyanets-Podilsky: Kamyanets-Podilsky National University named after Ivan Ogienko. 2019. Issue 12. 108 p.
4. Nikitushkin V.G. Track and field at school: a teaching aid / V.G.Nikitushkin, G.N.Germanov. - Voronezh: Istoki, 2007.-603 p.
5. Rodichenko V.S. Track and Field: textbook/under the general editorship of N.N.Chesnokov, V.G.Nikitushkin.-M.: Physical Education, 2010.-448 p.

International Scientific Conference
„ Actualities and Perspectives of Physical Education and Sport Sciences", 2025

MOTOR PREPARATION OF FOOTBALL PLAYERS IN THE GOALKEEPER POSITION

Alin Răzvan Dincă [1]

[1] *Moldova State University, Institute of Physical Education and Sport, Chisinau*

Abstract

The problem of sports preparation in football has been and continues to be a constant search for the most efficient methods and means of training, aiming to increase the quality of the football game at all levels. In recent years, digital tools have been applied in almost all sports, both in the arbitration process and the training process. This fully applies to football, which has become quite fast with sudden changes in situations, demanding maximum responsibility and appropriate preparation from every player. Increasingly, in senior teams, differentiated training is used based on the playing position, especially in the training of goalkeepers, as they are one of the fundamental pillars in any football team. In this regard, the use of the GPEXE software has been proposed, both in the training process and during game conditions, and the recorded results are examined by the specialized coach, who then offers recommendations to enhance the qualitative level of their sports preparation.

Key words: *Football, seniors, motor preparation, goalkeeper, digital software*

1. Introduction

Football at the current stage has become very fast, with a high speed of execution for technical elements and procedures, which requires appropriate preparation from the athletes. More and more specialists emphasize the differentiated preparation of footballers at all stages of training, even though they must cope with all game situations, regardless of their specialized position [Ciocănescu, 2012; Savu, 2021; Sîrghi, 2016; Stoica, 2007]. Nevertheless, the goalkeeper position is a basic one in every football team, and the score of a match or a competition often depends on the level of their sports preparation. This obliges coaches to intervene with a specialized program for goalkeepers, which differs significantly from the actions of field players, as goalkeepers are entitled to act both in the goal and as field players, where they must cope in both situations [Enoiu, 2015; Ploeșteanu, 2005].

2. Material and methods

Analyzing several sports, it has been noted that various digital methodologies are increasingly applied, both in the training process and directly during official games, which aim to enhance the qualitative level of sports training organization and the successful running of official games [Ciocoiu, 2011; Harabagiu, 2019; Mârza, 2006].

The goalkeeper position is no exception in this regard, where high-level competitions are video-monitored, allowing intervention at any time to clarify a game situation or others. Recently, certain digital methodologies have been increasingly used to analyze the actions of players, both on the field and in the goalkeeper position.

Thus, the use of the GPEXE software was proposed for the sports preparation process of goalkeepers over a competitive year. GPEXE represents:

- A device placed on the athlete's back, which determines several specific characteristics of the Goalkeeper in football, such as the goalkeeper's position, speed of movement, accelerations, and other specific movements of goalkeepers (Photo 1).
- This device can also record physiological parameters, such as heart rate during the match, representing the athlete's work capacity and their reaction to physical effort during the game.
- It ensures the transfer of goalkeeper data, which is done through the so-called "cloud" via USB, using the GPEXE bridge application (Photo 3).
- Through the GPEXE web application, the user can visualize and analyze all recorded data, especially information summaries, graphs, and statistical reports for specific sessions or the entire season.
- The information becomes accessible to the user through any common web browser running on any device – computer (Photo 2), tablet, or smartphone.

Photo 1. The GPEXE System in action Photo

Photo 2. Laptop for recording and processing information

Photo 3. GPEXE system for information storage

3. Results and Discussions

One of the performance criteria in any sport, including football, is the level of motor preparation of the athletes. In the specialized literature related to football, physical preparation is further divided into general physical preparation and specific physical preparation, i.e., the specific indices of footballers' motor preparation. In the research conducted, we were particularly interested in how the indices of motor preparation evolved for football players in the goalkeeper position, which was one of the basic objectives of the research undertaken over a competitive year.

According to the results of several studies at the senior level, it is quite complicated to radically increase the level of motor preparation, given that the sensitive periods for developing motor qualities are between 6-16 years, and seniors are already over 21 years old. However, at this level, maintaining sporting form is important, especially during the competitive period, which in football has a relatively long duration, reaching 3-4 months.

In the literature concerning the sports preparation of footballers at different levels, there are several control tests that assess their level of motor preparation. These largely refer to field players, but there are still tests proposed by several specialists that specifically refer to the preparation of players in the goalkeeper position.

In any case, specialized coaches for this position are directly involved in the preparation, conducting individual activities in their training process. However, goalkeepers carry out part of the sports training volume with the team, given that they are often placed in the situation of a field player, where they should cope with the situations.

To verify the efficiency of the motor preparation of football players in the goalkeeper position, several general motor tests and specific tests for goalkeeper activity were selected, involving all motor qualities necessary for a player in this position. Equally analyzed were tests for speed (30-meter sprint), endurance (Cooper Test), strength (trunk raises in 30 seconds), three strength-speed tests (standing long jump, running long jump, vertical jump), and three tests with different oxygen consumption regimes, either aerobic, anaerobic, or intermittent aerobic (YO YO test, Gacon Test, Beep Test). All these tests were applied at both the beginning and the end of the experiment, with the results being statistically processed and presented in Table 1.

Fifteen goalkeepers participated in the experiment, with three goalkeepers from five teams in the Iranian National Championship, where I work as a coach. The experiment was longitudinal because it is impossible to form two large groups of goalkeepers at the national championship level and intervene with certain experimental programs in their training process.

Table 1. *Indices of motor preparation for football goalkeepers*

Nr.	Control Exercise	T.I. (Initial Test) X ± m	T.F. (Final Test) X ± m	t	P
1.	Speed run, 30m, s	3.54 ± 0.04	3.32 ± 0.6	3.14	<0.001
2.	Forward bend, cm	5.31 ± 0.25	6.22 ± 0.28	2.39	<0.01
3.	Cooper Test, m	3542.12 ± 3.61	3561.36 ± 4.48	3.34	<0.001
4.	Trunk raises in 30 s, no. reps	26.12 ± 1.03	29.47 ± 1.05	2.36	<0.01
5.	Standing long jump, m	2.87 ± 0.04	3.05 ± 0.07	2.25	<0.05
6.	Vertical jump, cm	74.73 ± 1.14	78.17 ± 1.21	2.07	<0.05
7.	Running long jump, m	5.37 ± 0.26	5.48 ± 0.21	2.69	<0.01
8.	YO YO test, aerobic-anaerobic, m	2335.28 ± 4.58	2352.17 ± 5.36	2.39	<0.01
9.	Gacon test, intermittent aerobic, m	2622.43 ± 5.41	2640.21 ± 5.37	2.34	<0.01
10.	Beep test, aerobic, s	11.64 ± 0.17	12.23 ± 0.18	2.36	<0.01

Analyzing the results of the pedagogical experiment regarding the physical preparation of goalkeepers, we mention that one of the absolute necessary qualities for a goalkeeper in football is speed in all its forms of manifestation. In the research undertaken, we first examined the speed of movement through the 30-meter sprint test and the flexibility of those involved in the pedagogical experiment through the forward bend test from the gymnastics bench (Figure 1).

According to the recorded data, in the speed test (30-meter sprint), the goalkeepers recorded an average of 3.54 seconds in the initial test, which is a quite high result, including for players in the goalkeeper position. At the end of the pedagogical experiment, the average result in this test increased to 3.32 seconds, which is an improvement of 0.18 seconds compared to the initial test. Statistical calculations showed that this increase in the given result is statistically significant (P<0.001), a fact that demonstrated good stability of the results, in this case for the speed test represented by the 30-meter sprint, as this distance is characteristic for a goalkeeper in football, who often cover such distances.

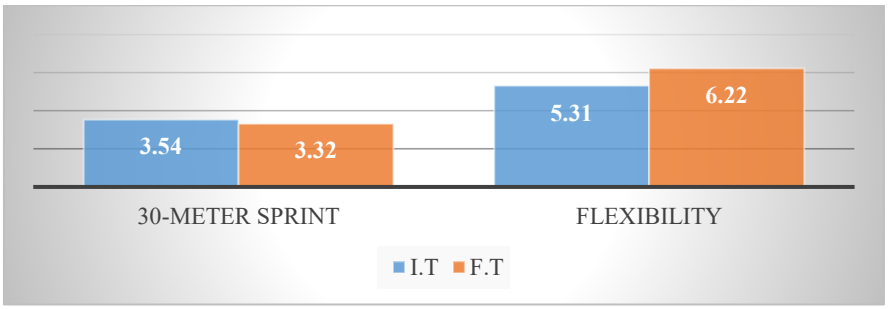


Fig. 1. *Results of speed and flexibility tests*

Another motor quality characteristic of football goalkeepers is flexibility, given that the goalkeeper is often put in the situation of stretching the muscles to gain possession of balls sent towards the goal by opposing players in different corners of the goal. This requires good mobility in the body joints, whether at the level of the arms, legs, body, and others. This test was performed from a standing position on the gymnastics bench, executing a forward bend and fixing the lowest possible point with the hands. In this case, the mobility of the hip joint and the vertebrae of the spinal column is highlighted the most. Analyzing the results of this test in the initial assessment, we note that the average flexibility was plus 5.31 centimeters, which is a relatively good average for seniors, reaching an average of 6.22 centimeters at the end of the pedagogical experiment. Even though the difference between the initial and final test is relatively small, statistical calculations showed a statistically significant difference ($P<0.01$). It should be noted that at the senior age, any motor quality can be improved, including mobility, but their increase will not be very impressive, given that the sensitive period for this quality is the age of 5-7 years.

Another necessary motor quality for football goalkeepers, and not only, is strength in all its forms of manifestation. In our case, only the evolution of the motor quality of abdominal strength was researched, expressed by the number of trunk raises from a supine position in 30 seconds.

Based on the analysis of the actions of football goalkeepers, it was found that the great majority of actions performed by goalkeepers are of the strength-speed type, expressed by jumps, throws, starts, etc. In this regard, two tests of this type were applied in this research: the "Standing long jump" and the "Running long jump" (Figure 2).

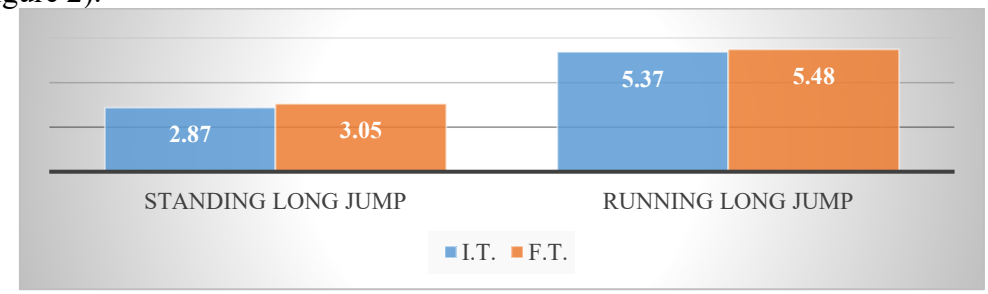


Fig. 2. *Results of strength-speed tests*

According to the figure above, in both cases, approximately the same tendency for final results is observed. In the first case, the standing long jump and the running long jump, the goalkeepers significantly improved their performance. Even if this is not so evident at first glance, statistical calculations showed a significant increase in both cases ($P<0.01$). Thus, in the standing long jump, the athletes recorded an average of 2.87 meters in the initial test, and at the end of the experiment, this result

was improved by an average of 18 centimeters, the difference being statistically significant (P<0.05). In the running long jump test, the athletes' average in the initial test was 5.37 meters, and at the end, this result increased by an average of 11 centimeters, reaching values of 5.48 meters, with the difference being statistically significant (P<0.01). At first glance, for a goalkeeper with very high motor indicators, the result seems quite modest. However, here we will take into account the fact that the running long jump test has a quite complex execution technique, and goalkeepers do not possess this, which did not allow for very high results.

Another strength-speed test and specific to the activity of a goalkeeper is the vertical jump from a standing position (Figure 3). In fact, the vertical jump from a standing position is also a test that largely depends on the technique of its execution. Goalkeepers, performing this type of movement quite often, executed the test quite technically, referring to the arm swing and leg movement.

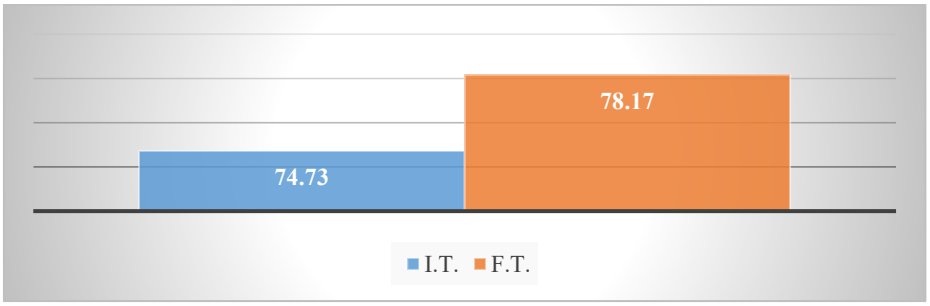


Fig. 3. *Results of the "vertical jump" test*

Thus, in the initial test, the goalkeepers demonstrated jumps averaging 74.73 centimeters, and at the end of the formative experiment, this result was improved by an average of 3.5 centimeters. The difference between the initial and final test was approximately 3.5 centimeters, which is statistically significant (P<0.05). Therefore, the applied experimental program was quite efficient, at least for the strength-speed preparation tests.

The next three tests applied in the formative experiment with football goalkeepers were functional tests, meaning tests that highlighted the level of functional preparation of the footballers in different work regimes.

Thus, the YO YO Test represents an aerobic-anaerobic control exercise, where athletes were supposed to run between two cones located at a distance of 20 meters, following audio cues that dictated their running speed. After every 40 m of running, the athlete has a 10-second active break before running 40 m again. At equal distance intervals, the running speed will increase. The test will continue as long as the athlete is no longer able to maintain the imposed pace (Figure 4). The maximum possible distance to cover at a constant speed is 2400 meters, a distance that not all goalkeepers are able to cover.

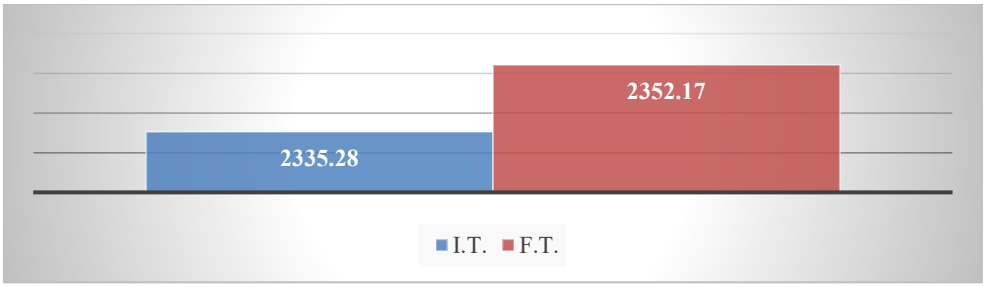


Fig. 4. *Results of the YO YO test*

Thus, in the initial test, the average distance covered by the footballers involved in the formative experiment was 2335.28 meters, and at the end of the experiment, this average increased by almost 17 meters. This is a quite high result, also demonstrated by statistical calculations ($P<0.01$).

Another test applied at the beginning and end of the formative experiment was the Gacon Test (Figure 5), which is an intermittent aerobic control exercise. The content of this test is as follows: the athlete is at the starting line where several cones are distributed at fixed distances such as 125 m, 131.25 m, 137.5 m, etc. The athlete must run 125 m within 45 seconds, after which a 15-second break will be granted. After the break, the run will be repeated in the opposite direction, back to the starting point, but the distance will increase by 6.25 m (131.25m). Thus, with each repetition, the distance will increase by 6.25 m while the running time of 45 seconds and the 15-second break remain constant. The athlete will continue at this pace until they can no longer cover the proposed distance within the established time. According to the requirements of this test, the maximum distance possible to cover in this regime was 2750 meters, a distance that not all athletes managed to cover, especially in the initial test. The result will be the total distance run by the athlete at the given tempo.

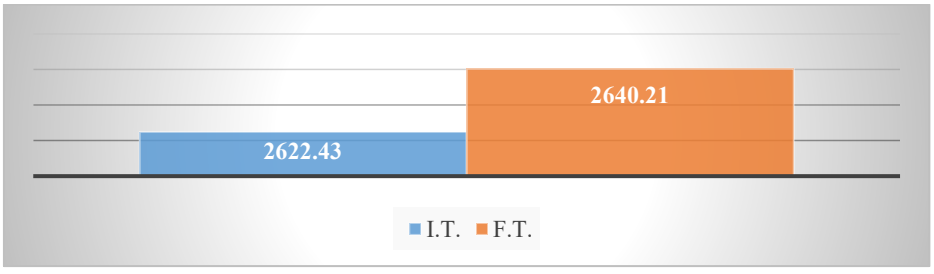


Fig. 5. *Results of the Gacon test*

Thus, in the initial test, the athletes ran an average of 2622.43 meters of the track at the speed proposed by the coach. At the end of the formative experiment, this distance increased to 2640.21 meters. The difference between the two tests is

statistically significant (P<0.05), which demonstrated the efficiency of the experimental program applied during the sports preparation of the goalkeepers subjected to our research.

The third test representing the functional level of the athletes included in the pedagogical experiment was the Beep Test (Figure 6), which is an aerobic exercise, used equally for all football players, regardless of the playing position. The essence of this exercise consists of continuous running between 2 lines located 20 meters apart. Participants stand behind the first line facing the second line and begin to run after an acoustic "beep" signal from the recording. The starting speed is relatively low, running continuously. After one minute, a new "beep" signal indicates an increase in speed, and the "beeps" will be heard at closer intervals. It will continue in the same way, at 1-minute intervals. If one of the lines is reached before the "beep" signal is heard, the athlete must wait for the sound signal before continuing. If the line is not reached before the sound signal is heard, the athlete will receive a warning and will have to continue running to the line, turn back, and try to recover the lost time within 2 "beeps". The athlete is warned on the first mistake and eliminated on the second. The athlete's result is calculated by the number of "shuttles" between the 2 lines at 20 meters, reached before the inability to maintain the pace imposed by the sound signal (Figure 6).

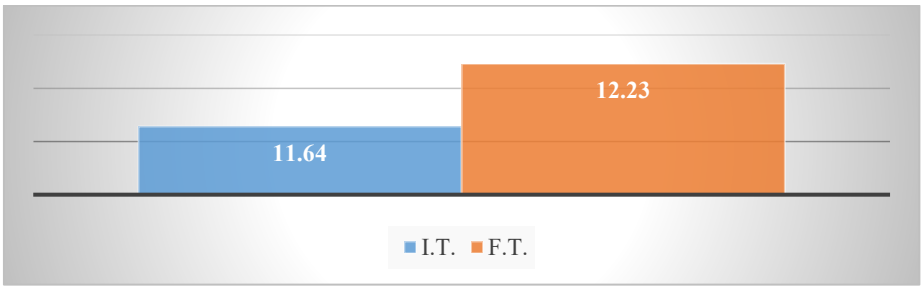


Fig. 6. *Results of the Beep test*

According to the requirements of this test, the maximum number of shuttles can reach 13, which is the maximum performance for the athletes involved in the testing. Analyzing the results in the figure above, it becomes clear that the average number of shuttles completed by the goalkeepers involved in the research reached an average of 11.64 shuttles in the initial test. In the final test, the athletes improved their result, reaching an average of 12.23 shuttles, this increase being statistically significant (P<0.01), meaning the efficiency of the program in this regard is undeniable.

4. Conclusions

The general conclusion regarding the motor preparation aspect of the footballers involved in the pedagogical experiment is that the application of digital

methodologies in the training process, in this case for the goalkeepers, did not negatively influence their level of motor preparation. On the contrary, in all ten tests subjected to analysis, the athletes improved their performance. This was clearly demonstrated both by the recorded results and by the statistical calculations, which allowed for their theoretical and scientific argumentation.

Bibliography

1. Ciocănescu, D. (2012). *Pregătirea fizică în jocul de fotbal,* Ed. Universitaria, Craiova, pg. 11-15.
2. Ciocoiu, D.L. (2011). *Baschet. Intensificare posibilităţilor de mişcare a segmentelor corpului prin abordarea jocului de baschet*, Ed. Europlus, Galaţi, 134 p.
3. Enoiu, R.S. (2015). *Bazele generale ale antrenamentului sportiv. Generalităţi*, Universitatea Transilvania din Braşov, pg. 25-40, 54-63.
4. Harabagiu, N. (2019). Pregătirea motrică a voleibaliştilor seniori prin aplicarea programului Data-Volley, *Ştiinţa culturii fizice*, nr. 34/2, pg. 101-107.
5. Mârza, D. (2006). *Optimizarea şi dirijarea pe baze informatice a pregătirii şi competiţiei în jocurile sportive*, Ed. PIM, Iaşi, 194 p.
6. Ploeşteanu, C. (2005). *Antrenament diferenţiat de pregătire de forţă-viteză*, „Valinex", Chişinău, 144 p.
7. Savu, C. (2021). *Fundamente ştiinţifice ale fotbalului*, Ovidius University Press, Constanţa, 285 p.
8. Sîrghi, S. (2016). *Pregătirea fizică specială şi diferenţiată a fotbaliştilor de 13-14 ani într-un ciclu anual de antrenament*, Teză de doctor în pedagogie, USEFS, Chişinău, 250 p.
9. Stoica, D. (2007). *Fotbal. Teoria jocului şi a antrenamentului sportiv modern*, Ed. Universitaria, Craiova, 168 p.

THE IMPACT OF CAPITALIZING ON THE DEVELOPMENT OF JUNIOR GYMNASTS II MOTOR QUALITIES AT THE BASIC STAGE OF SPORTS SPECIALIZATION

Răzvan Constantin Dumitru [1]

[1] *"Vasile Alecsandri" University, Bacau, Romania*

Abstract

The study investigated the impact of motor qualities development in junior gymnasts aged 11-12 at the basic stage of sports specialization. The main objective was to optimize special physical preparation, which aims to increase indices of strength, speed, coordination, and endurance, all essential for women's artistic gymnastics all-around.

The experimental research, conducted on a sample of 22 gymnasts (experimental and control group), included specific training sessions that focused on physical and choreographic exercises supporting contemporary physical and technical preparation. Initial and final testing showed group homogeneity at the start, but a significantly superior progression for the experimental group in most criteria (e.g., bent leg raises from a hang, standing long jump, 20m speed run, straight-body press to support on uneven bars).

The conclusions emphasize the need for the coach to competently utilize biopsychological-energetic factors to maximize the gymnasts' availabilities. The statistical data confirm that the application of the specialized physical preparation module leads to a significant optimization of motor and technical performance.

Key words: *junior gymnasts, motor qualities, physical preparation, sports specialization, biopsychological-energetic factors*

1. Introduction

The basic stage of sports specialization has the following framework objectives:

- harmonious development of all muscle groups of the gymnast, represented as "facilitation techniques" of neuromuscular electrical stimulation;
- development of effort capacity as a mechanism of "motor education" and a complex facilitation mechanism for head-neck-body reflexes and vestibular balance reactions (Sbenghe, 2005, p. 362);
- learning and perfecting technical elements included in the classification program and the Code of Points, in close connection with the refinement of movements and special physical preparation;
- intensification of the appropriate increase in circulatory activity of the vital energy flow, enhancing the biopsychological electromagnetic fields of the body's meridians at the physical, mental, and emotional levels (Sbenghe, 2005, p. 94).

Special physical preparation (SPP) is understood as the development of all physical capacities of the human personality, including high indices of strength, speed, coordination, and endurance, mastering a wide variety of motor skills, and using them skillfully and consciously in any activity within the women's gymnastics polyathlon to achieve high performance (Ploeșteanu, 2009; Niculescu, 2003).

Women's gymnastics has specific features regarding the athletes' sports preparation. Along with the artistic execution technique of the elements, the formation and perfection of motor qualities are necessary (Grigore, 2001; Nanu, 2022). Physical preparation is the superior step in developing capacities specific to women's gymnastics. Sports training sessions are based on multilateral and special physical preparation specific to the gymnastics apparatus. Physical preparation is all the more necessary as the gymnastics polyathlon has its own number for the degree of difficulty (A-GF) classification of exercises, approved by the International Gymnastics Federation (IGF).

2. Material and methods

Within the pedagogical constatative experiment, specific training sessions were carried out for:

- continuously increasing the physical effort and maintaining the phases of development, sustainment, and recovery;
- perfecting the artistic execution technique specific to each apparatus of the gymnastics polyathlon;
- multiple repetition of exercises until the technical image of the valuable element appears, changing the initial position, rhythm, tempo, and execution conditions, utilizing various means for rational technical perfection;
- maintaining contemporary technical posture, laying the foundation for the technical base.

Depending on the goal, the sports training sessions included the development of one quality, or combined static and dynamic qualities, in accordance with the age of the gymnasts (11-12 years old). The research utilized classical choreographic exercises that met contemporary demands and contributed to achieving contemporary physical and technical preparation for exercises on the balance beam and floor. These physical preparation and choreographic exercises are considered a module, a therapy for producing and maintaining body energies in a state of balance and physical health, including strategies for perceiving and correcting energy imbalances by stimulating certain "energy points" and meridians (Grimalschi, 2021).

To obtain the most objective knowledge of the physical preparation characteristics of the experimental groups, a concrete ex-post-facto (after the event) research was conducted, which involved measuring the parameters of general and special physical preparation. The groups consisted of 22 girls in total, with 11 gymnasts in the experimental group (EG) and 11 in the control group (CG).

3. Results and Discussions

The performances obtained by the subjects at the initial (IT) and final (FT) tests were analyzed, particularly focusing on abdominal muscle strength (bent leg raises in hang) and spinal muscle extensions (trunk extensions from the prone position).

Table 1. Core and spinal strenght

No	Test Parameter	Groups	Statistical data		t	P
			IT	FT		
			x ± m	t ± m		
1	Bent leg raises in hang (no. reps)	EG	12,36±1,08	16,82±1,15	3,080	<0,01
		CG	11,64±0,79	12,83±0,76	1,789	>0,05
		t	0,538	2,895		
		P	>0,05	<0,01		
2	Trunk extensions from prone (no. reps)	EG	31,64±0,90	35,91±0,69	6,031	<0,001
		CG	31,36±0,41	32,39±0,31	3,199	<0,05
		t	0,283	4,654		
		P	>0,05	<0,01		

- *Abdominal strength:* The experimental group's mean for bent leg raises increased significantly from 12,36±1,08 to 16,82±1,15 repetitions (t=3,08, P<0,01).

- *Spinal muscle strength:* Trunk extensions in the experimental group increased significantly from 31,64±0,90 to 35,91±0,69 repetitions (P<0,001), with a 99,9% probability.

The final testing results for both groups were statistically significant compared to the initial testing, with a 99% probability (P<0,01). The final difference between groups was also significant (P<0,01) for both core strength tests.

Table 2. Explosive strength and speed capacities

No	Test Parameter	Groups	Statistical data		t	P
			IT	FT		
			x ± m	t ± m		
1	Standing long jump (cm)	EG	160,40±0,81	164,50±0,71	6,138	<0,001
		CG	158,70±0,97	160,40±0,35	2,136	>0,05
		t	1,340	5,012		
		P	>0,05	<0,001		
2	20m speed run (s)	EG	3,94±0,08	3,43±0,09	6,986	<0,001
		CG	3,90±0,66	3,88±0,12	0,034	>0,05
		t	0,60	3,00		
		P	>0,05	<0,01		

- *Standing long jump:* The experimental group's jump distance increased from 160.4 cm to 164.5 cm, demonstrating a statistically significant result (P<0,001). The final difference between the groups was significant (P<0,001).

- *20m speed run:* The experimental group showed a significant improvement in time, with final data being significant compared to initial data (P<0,001). The final difference between the groups was also significant (P<0,01).

Table 3. Other strength and balance capacities

No	Test Parameter	Groups	Statistical data		t	P
			IT	FT		
			x ± m	t ± m		
1	Trunk raises from supine (no. reps)	EG	22,82±0,50	25,36±0,65	4,971	<0,001
		CG	21,45±0,86	22,82±0,83	1,890	>0,05
		t	1,377	2,410		
		P	>0,05	<0,05		
2	Pull-ups in hang (no. reps)	EG	4,82±0,69	7,27±0,74	4,000	<0,01
		CG	3,82±0,27	4,91±0,84	1,555	>0,05
		t	1,349	2,109		
		P	>0,05	>0,05		
3	Vertical jump (cm)	EG	26,64±0,24	30,82±0,23	5,946	<0,001
		CG	27,45±0,89	28,45±0,97	1,248	>0,05
		t	0,825	2,633		
		P	>0,05	<0,05		
4	Static balance (handstand) (min)	EG	2,36±0,28	3,95±0,43	4,775	<0,01
		CG	2,18±0,23	2,70±0,35	1,919	>0,05
		t	0,497	2,256		
		P	>0,05	<0,05		
5	Dynamic balance (handstand walk) (m)	EG	23,64±0,78	27,73±0,65	6,554	<0,001
		CG	22,61±0,49	23,42±0,49	1,928	>0,05
		t	1,118	5,295		
		P	>0,05	<0,001		
6	Rise to support on uneven bars (no. reps)	EG	7,45±0,77	12,24±0,92	6,499	<0,001
		CG	6,40±0,21	8,40±0,91	2,954	<0,05
		t	1,331	2,294		
		P	>0,05	<0,05		

The initial tests showed no significant differences between the groups for trunk raises from the supine position, pull-ups on the fixed bar, and vertical jump, confirming the homogeneity of the subjects.

- *Vertical jump:* This test determines the force of repulsion from the ground. The experimental group showed a significant progression from 26,64 cm initially to 30,82 cm finally, with t=5,946, P<0,001 and a 99,9% probability.

- *Static balance (handstand):* This test requires perfect balance and strength in a static resistance regimen. The experimental group's time increased significantly (P<0.01) with t=4.775.

- *Dynamic balance (handstand walk):* The experimental group walked 27,73±0.65 m, compared to the control group's 23,42±0,49 m, a statistically significant result (t=5,295, P<0,001).

- *Rise to support on uneven bars:* The experimental group significantly improved from 7,45±0,77 to 12,24±0,92 repetitions (t=6,499, P<0,001). The control group also progressed, but to a lesser extent.

The statistical data demonstrates that the experimental group's results showed significant improvement in all tested criteria compared to their initial measurements, and often significantly better than the control group's final results.

4. Conclusions

1. The experimental research results prove that for the formative capacities of gymnasts' physical preparation to be valuable in the training process, the professor-coach must competently utilize the influence of biopsychological energy factors.
2. The study highlighted that in the stage of maximum realization of individual and group possibilities, the training effort can vary from easy to medium and complex forms of execution of exercises for the gymnastics polyathlon, using specific modules for in-depth specialization. At this stage, the volume of special physical preparation effort for each gymnastics apparatus, as well as the volume of means for competition preparation, increases.
3. The experimental data obtained lead to the identification of conditions that serve as adequate modalities for optimizing physical and technical preparation strategies for the following criteria: 20m speed run, vertical jump, rise to support on uneven bars, and trunk raises from the supine position, all showing a significant effect where the calculated *t* value (*t*=3,80 - 6.986) is greater than the table value, with P<0,01 – 0,001 and a probability of 99-99,9%.

Bibliography

1. Grigore, V. (2001). *Gimnastica artistică - Bazele teoretice ale antrenamentului sportiv*, Ed. Semne, București, 194 p.
2. Grimalschi, T. (2021). *Fundamente psihopedagogice ale antrenamentului sportiv în gimnastica artistică. Principiul fenomenelor energiei biopsihoelectromagnetice,* Ed. Foxtrot, Chișinău, 230 p.
3. Nanu, M.C. (2022). *Gimnastica artistică,* Editura Universtaria, Craiova, 214 p.
4. Niculescu, G. (2003). *Gimnastica artistică. Repere teoretice și metodice*, Editura Presa Arvin, București, 153 p.
5. Ploeşteanu, C. (2009). *Bazele teoretice şi metodice ale pregătirii fizice în antrenamentul sportiv*, Ed. Europlus, Galaţi, 331 p.
6. Sbenghe, T. (2005). *Kinesiologie. Știința mișcării,* Ed. Medicală, București.

COMPARATIVE STUDY ON THE NUMBER AND EFFICIENCY OF PASSING TYPES BETWEEN THE LATERAL DEFENDERS OF FOOTBALL TEAMS IN THE PLAY-OFF AND PLAY-OUT, LEAGUE I

Ion Frățilă[1], George Alexandru Platini Enescu[2]
[1,2] *Ecological University of Bucharest, 1 G, Doina Cornea Street, Bucharest, Romania*

Abstract

The study aimed to identify the differences in value levels that exist between defenders specializing in the full-back position of play-off teams and those in the play-out of the Romanian First Football League. The comparative analysis was focused on the number and efficiency of the frequent types of passes used by the selected players. The study started from the premise that players specializing in the full-back position of play-off teams present a greater number of passes and a higher efficiency of them, in terms of the types analyzed, compared to players of play-out teams. The final goal of the work was, based on the information accumulated regarding the selected performance indices, to determine the causes of the appearance of these differences, and that these constitute a support, a useful benchmark for specialists in the field. Both the results of descriptive and inferential statistics demonstrated that the value level of the full-backs of play-off teams is significantly higher compared to the full-backs of teams in the play-out spot.

Key words: *football, full-back, passes*

1. Introduction

If in the past, the tasks of full-backs were strictly limited to the defensive phase and generally consisted of supporting the central defenders, with a role in securing the goal, preventing the opposing wingers from providing crosses, today, due to the evolution and modernization of the game, they have become much more versatile, ensuring dynamics and balance of actions, both in the defensive phase and in the attacking phase.

Thus, defenders specialized in this position can substitute themselves in central, inner or wing midfielders, depending on the chosen tactical strategy, also having multiple other roles and tasks: ensuring passing options, ensuring the team's amplitude in the construction phase, participating in various combinations and technical-tactical routes, ensuring numerical and positional superiority, providing crosses, actively participating in the transition phases and even the role of completing actions.

Studying players specializing in the full-back position in terms of the number and efficiency of passes can provide important guidelines for tactical strategy, and is also an indirect tool for evaluating the value level of a team. The collection, analysis

and interpretation of this data can lead to better management and orientation of training and, implicitly, to increased sports performance.

Passes are a "key" predictor in a quantitative analysis (Hughes & Franks, 2005); (Liu et al. 2015), they are the most common performance indicator encountered in the game of football, their number and efficiency being used in the evaluation of players. At the same time, they represent a criterion in the ranking and in establishing the value level of teams (Bradley et al. 2013; Anzer & Bauer, 2022).

A number of studies have shown that short passes are used more often than long passes (Hjelm, 2011). It seems that the main reason is the risk that a long pass entails of being intercepted by the opponent. Also, a long pass, due to the greater distance between teammates, presents an increased degree of difficulty both technically and biomechanically and cognitively-perceptually.

In modern football, full-backs must possess a high level of offensive skills that can be decisive in completing attacking actions (Konefał, Chmura &Andrzejewski, 2015).

Numerous studies have shown that the number and efficiency of passes made by full-backs differ depending on the championship of the respective country (Dellal et al. 2011; Andrzejewski et al. 2014). Also, the passes of players specialized in the full-back position are dependent on the physical and technical-tactical skills (Carling, 2011; Stølen et al. 2005; Barros et al. 2007; Clemente et al. 2013), the responsibilities and tasks imposed by the coach (Di Salvo et al, 2007), the tactical strategy applied and the playing system used (Bradley et al. 2011).

2. Material and method

In this study, we started from the premise that full-backs specialized in the full-back position of teams ranked in the play-offs have a higher number and efficiency in terms of passes, compared to full-backs of teams ranked in the play-out places.

The research was conducted during the regular season of the Romanian League I football championship, 2017/2018 edition.

For the research, we selected from the 14 football teams participating in the League I championship, a number of ten teams, five located in the first part of the ranking, respectively places 1-5, located in play-off positions and five teams located in the second part of the ranking, in play-out positions, respectively places 10-14. The criterion that formed the basis for choosing the 10 teams was the place occupied in the ranking at the time of the start of the research. From the total of 14 participating teams, we eliminated the teams located in the middle of the ranking, respectively places 6-9.

A number of 20 players specialized in the full-back position were selected, respectively the full-back pairs from the following teams:

-CFR Cluj, FCSB, CSU Craiova, Viitorul Constanţa, CSMS Iaşi, for the teams located in the first part of the ranking, in play-off positions;

-ACS Poli Timişoara, Concordia Chiajna, Sepsi Sf Gheorghe, Gaz Metan Mediaş, Juventus Bucureşti, for the teams located in the second part of the ranking, in play-out positions.

Data from 10 matches of the League 1 championship, regular season, were recorded.

In order to simplify the typology of passes, they were coded and abbreviated as follows: -Take-over-pass (TP); Pass preceded by more than two touches of the ball (MOTP); Passes executed with a single touch (OTP); Long passes (LP); Successful passes (AP); Wrong passes (WP).

The methods used in the research were represented by the methods of: bibliography, observation, comparative analysis, case study, statistical-mathematical.

To verify the hypotheses, we chose both basic statistics (sum, average, minimum and maximum values, standard deviation and coefficient of variation), and inferential statistics, using the non-parametric "Mann-Whitney" test, setting the significance threshold $p \leq 0.05$

3. Results and Discussions

Comparing the results obtained, one can observe the clear superiority that the players specialized in the full-back position of the teams located in the play-off places have over the players of the teams ranked in the play-out places.

Table 1 *Basic statistics - play-off players*

Nr crt	Player	TP	MOTP	OTP	LP	AP	WP
1.	J.C	19	5	15	0	30	9
2.	C.M	26	9	21	5	51	10
3.	M.M	17	6	18	3	38	6
4.	R.B	18	6	13	2	33	6
5.	M.B	15	5	6	2	19	9
6.	I.M	16	9	11	2	32	6
7.	B.N	18	7	7	1	23	10
8.	S.M	14	3	9	1	25	2
9.	I.P	11	4	10	3	21	7
10.	G.B	7	3	11	1	17	5
11.	**Sum**	161	57	121	20	289	70
12.	**Min**	7	3	6	0	17	2
13.	**Max**	26	9	21	5	51	10
14.	**Average**	16.1	5.7	12.1	2	28.9	7
15	**Stdev**	5.04	2.17	4.75	17	10.28	2.54
16.	**Cv (%)**	31	38	39	85	36	36

Analyzing the basic statistical information of the play-off players, recorded in table. 1, corroborated with the data of the play-out players, recorded in table. 2, we note the following:

Table 2 *Basic statistics - players in the play-out*

Nr crt	Player	TP	MOTP	OTP	LP	AP	WP
1.	S.B	10	7	8	2	15	12
2.	N.F	7	3	5	1	11	5
3.	M.O	13	8	8	3	21	11
4.	A.C	15	9	2	5	15	16
5.	D.S	6	8	9	3	17	9
6.	D.M	5	3	7	1	9	7
7.	S.P	8	9	3	3	11	12
8.	V.C	11	3	7	1	15	7
9.	F.S	5	6	6	5	7	15
10.	V.D	10	3	9	6	16	12
11.	**Sum**	90	59	64	30	137	106
12.	**Min**	5	3	2	1	7	5
13.	**Max**	15	9	9	6	21	16
14.	**Average**	9	5.9	6.4	3	13.7	10.6
15.	**Stdev**	3.4	2.64	2.41	1.83	4.16	3.56
16.	**Cv (%)**	38	45	38	61	30	34

Regarding the comparative analysis between the averages obtained by players in play-off positions versus play-out, broken down by the types of passes selected, we have: TP: 16.1 vs 9; MOTP: 5.7 vs 5.9; OTP: 12.1 vs 6.4; LP: 2 vs 3; AP: 28.9 vs 13.7; WP: 7 vs 10.6.

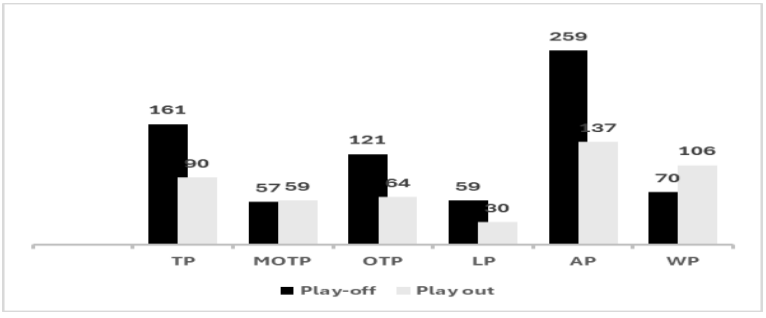


Figure 1. *Distribution of the number of passes by typology, play-off/play-out*

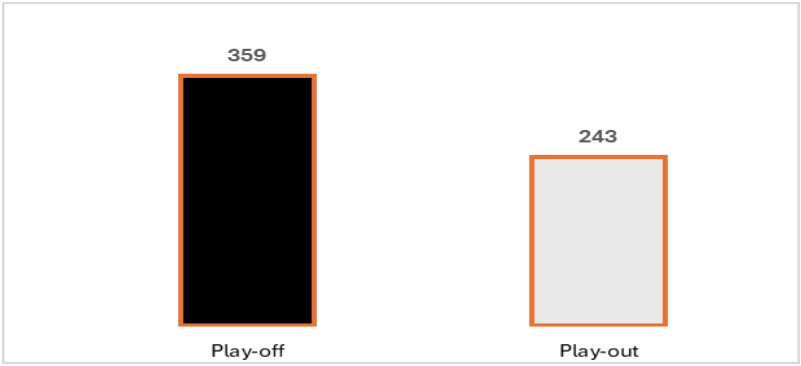


Figure 2. *Total number of passes, play-off/play-out*

In Fig. 3, we present the results regarding the percentages between two types of passes, namely the ratio between successful and unsuccessful passes. It is observed that the players of the play-off teams have a percentage of 80% successful passes vs. 20% unsuccessful passes, while the players of the play-out teams have a percentage of 56% successful passes vs. 44% unsuccessful passes.

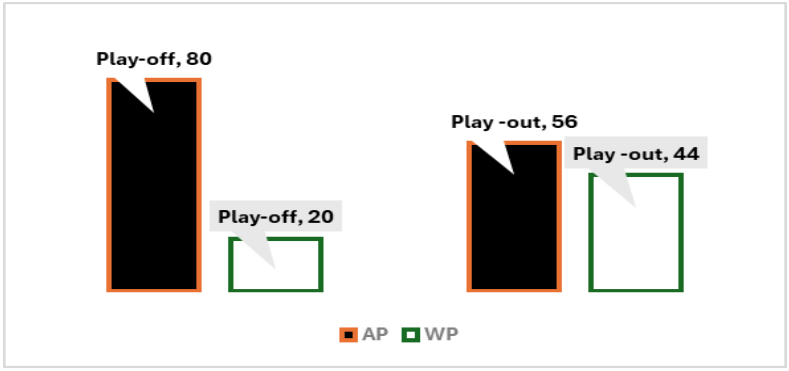


Figure. 3. *Percentage of successful passes and unsuccessful passes*

Regarding the inferential statistics, performed by applying the Mann-Whitney test and setting the threshold at a p value ≤ 0.05, we obtained the following results presented in table 3.

Table. 3.*Inferential statistics Mann Whitney test values*

	U-value	The critical value	Z-score	p-value
TP	10,5	27	2,95	0.00159
MOTP	48,5	27	-0,07559	0.46812.
OTP	12,5	27	2.79694	0.00256.
LP	34	27	1.17169	0.121
AP	3	27	-3.51507	0.00022
WP	20,5	27	2.19219	0.01426

4. Conclusions

Following the results obtained, we can advance the following conclusions:

1. The research hypothesis is confirmed, thus, the players specialized in the full-back position of the play-off teams made a greater number of passes and presented a higher percentage of successful passes compared to unsuccessful ones;
2. The players of the play-off teams participate in a much more active way in the game, having a superior technical-tactical quality, which is manifested by making a significantly higher number of passes from one touch, or those preceded by a takeover;
3. The players of the play-out teams presented a significantly higher number of unsuccessful passes, also based their actions on long passes and passes preceded by several touches, which led in many moments to the loss of possession of the ball and the slowing down of the actions;
4. In order to raise the level of performance, it is recommended to increase the involvement of full-backs in the attacking actions of football teams and to practice technical-tactical procedures in training, which will provide a greater degree of efficiency to the actions.

Bibliography

1. Andrzejewski, M. Chmura, J., Pluta,B. (2014). Analysis of motor and technical activities of professional soccer players of the UEFA Europa League. Int J Perform Anal Sport; 14 (2): 504–523. DOI: 10.18276/cej.2015.3-05.
2. Anzer, G, Bauer, P. (2022). Expected passes Determining the difficulty of a pass in football (soccer) usingspatio-temporal data. Data Mining and Knowledge Discovery.36:295–317.doi.org/10.1007/s10618-021-00810-3.
3. Barros, R, M., Misuta, M, S., Menezes, R, P., Figueroa, PJ., Moura,FA., Cunha,SA.,Anido,R.,Leite, N J. (2007). Analysis of the distances covered by first division brazilian soccer players obtained with an automatic tracking method. J Sports Sci Med.6(2):233-42. PMID: 24149334; PMCID: PMC3786245.
4. Bradley, PS., Carling, C, Archer, D, Roberts, J, Dodds, A., DiMascio, M., Paul, D., Diaz, AG, Peart, D., Krustrup, P. (2011). The effect of playing formation on high-intensity running and technical profiles in English FA Premier League soccer matches. J Sports Sci.29(8):821-30. doi: 10.1080/02640414.
5. Bradley PS, Carling C, Gomez Diaz A, Hood P, Barnes C, Ade J, Boddy M, Krustrup P, Mohr M. Match performance and physical capacity of players in the top three competitive standards of English professional soccer. Hum Mov

Sci. 2013 Aug;32(4):808-21. doi: 10.1016/j.humov.2013.06.002. Epub 2013 Aug 24. PMID: 23978417.

6. Carling, C. (2011). Influence of opposition team formation on physical and skill -related performance in a professional soccer team. Eur J Sports Sci.11 (3): 155–164. DOI:10.1080/17461391.2010.499972.
7. Clemente, F M., Couceiro, MS., Martins, FM., Ivanova, MO., Mendes, R. (2013). Activity profiles of soccer players during the 2010 world cup. J Hum Kinet.38:201-11. doi: 10.2478/hukin-2013-0060. PMID: 24235995; PMCID: PMC3827759.
8. Dellal, A., Chamari, K., Wong D.P., Ahmaidi S., Keller, D., Barros R., Carling, C. (2011). Comparison of physical and technical performance in European soccer match-play: FA Premier League and La Liga. Eur J Sports Sci.; 11 (1): 51–59. Doi: 101080/174613912010481334.
9. DiSalvo, V., Baron, R., Tschan, H., Calderon, Montero, F., Bachl, N., Pigozzi,F. (2007). Performance Characteristics According to Playing Position in Elite Soccer. Int J Sports Med. 28 (3): 222–227. doi: 10.1055/s-2006-924294.
10. Frățilă,I.(2018). Conținutul tehnico-tactic al jocului fotbalistului specializat pe postul de fundaș lateral, seniori din Liga I, campionatul intern. teză de disertație pg 18-66.
11. Hjelm, J. (2011). The bad female football player: women's football In Sweden Soccer and Society 12(2):143-158. DOI: 10.1080/14660970.2011.548352.
12. Hughes, M., Franks, I. (2005). Analysis of passing sequences, shots and goals in soccer. J. Sports Sci.23, 509–514. doi: 10.1080/02640410410001716779.
13. Konefał, M., Chmura, P., Andrzejewski, M. (2015). Analysis of Match Performance of Full-backs from Selected European Soccer Leagues. Central European Journal of Sport Sciences and Medicine 11(11):45-53 DOI:10.18276/cej.2015.3-05.
14. Liu H, Gomez MÁ, Lago-Peñas C, Sampaio J. Match statistics related to winning in the group stage of 2014 Brazil FIFA World Cup. J Sports Sci. 2015;33(12):1205-13. doi: 10.1080/02640414.2015.1022578. Epub 2015 Mar 20. PMID: 25793661.
15. Stølen, T., Chamari, K., Castagna, C., Wisløff, U. (2005). Physiology of soccer: an update. Sports Med.35(6):501-36. doi: 10.2165/00007256-200535060-00004. PMID: 15974635.

DETERMINING THE CHARACTERISTICS OF DYNAMIC BALANCE IN YOUNG FOOTBALL PLAYERS

Robert Aurel Enache[1], Vladimir Potop [2], Ilie Mihai [3], Ion Mihaila [4], Gheorghe Gabriel Cucui [5], Liviu Emanuel Mihailescu [6]

[1,2,4] *Doctoral School of Sport Science and Physical Education, National University of Science and Technology "Politehnica" Bucharest, University Center Pitesti, Romania*
[1]*ACSC FC Arges, Pitesti, Romania*
[1,2,3,4,6] *Department of Physical Education and Sport, National University of Science and Technology "Politehnica" Bucharest, University Center Pitesti, Romania*
[2] *Moldova State University, Institute of Physical Education and Sport, Chisinau, Republic of Moldova*
[5] *"Valahia" University of Targoviste, Romania*

Abstract
This study analyzed the characteristics of vertical dynamic balance in young football players. The purpose is to give a scientific basis for the development of training strategies that enhance both performance and injury prevention. Eighteen male players aged twelve to thirteen years from the "Argeș" Football Club in Pitești participated in the research. Dynamic balance was assessed under bipedal and single-leg conditions using a force platform (Sensimove miniboard). Measured parameters included general performance, mediolateral weight transfer to the left and right sides and mean angular deviations in the anterior, posterior, left and right directions. Descriptive statistical analysis was performed with the KyPlot software to determine mean values, standard deviations and ninety-five percent confidence limits. Findings revealed generally good postural control in two-leg stance, but pronounced variability in single-leg tasks. Right-leg support, despite being the dominant limb, showed the lowest minimum performance and the greatest dispersion of mediolateral deviations, reflecting functional asymmetry. Lateral sway proved more variable than anterior–posterior control across all conditions, highlighting mediolateral stability as the most challenging component of balance. These results emphasize the importance of individualized, unilateral and lateral-focused neuromuscular and proprioceptive training meant to reduce inter-limb differences, improve postural stability and lower the risk of sport-related injuries in adolescent football players.
Key words: *dynamic balance, youth football, postural stability, unilateral training, injury prevention*

1. Introduction

Dynamic balance is a fundamental component of physical preparation in modern football, a discipline characterized by abrupt changes of direction, rapid accelerations and decelerations, jumps and frequent physical contact with opponents. This ability supports both the efficiency of technical execution and the decrease of injury risk.

Recent research underlines the central role of structured neuromuscular training (NMT) in developing postural control and dynamic stability in young athletes (Wang et al., 2024). Football-specific injury-prevention programs, such as FIFA 11+, have

proven effective in enhancing both static and dynamic balance while reducing the incidence of traumatic injuries (Fard et al., 2022). Moreover, short-term interventions focused on dynamic balance exercises lead to neuromuscular adaptations that enhance postural control and movement quality (Kenville et al., 2021).

Another critical aspect is the monitoring and correction of motor asymmetries, which can disrupt neuromuscular coordination and compromise overall performance. This justifies the early implementation of targeted interventions in the training programs of young football players (Haddad, 2024). Thus, maintaining bodily stability during continuous movement emerges as a key factor in both optimizing performance and preventing injuries.

At an early age, the development of dynamic balance is intrinsically linked to processes of neuromuscular maturation, coordination and postural control, which progress gradually throughout childhood and adolescence (Ludwig et al., 2020). In performance football, the level of biological maturity has been shown to be an important predictor of postural stability and lower-limb strength, directly influencing the ability to maintain balance under dynamic conditions (Wilczyński et al., 2022). Furthermore, research points out that neuromuscular asymmetries arising during growth can impair coordination and increase injury risk; so, early monitoring and correction of these deficits is needed (Read et al., 2018).

Recent studies confirm that training programs integrating proprioceptive exercises, plyometrics and stability drills on unstable surfaces can significantly improve dynamic balance and reduce the risk of sprains, dislocations and other joint injuries. Interventions combining plyometric training with postural control and stabilization exercises are effective in enhancing neuromuscular control and preventing injuries across various sports and skill levels (Yan et al., 2025; Yılmaz et al., 2024; Huang et al., 2021). At the same time, systematic assessment of dynamic balance parameters provides coaches and sport science specialists with essential information for individualizing training programs and monitoring athlete progress.

The present study aims to determine the characteristics of dynamic balance in young football players, analyzing both biomechanical particularities and their relationship with physical training and potential injury risk. The findings are expected to support practical recommendations for coaches, contributing to the refinement of training methodologies and the enhancement of athletic performance from the early stages of development.

2. Material and method

The primary aim of this study was to identify the characteristics of vertical dynamic balance in both bipedal and unipedal conditions among young football players, So, a solid foundation is provided for the development of training strategies meant to optimize athletic performance and enhance on-field safety.

The central research hypothesis proposes that young football players exhibit greater postural stability during unipedal tasks compared with bipedal stance and that training programs focused on single-leg balance would lead to improved sports performance and a reduced risk of injury.

The investigation included eighteen male football players aged 12–13 years from the FC Argeș Sports Club in Pitești, Romania. Dynamic balance was assessed using a Sensamove MiniBoard platform, which recorded the following parameters: overall performance (percentage), left-side weight transfer (percentage), right-side weight transfer (percentage), mean anterior deviation (degrees), mean posterior deviation (degrees), mean left lateral deviation (degrees) and mean right lateral deviation (degrees).

Statistical analysis was performed with KyPlot software, version 6.0, employing descriptive indicators including standard deviation, confidence level of the mean and the lower and upper confidence limits of the mean.

3. Results and discussions

The comparative analysis of the static balance results in young football players can be carried out by comparing each specific parameter: performance, mean deviations front/back and left/right, standard deviation, coefficient of variation, lower and upper limits of confidence intervals. These comparisons are detailed in tables no. 1, 2 and 3)

Table no. 1. *Results of the dynamic bipedal balance in young football players*

Parameters	mean	SD	CV(%)	CLM (0.95)	LCLM	UCLM
Performance (%)	81.28	7.87	9.69	3.91	77.36	85.19
Left, inside (%)	40.94	12.02	29.35	5.98	34.97	46.92
Right, inside (%)	40.33	14.44	35.80	7.18	33.15	47.51
Front, avg. deviation (degrees)	4.12	0.75	18.20	0.37	3.75	4.50
Back, avg. deviation (degrees)	-3.59	1.15	32.07	0.57	-4.17	-3.02
Left, avg. deviation (degrees)	-1.35	0.41	30.06	0.20	-1.56	-1.15
Right, avg. deviation (degrees)	1.48	0.54	36.84	0.27	1.21	1.75

Notes: SD- standard deviation; CLM – Confidence Level of Mean; LCLM – Lower Confidence Limit of Mean; UCLM – Upper Confidence Limit of Mean

Table no. 1 presents the descriptive statistics for the bipedal dynamic balance performance of young football players. The overall performance score reached a mean value of 81.28 % (SD = 7.87), indicating a generally high level of postural control in dynamic tasks. The coefficient of variation (CV = 9.69 %) and the narrow 95 % confidence limits (77.36–85.19 %) reflect relatively homogeneous group performance and suggest that most participants demonstrated consistent balance abilities.

Directional components reveal more variability. The left–inside and right–inside parameters, representing lateral weight-transfer efficiency, had similar mean values (40.94 % and 40.33 %, respectively) but showed markedly higher dispersion (CV = 29.35 % and 35.80 %). The wide confidence limits (e.g., right–inside 33.15–47.51 %) highlight inter-individual differences in medio-lateral control, which may point to limb-dominance effects or asymmetries in neuromuscular coordination.

Analysis of average angular deviations provides insight into postural alignment under dynamic conditions. The front deviation averaged 4.12° (CV = 18.20 %), revealing a slight forward sway within acceptable limits. Conversely, the back deviation was negative (−3.59°) with a higher relative variability (CV = 32.07 %), suggesting occasional posterior shifts when correcting balance. Lateral deviations were small (left −1.35° and right 1.48°) but both displayed coefficients of variation above 30 %, again confirming notable individual differences in lateral stability.

Table no. 2 summarizes the descriptive statistics for vertical unipedal dynamic balance on the right foot in young football players.

The overall performance score averaged 93.39 % (SD = 7.32), with a low coefficient of variation (CV = 7.84 %) and narrow 95 % confidence limits (89.75–97.03 %), showing high and relatively uniform postural control when balancing on the dominant limb.

The medio-lateral weight-transfer indicators reveal greater heterogeneity. The left-inside value was significantly lower (39.33 %) than the right-inside value (54.06 %). Both exhibited very high variability (CV = 62.97 % and 42.90 %, respectively). Such dispersion suggests individual differences in load distribution and may reflect asymmetries in hip–ankle stabilization or habitual preference for the right support leg during football actions.

Table no. 2. *Results of the vertical unipedal dynamic balance (right foot) in young football players*

Parameters	mean	SD	CV(%)	CLM (0.95)	LCLM	UCLM
Performance (%)	93.39	7.32	7.84	3.64	89.75	97.03
Left, inside (%)	39.33	24.77	62.97	12.32	27.02	51.65
Right, inside (%)	54.06	23.19	42.90	11.53	42.52	65.59
Front, avg. deviation (grade)	3.99	1.04	26.01	0.52	3.47	4.51
Back, avg. deviation (degrees)	-3.98	0.98	24.55	0.49	-4.46	-3.49
Left, avg. deviation (degrees)	-0.78	0.32	40.54	0.16	-0.94	-0.63
Right, avg. deviation (degrees)	1.04	0.47	45.33	0.24	0.81	1.28

Notes: SD- standard deviation; CLM - Confidence Level of Mean; LCLM - Lower Confidence Limit of Mean; UCLM - Upper Confidence Limit of Mean

Angular deviations confirm a stable anteroposterior control: Front deviation averaged 3.99° (CV = 26.01 %) and Back deviation −3.98° (CV = 24.55 %), indicating balanced forward–backward sway around a neutral axis.

In contrast, lateral deviations were small in magnitude (left −0.78° and right 1.04°), but displayed high relative variability (CV > 40 %), again pointing to inter-individual differences in medio-lateral fine control.

Table no. 3. *Results of the vertical unipedal dynamic balance (left foot) in young football players*

Parameters	mean	SD	CV(%)	CLM (0.95)	LCLM	UCLM
Performance (%)	74.78	22.02	29.45	10.95	63.83	85.73
Left, inside (%)	54.83	22.88	41.72	11.38	43.46	66.21
Right, inside (%)	19.89	22.69	114.11	11.29	8.60	31.17
Front, avg. deviation (degrees)	4.39	1.03	23.53	0.51	3.88	4.91
Back, avg. deviation (degrees)	-3.57	1.49	41.85	0.74	-4.31	-2.83
Left, avg. deviation (degrees)	-1.60	0.84	52.54	0.42	-2.02	-1.18
Right, avg. deviation (degrees)	0.51	0.52	101.61	0.26	0.25	0.77

Notes: SD- standard deviation; CLM - Confidence Level of Mean; LCLM - Lower Confidence Limit of Mean; UCLM - Upper Confidence Limit of Mean

Table 3 shows that support on the left limb achieved a mean performance of 74.78 % (SD = 22.02), accompanied by a coefficient of variation of 29.45 %, revealing considerable heterogeneity in the values and a lower level of stability than that recorded for the right leg. The 95 % confidence interval (63.83–85.73 %) confirms this variability.

In the medio-lateral plane, load distribution demonstrates marked differences: left, inside presents a mean of 54.83 % (SD = 22.88; CV = 41.72 %), whereas right, inside drops to 19.89 % with an extremely high variability (CV = 114.11 %). This fact suggests a reduced capacity to transfer body weight to the contralateral side during left-leg support.

In the sagittal plane, mean deviations are 4.39° anteriorly (SD = 1.03; CV = 23.53 %) and –3.57° posteriorly (SD = 1.49; CV = 41.85 %). These values are comparable in amplitude and relatively balanced front-to-back, though posterior displacement has greater variability.

For lateral deviations, the mean is –1.60° to the left (SD = 0.84; CV = 52.54 %) and 0.51° to the right (SD = 0.52; CV = 101.61 %), indicating pronounced instability in medio-lateral control, particularly toward the right side.

Figure 1 highlights the minimum and maximum values of performance and medio-lateral load distribution during dynamic vertical balance (EDV) in young football players, under bipedal, unipedal-left and unipedal-right conditions.

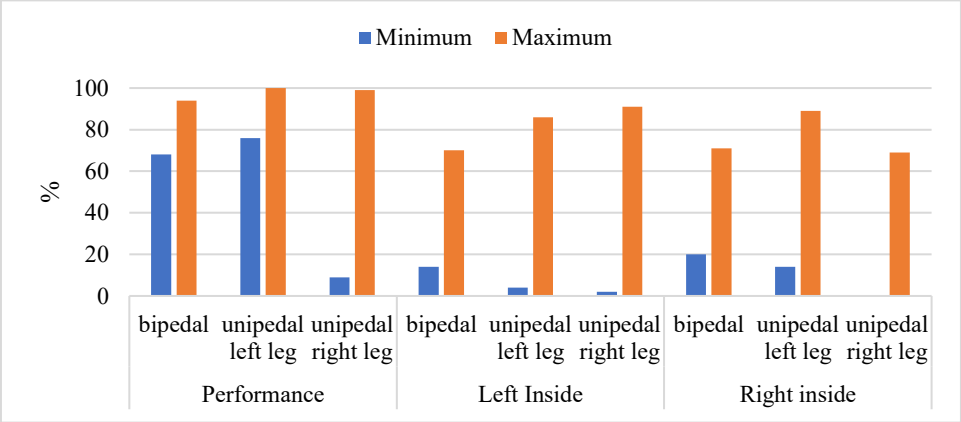


Fig. 1. *Minimum and maximum value of performance and keeping inside at EDV testing in young football players*

Overall performance shows the highest consistency in bipedal stance (68–94 %), moderate stability on the left leg (76–100 %) and the greatest variability on the right leg (9–99 %). Thus, there are highlighted significant inter-individual differences when balancing solely on the dominant limb.

Load distribution follows a similar pattern: left-side support has a broad range (4–86 %), while right-side transfer during left-leg stance varies even more widely (2–91 %). Notably, right-side loading during right-leg stance drops to 0 % in some athletes, evidencing asymmetrical control strategies.

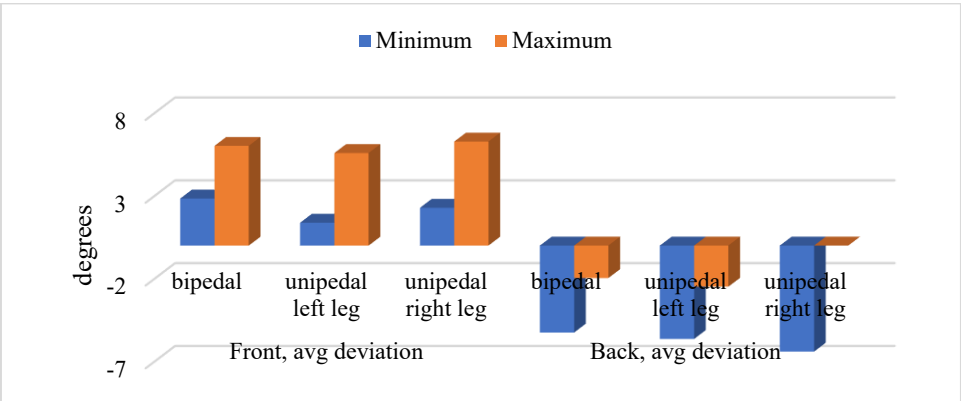


Fig. 2. *Minimum and maximum values of front-back deviations at EDV testing in young football players*

Figure 2 shows the minimum and maximum values of anterior (front) and posterior (back) mean deviations in dynamic vertical balance testing of young football players, comparing bipedal, unipedal-left and unipedal-right stances.

Front deviation ranges from 2.84° to 6.02° in bipedal stance, 1.38° to 5.59° on the left leg and 2.28° to 6.28° on the right leg. These values reflect a generally small forward sway across all stances, with slightly greater variability under unipedal

tasks, proving the higher neuromuscular demands of single-leg balance.

Back deviation shows wider dispersion, spanning –5.25° to –1.96° for bipedal, –5.64° to –2.48° for left leg and –6.40° to 0° for right leg. The right-leg stance exhibits the largest negative and positive extremes, suggesting that some athletes experience both pronounced backward sway and occasional neutral/forward shifts when relying on the dominant limb.

Figure 3 presents the minimum and maximum values of medio-lateral mean deviations during dynamic vertical balance testing (EDV) in young football players, evaluated under bipedal, unipedal-left and unipedal-right support conditions.

For left deviation, the recorded ranges were –2.02° to –0.55° in bipedal stance, –1.38° to –0.29° in unipedal support on the left leg, and –3.80° to –0.54° in unipedal support on the right leg. All values are negative, indicating a consistent tendency toward leftward sway. The widest interval was observed when the athletes balanced on the right leg, reflecting greater medio-lateral instability when the dominant limb served as the sole base of support.

For right deviation, the values ranged from 0.76° to 2.56° in bipedal stance, from 0.29° to 2.17° in unipedal left-leg support, and from 0° to 1.82° in unipedal right-leg support. The positive direction of these deviations reflects sway toward the right side. In particular, the bipedal position had the highest upper limit (2.56°), implying that symmetrical support permits slightly broader rightward excursions without compromising postural control.

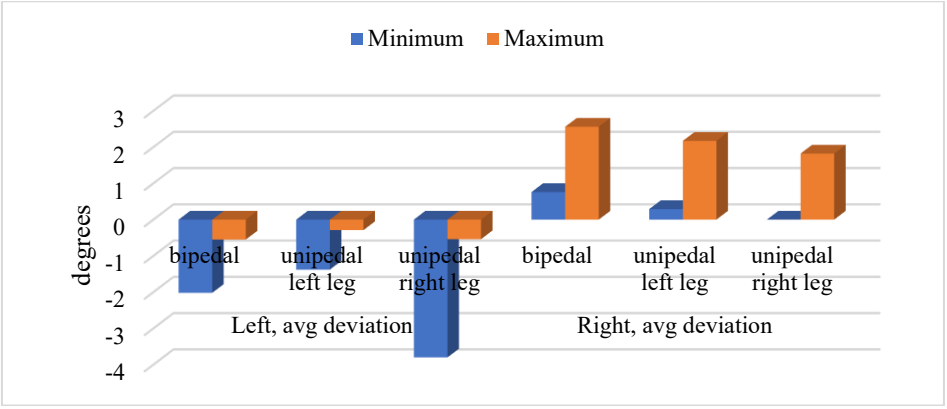


Fig. 3. *Minimum and maximum values of medio-lateral deviations at EDV testing in young football players*

The comparative analysis of bipedal and unipedal dynamic balance in young football players proves that, although overall bipedal stability is generally strong, unipedal tasks—particularly on the dominant right leg—exhibit wider performance ranges and greater medio-lateral variability. This pattern suggests that repeated sport-specific use of the dominant leg may contribute to subtle proprioceptive and neuromuscular imbalances. The need for early identification of asymmetries to

prevent injuries and to improve balanced motor development is underlined (Heshmati et al., 2025; Haddad, 2024; Moreno-Villanueva et al., 2025). Anterior–posterior deviations remain relatively stable, whereas lateral sway displays higher coefficients of variation, particularly under single-leg conditions, indicating that medio-lateral control is the most challenging component of dynamic balance. Targeted exercises such as lateral hopping, side-plank stabilization and perturbation training have been shown to improve medio-lateral postural control and trunk stability (Sung & Lee, 2024; Appiah-Kubi & Wright, 2019; Shibata, 2020). Implementing individualized neuromuscular and proprioceptive training, including programs like FIFA 11+, can reduce inter-limb differences, enhance unilateral stability, improve technical football skills and lower the risk of ankle, knee and overuse injuries (Eraslan et al., 2025; Wang et al., 2024; Álvarez-Serrano et al., 2023). This information underscores the importance of evidence-based, individualized interventions to optimize performance and safeguard long-term musculoskeletal health in youth football players.

4. Conclusions

The findings of this study lead to several key conclusions that highlight the specific balance characteristics, asymmetries and practical training implications for young football players:

1. Young football players demonstrate generally strong bipedal dynamic balance, yet unipedal tasks—especially on the right (dominant) leg—reveal wider performance ranges and greater postural variability.

2. Lateral sway parameters consistently show higher coefficients of variation than anterior–posterior measures, identifying medio-lateral control as the most challenging component of dynamic balance in this population.

3. Despite functional dominance, the right leg demonstrates both the lowest minimum performance and the greatest variability, suggesting that repeated sport-specific use may contribute to proprioceptive and neuromuscular imbalances.

4. Evidence supports the inclusion of unilateral stabilization, proprioceptive drills and mediolateral control exercises to correct inter-limb differences, reduce injury risk and improve overall postural stability.

5. Regular assessments—such as force-platform testing or field-based balance protocols—are recommended to detect asymmetries early and to guide tailored interventions, complementing established programs like FIFA 11+ for youth football players.

Bibliography

1. Álvarez-Serrano, C., Alfaro-Segovia, J., Guzmán-Muñoz, E., & Alarcón-Rivera, M. (2023). Neuromuscular training in football: a Literature Review. *J Nov Physiother Rehabil,* 7, 39-47.
2. Appiah-Kubi, K. O., & Wright, W. G. (2019). Vestibular training promotes

adaptation of multisensory integration in postural control. *Gait & posture*, 73, 215-220.

3. Eraslan, M., Gürkan, A. C., Aydın, S., Şahin, M., Çelik, S., Söyler, M., ... & Mülhim, M. A. (2025). The effect of proprioceptive training on technical soccer skills in youth professional soccer. *Medicina,* 61(2), 252.
4. Fard, R. B., Atri, A. E., Yazdi, N. K., & Shahtahmassebi, B. (2022). Assessing changes in static and dynamic postural stability in youth football players following the FIFA 11+ injury prevention program. *Science & Sports*, 37(3), 215-e1.
5. Haddad, M. (2024). Motor Asymmetry in Football: Implications for Muscular Power, Balance, and Injury Prevention. *Symmetry,* 16(11), 1485. https://doi.org/10.3390/sym16111485
6. Heshmati, S., Ghahraman Tabrizi, K., Daneshjoo, A., Hosseini, E., Bahiraei, S., Sahebozamani, M., ... & Behm, D. G. (2025). Effects of asymmetric and symmetric sport load on upper and lower extremity strength and balance: A comparison between the dominant and non-dominant side in adolescent female athletes. *Sports,* 13(3), 89.
7. Huang, P. Y., Jankaew, A., & Lin, C. F. (2021). Effects of plyometric and balance training on neuromuscular control of recreational athletes with functional ankle instability: a randomized controlled laboratory study. *International journal of environmental research and public health*, 18(10), 5269.
8. Kenville, R., Maudrich, T., Körner, S., Zimmer, J., & Ragert, P. (2021). Effects of short-term dynamic balance training on postural stability in school-aged football players and gymnasts. *Frontiers in Psychology*, 12, 767036.
9. Ludwig, O., Kelm, J., Hammes, A., Schmitt, E., & Fröhlich, M. (2020). Neuromuscular performance of balance and posture control in childhood and adolescence. Heliyon, 6(7). https://doi.org/10.1016/j.heliyon.2020.e04541
10. Moreno-Villanueva, A., Soler-López, A., Cuartero-Martínez, J. C., & Pino-Ortega, J. (2025). Assessment of limb imbalance in professional soccer players. *Appl. Sci.,* 15(4), 1875.
11. Read, P. J., Oliver, J. L., Myer, G. D., Croix, M. B. D. S., & Lloyd, R. S. (2018). The effects of maturation on measures of asymmetry during neuromuscular control tests in elite male youth soccer players. Pediatric exercise science, 30(1), 168-175.
12. Shibata, D. (2020). Improvement of dynamic postural stability by an exercise program. *Gait & posture*, 80, 178-184.
13. Sung, P. S., & Lee, D. (2024). Postural control and trunk stability on sway parameters in adults with and without chronic low back pain. *European Spine Journal,* 33(4), 1455-1464.
14. Wang, P., Liu, Y., & Chen, C. (2024). Effects of neuromuscular training on

dynamic balance ability in athletes: A systematic review and meta-analysis. *Heliyon*, 10(16). https://doi.org/10.1016/j.heliyon.2024.e35823

15. Wilczyński, B., Radzimiński, Ł., Sobierajska-Rek, A., de Tillier, K., Bracha, J., & Zorena, K. (2022). Biological maturation predicts dynamic balance and lower limb power in young football players. *Biology,* 11(8), 1167.
16. Yan, Y., Seoyoung, P., Seomyeong, H., & Zhao, Y. (2025). The effect of 12-week combined balance and plyometric training on dynamic balance and lower extremity injury risk in college dancers. *Frontiers in Physiology*, 16, 1501828.
17. Yılmaz, O., Soylu, Y., Erkmen, N., Kaplan, T., & Batalik, L. (2024). Effects of proprioceptive training on sports performance: a systematic review. BMC Sports Science, Medicine and Rehabilitation, 16(1), 149.

EFFECTIVENESS OF EXPERIMENTAL PROGRAMS ON THE TRAINING OF TECHNICAL-TACTICAL SKILLS IN MIXED MARTIAL ARTS

Ivan Gheorghiu [1], Ivan Carp [2], Natalia Reaboi [3]

[1] *"Ştefan cel Mare" Academy of the MIA, Chisinau, Republic of Moldova*
[2,3] *Institute of Physical Education and Sport, Chisinau, Republic of Moldova*

Abstract

This article reflects the problem of mastering the technical-tactical actions of mixed martial arts (hereafter MMA) fighters at the stage of in-depth specialization and orientation towards high performance. At present, the content of the researches carried out on the process of instruction and training of technical-tactical actions is supplemented by the use of experimental programs in order to assess the effectiveness of both the means of instruction and the results obtained from their application. The rapid, incredible progress in mixed martial arts technique and tactics has created problems for national and international MMA regulations, leading to frequent changes in them. In turn, these changes have had consequences for the training and instruction process, leading to the emergence of new models and means of training that are increasingly effective in terms of technical and tactical training at the advanced training stage. Thus, there is a need to determine and scientifically argue the theoretical and practical benchmarks of technical-tactical training in mixed martial arts of fighters at the stage of advanced specialization and orientation towards high performance in the Republic of Moldova.

Keywords: *experimental curriculum, technical trening, technical-tactical action, mixed martial arts (MMA).*

1. Introduction

In recent years, due to the intensification of competition on the international stage, the training process of athletes in any sport discipline is carried out gradually, in stages, based on principles that are clearly determined by the level of development of motor abilities and the effectiveness of their interaction. One of the major issues in the pedagogy of sports training is the comprehensive education of the athlete in general, particularly of the younger generation, given that sport plays an important role in shaping a strong personality capable of creating material and spiritual values in various fields of activity (Cojocariu, A., 2015; Deliu, D. et al., 2018; Epuran, M. et al., 2001).

As countries around the world independently address these challenges, it is also necessary in our region to conduct a series of studies on such issues, so that Moldovan athletes can participate in Ultimate Fighting Championship (UFC) matches. It should be noted that the UFC is the largest mixed martial arts promoter in the world, hosting most of the top-ranked fighters in the sport and organizing events across the globe. This would certainly be possible if MMA fighter preparation

at all stages—especially during the stage of advanced specialization and orientation toward high performance—were to be organized strictly based on a rational program, driven by the strategic, technological, methodological, and organizational aspects of the technical-tactical training system (Gheorghiu, I. & Carp, I., 2017; Hartmann, H. et al., 2012; Vako, I., et al., 2024).

The aim of this paper is to provide the methodological foundation for an experimental curriculum focused on training mixed martial arts fighters.

2. Material and method

The concept of methodology in MMA has complex meanings, the essence of which determines the approach to organizing and training technical-tactical actions within the training process.

From a methodological standpoint, the way all training activities for fighters are structured and conducted is defined activities that are constructive in structure and logical from the perspective of developing cognitive, motor, and affective-attitudinal competencies.

Competencies in mixed martial arts include a rich array of full-body movements, characterized by the mastery of distinct psychomotor skills such as: coordination ability, execution and reaction speed, joint mobility and muscular flexibility throughout the musculoskeletal system, explosive strength, and, importantly, sport-specific endurance. These factors have led us to select and adapt the most appropriate specialized methods from various combat sports and martial arts, with the aim of developing athletes' technical-tactical actions.

The general objective of the study was the development and implementation of an experimental program aimed at achieving performance results in athletes who are in the stage of advanced specialization and orientation toward high performance.

Hypothesis: We assumed that the implementation of the experimental program in mixed martial arts would have a positive effect on the training process of athletes in the advanced specialization stage, by enhancing the methodological and praxiological content of fighter preparation.

It is important to mention that this content must be systematized and follow a clear functional logic within a complex system of directives, with a classical character, in which evaluation and control tools for technical-tactical actions are not absent. Evaluation and control are most effective when they serve a fundamental purpose, with a focus on quality, and when results are assessed according to objective criteria; when control and evaluation activities are constructively combined with guidance and feedback; and when they are conducted with competence, tact, and even discretion adapted to the status and role of each individual conducting the assessment, and considering the professional category, among other factors (Alzhanov, H. et al. 2021; Antoniettô, N. et al. 2023; Gheorghiu, I. & Carp, I. 2019).

The effectiveness of the experimental program in mixed martial arts demonstrates the efficiency of the training components, with the following proportions:

a) *general physical preparation*, which represents 50% of the total volume of activity and applied methods. This component primarily targets: - the development of speed, in all its forms; - the development of aerobic endurance;- the analytical development of strength in various muscle groups and the development of explosive strength.

b) *technical preparation*, accounting for 30% of the total activity, focuses on:- the acquisition of techniques from wrestling and martial arts;- learning the phases of movement;- determining movement regularity;- establishing the spatial, temporal, and dynamic characteristics of technical movements;- setting the rhythm of technical actions.

The perfection of technical procedures, as the final phase of training, encompasses the entire activity of the MMA fighter. Transitioning to this phase is marked by: -the complete and final consolidation of motor skills;- the ability to perform a wide range of variations of the basic motor skill under conditions of maximum demand on motor qualities;- the development of a large reserve of motor skills, allowing for technical restructuring after a certain period (Brechney, G. et. al. 2021; Chernozub, A. et.al. 2019; Fernandes, J. et.al. 2018; Gheorghiu, I. 2023).

c) *competition preparation*, which has a weight of 20%, refers to specialized training, targeting the following aspects:- motor capacity required for the study of each technical procedure, which must be based on an adequate development of motor skills;-coordination capacity, determined by the fighter's prior experience;- psychological capacity, necessary for assimilating movements that require overcoming passive and defensive reflexes (i.e., difficult techniques).

The experimental program developed for the experimental group is the document that presents information in a quantitative format regarding the means of influence: for the development of basic and combined motor abilities in mixed martial arts, for the development of psychomotor capacities, for the acquisition of technical-tactical structures, for the formation of practical skills**,** and for the assimilation of theoretical knowledge.

It is worth noting that the application of various technologies, methodologies, means, and forms, aimed at achieving high sports performance, must always ensure that the training process reaches an optimal level in terms of instruction**.**

The sample consisted of 28 MMA fighters at the stage of advanced specialization and orientation towards high performance, from the **"**Ștefan cel Mare" Police Academy Club**.**

3. Results and Discussions

It should be noted that the recorded progress is also statistically confirmed (Table 1).

Table 1 *Annual dynamics of the technical-tactical training indices of the fighters from the control group (n=14) and the experimental group (n=14)*

No.	Tested parameters	Group	Statistical data		t	P
			Initial testing	*Final testing*		
			$\overline{X} \pm m$	$\overline{X} \pm m$		
1	Roundhouse Punches to the Punching Bag – 8 seconds (no./reps)	C	31,071 ± 0,588	32,214 ± 0,447	2,320	<0,05
		E	31,286 ± 0,667	34,429 ± 0,510	5,619	<0,001
		t	0,241	3,264	-	-
		P	>0,05	<0,01	-	-
2	Two Straight Kicks, Two Lateral Hook Arm Strikes, and Two Upper Hook Arm Strikes (seconds)	C	5,049 ± 0,325	5,746 ± 0,266	2,521	<0,05
		E	5,209 ± 0,351	3,448 ± 0,314	5,715	<0,001
		t	0,336	5,584	-	-
		P	>0,05	<0,001	-	-
3	Takedown Techniques of Varying Difficulty – 30 seconds (no./reps)	C	8,714 ± 0,412	9,786 ± 0,334	3,058	<0,01
		E	8,643 ± 0,440	10,857 ± 0,417	5,602	<0,001
		t	0,119	2,003	-	-
		P	>0,05	>0,05	-	-
4	From Ground Fighting Position – Execution of Joint Locks and Chokes – 20 seconds (no./reps)	C	10,071 ± 0,497	10,857 ± 0,467	1,767	>0,05
		E	10,286 ± 0,474	12,429 ± 0,441	5,074	<0,001
		t	0,312	2,633	-	-
		P	>0,05	<0,05	-	-
5	Straight Punches to the Punching Bag – 30 seconds (no./reps)	C	49,857 ± 0,533	50,929 ± 0,399	2,406	<0,05
		E	49,643 ± 0,570	52,643 ± 0,357	6,422	<0,001
		t	0,274	3,203	-	-
		P	>0,05	<0,01	-	-
6	Two Roundhouse Kicks, Two Circular Arm Strikes, and Two Upward Arm Strikes – 30 seconds (no./reps)	C	5,929 ± 0,322	6,714 ± 0,266	2,852	<0,05
		E	6,000 ± 0,331	7,857 ± 0,275	6,549	<0,001
		t	0,154	2,991	-	-
		P	>0,05	<0,01	-	-
7	Ground Takedown Techniques Using Various Technical-Tactical Complexities – 30 seconds	C	8,143 ± 0,376	9,286 ±0,322	3,518	<0,01
		E	8,357 ± 0,387	10,500 ± 0,310	6,534	<0,001
		t	0,397	2,560	-	-
		P	>0,05	<0,05	-	-

Note: (n=28); f = 27 (n=14); f = 12

C – control group; E-experimental group *P – 0,05; 0,01; 0,001* *P – 0,05; 0,01; 0,001*

n = 28; f = 27; r = 0,396 t = 2,056; 2,779; 3,707 t = 2,160; 3,012; 4,221

The repeated execution of a technique from any martial art allows for the consolidation of skills and the refinement of technical-tactical actions, while also developing the muscle chains involved in the movement's execution (Folhes, O. et

al., 2022; Gheorghiu, I., 2024; Issurin, V.B., 2017; Kirk, C. et al., 2021). In mixed martial arts**,** the combination of strength and speed plays a crucial role in the execution of technical-tactical actions, which must be performed with maximum force and at the highest possible speed**.**

It is important to note that throughout a fight, strength can also be expressed in combination with other motor abilities**.** Depending on the context of the fight, the following training methods are used by MMA fighters: offensive actions**,** defensive actions**,** and counterattacks.

In the test “roundhouse punches to the punching bag – 8 seconds”, a significant difference was observed between the results recorded in both the initial and final assessments (Figure 1). It is worth mentioning that this test reflects coordination ability under speed conditions. Thus, a significant increase ($t = 5.619$; $P<0.001$) was recorded in the indices of the experimental group, and a significant difference was also found in the values of the control group ($t = 2.320$; $P<0.05$). The’t’ variable for the final tests of the two groups in this trial demonstrates that the values exceeded the significance threshold ($t = 3.264$; $P>0.01$)

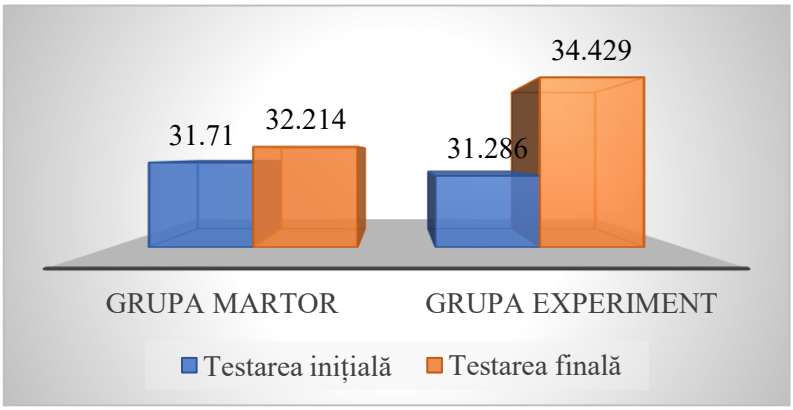


Figure 1. *Results recorded in the "number of arm strikes to the punching bag in 8 seconds" test (no./reps)*

As previously mentioned, we consider that this difference is primarily based on improved coordination and the development of the ability to sustain high-speed effort over a longer period that is, in a resistance-based regime.

At the same time, ambidexterity is enhanced by repeating techniques with both the right and left arms, since attacks may occur from either side. Therefore, strikes must be practiced on both sides, with even greater emphasis on the non-dominant side.

In conclusion, we can state that the experimental group achieved better results in the "arm strikes to the bag 8 seconds" test, as a result of using the following methods: from a standing position, at a visual signal: turning 180° to the right or left, followed by entry into a fighting stance specific to the practiced style – 3 to 6 reps

with 30 seconds rest; while walking, at a visual signal: simulation of an attack, block, dodge, or counterattack using arm strikes (right/left); while running, at a visual or tactile signal: 360° turn to the right or left by jumping, followed by an elbow strike; simulation of various strikes at a visual signal, performed at maximum speed for 10 seconds; from a prone position, supported on the hands, facing a partner, reciprocal palm strikes on the partner's hands – 2 to 4 reps, followed by switching partners; from a prone position, simultaneously raising the torso and legs to a 90° angle for 30 seconds.

In the test "*two straight kicks, two lateral hook arm strikes, and two upper hook arm strikes (seconds)*," the experimental group showed an initial arithmetic mean and standard error of 5.209 ± 0.351, and a final result of 3.448 ± 0.314, reflecting an improvement of 1.721 seconds (Figure 2).

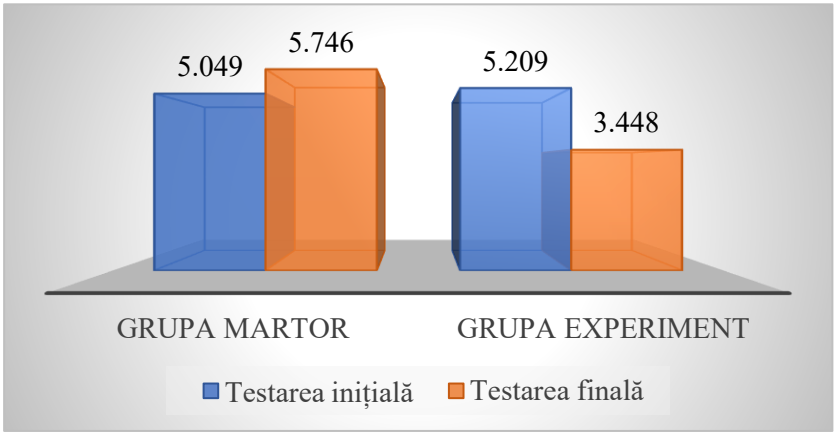


Figure 2. *Results recorded in the test: "Two Straight Kicks, Two Lateral Hook Arm Strikes, and Two Upper Hook Arm Strikes (seconds)" (s)*

A comparative analysis of the means from the two testing shows that the calculated t-value is 5.715, which exceeds the critical t-value (Fisher) at P<0.001, indicating significant differences.

For the control group, the mean and standard error values were 5.049 ± 0.325 at the initial testing and 5.746 ± 0.266 at the final testing. Comparative analysis in the control group reveals a calculated t-value of 2.521 (P<0.05), indicating significant differences between testing. The t-value for the final testing of the two groups in this test also exceeds the significance threshold (t = 5.584; P<0.001).

In mixed martial arts, all coordinated movements are intentional, and achieving a higher level of coordination requires frequent and varied practice of psychomotor structures. These movements are distinguished as specific skills, such as striking, defending, combining actions, etc. Any technical action, trained in the complex context of fighting, develops outstanding coordination in MMA fighters and serves as a key means of improving combined motor actions.

Another factor contributing to increased execution speed was the performance of the following technical actions during paired circuit training with style-specific exercises performed at maximum speed, targeting specific muscle groups for no more than 30 seconds per station (targeted muscle groups: triceps and pectorals, biceps and deltoids, anterior fascicle, core, back, and legs).

In the test "*Takedown Techniques of Varying Difficulty – 30 seconds (no./reps),"* the experimental group showed a significant improvement of 99.9% from initial to final testing. This evolution reflects the acquisition of fighting styles at the advanced training stage. However, the difference between the control and experimental groups in this test proved statistically insignificant ($t = 2.003$; $P>0.05$).

Movement coordination during takedown execution is also influenced by the subjects' maturity process. In the experimental group, a direct and meaningful contribution to coordination development came from the diversity of specific movements derived from combat disciplines (judo, freestyle wrestling, Greco-Roman wrestling) and martial arts (grappling, jiu-jitsu, karate, kickboxing, Sambo).

In conclusion, we can affirm that the experimental group's results were significant ($P<0.001$) in the following tests : "*From Ground Fighting Position – Execution of Joint Locks and Chokes – 20 seconds (no./reps); Straight Punches to the Punching Bag – 30 seconds (no./reps); Two Roundhouse Kicks, Two Circular Arm Strikes, and Two Upward Arm Strikes – 30 seconds (no./reps)*"; and "*Ground Takedown Techniques Using Various Technical-Tactical Complexities*– 30 s.", these results stemmed from the implementation of the following training means: 30-second shadow-fighting rounds where at least 10 attacks or combinations must be performed; high-speed takedown throws with a passive partner – 5–10 seconds; rapid repetitions of entry techniques for throws – 10 seconds, 5–10 sets with 30-second to 1-minute breaks; repeated entries between two partners positioned 2 meters apart, performed at maximum speed, 10 times over 6–10 sets.

Typically, the tactical preparation level of MMA fighters is assessed alongside their technical preparation level. A challenge in differentiating these two aspects is that in analyzing techniques and tactics, it is very difficult to separate one from the other. This process is further complicated by the subjectivity of such evaluations.

Coaching practice in MMA suggests that trainers do not address technical-tactical preparation separately from other components of athletic training.

The effectiveness of evaluating the level of technical-tactical preparation of martial arts fighters allows for the programming of sports training and, subsequently, the forecasting of competitive outcomes, as the final goal of the MMA training process (Gheorghiu, I. 2024).

Conclusions

1. As a result of the analysis and synthesis of the theoretical-methodological research of the specialized literature regarding the approach to instructional-educational content during the stage of advanced specialization, it was found that the

methodology of organizing and conducting this process is in continuous improvement. This is driven both by the need to identify the most effective and engaging forms of multilateral development through the integration of various means from combat sports and martial arts into training activities and by the aim of creating the necessary conditions to ensure the development of the technical-tactical actions of the athletes directly involved in these activities.

2. It has been demonstrated that, from a progressive perspective on understanding the specific characteristics of fighters' skill manifestation, enhancing motor abilities through activities focused on the multilateral training of mixed martial arts fighters has decisively improved the technical-tactical performance of the experimental group. This group demonstrated statistically significant results ($P<0.001$, with a 99.9% probability). Correspondingly, the indicators of technical-tactical preparedness significantly improved in terms of both effective offensive and defensive technical actions. The observed difference is statistically significant, and the experimental outcome is conclusive, confirming that the experimental group improved its athletic performance, achieving a significantly higher level at the final testing compared to the initial one.

References

1. Alzhanov, H., Ivanov D., Sagiev, T., Kladov, E., Matyunina, N. (2021). A comparative analysis of the competitive fights of fighters in mixed martial arts. *Journal of Physical Education and Sport,* 21(6), pp. 3405–3410. https://doi.org/ 10.7752/jpes.2021.06461
2. Antoniettô, N., Bello, F., Queiroz, A., Carvalho, P., Brito, C., Amtmann, J., Miarka, B. (2023). Suggestions for Professional Mixed Martial Arts Training With Pacing Strategy and Technical-Tactical Actions by Rounds. *J Strength Cond Res*, https://doi.org/ 10.1519/JSC.0000000000003018
3. Brechney, G., Chia, E., & Moreland, A. (2021). Weight-Cutting Implications for Competition Outcomes in Mixed Martial Arts Cage Fighting. *Journal of Strength and Conditioning Research*, 35(12), pp. 3420–3424. https://doi.org/ 10.1519/JSC.0000000000003368
4. Chernozub, A., Danylchenko, S., Imas, Y., Kochina, M., Ieremenko, N., Korobeynikov, G., Korobeynikova, L., Potop, V., Cynarski, W., Gorashchenco, A. (2019). Peculiarities of correcting load parameters in power training of mixed martial arts athletes. *Journal of Physical Education and Sport.* 19(2), pp. 481–488. https://doi.org/ 10.7752/jpes.2019. s2070
5. Cojocariu, A. (2015). Antrenamentul sportiv în artele marțiale. Pregătirea fizică. Iași: Editura Universității „Alexandru Ioan Cuza", 186. ISBN 978-606-714-164-1
6. Deliu, D., Deliu, R., Deliu, D. (2018). Cursuri teoretice metodologice de combat. București, Editura Discobolul, 158. ISBN 978-606-798-054-7

7. Fernandes, J., Bello F., Duarte, M., Carvalho, P., Queiroz, A., Brito, C., Miarka, B. (2018). Effect of rule changes on technical-tactical actions correlated with injury incidence in Professional Mixed Martial Arts. *Journal of Physical Education and Sport,* 18(3), pp. 1713–1721. https://doi.org/ 10.7752/jpes.2018.03250
8. Folhes, O., Reis, V., Marques, D., Neiva, H., Marques, M. (2022). Maximum Isometric and Dynamic Strength of Mixed Martial Arts Athletes According to Weight Class and Competitive Level. *Int J Environ Res Public Health*, 19(14), 8741. https://doi.org/ 10.3390/ijerph19148741
9. Epuran, M., Holdevici, I., Tonita, F. (2001). Performance sport psychology: *Theory and practice. FEST Publishing House*, Bucharest.
10. Gheorghiu, I., Carp, I. (2017). Metodologia pregătirii fizice a sportivilor ce practică artele marțiale mixte *In the: Sports. Olympism. Health*: Print-Caro, Ediția a 2-a, pp.38-, ISBN 978-9975-56-935-4
11. Gheorghiu, I., Carp, I. (2019). Pregătirea tehnico-tactică a sportivilor în artele marțiale mixte (MMA). In the: *Sports. Olympism. Health*: Editura USEFS, 2019, Ediția 4, pp.51-53, ISBN 978-9975-131-76-6
12. Gheorghiu, I. (2023). Technical–tactical training methods applied in the training process of mixed martial arts fighters. *In Journal of Physical Education and Sport (JPES*), University of Pitesti, vol. 23, pp. 2259-2265. ISSN -. DOI: 10.7752/jpes.2023.08259
13. Gheorghiu, I. (2024). Pregătirea polivalentă a luptătorilor de arte marţiale mixte. Specialitatea: 533.04. Educaţie fizică, sport, kinetoterapie şi recreaţie. Universitatea de Stat De Educaţie Fizică și Sport. 232 p. CZU: 796.015:796.85(043)
14. Hartmann, H. et al. (2012). Influence of squatting depth on jumping performance. J. *Strength Cond Res* 26(12): 3243-61
15. Issurin, V.B. (2017). Sports talent. Forecast and implementation. *Monograph.* Moscow: Sport, 240 p. ISBN 978-5-906839-83-1
16. Vako, I., Kashuba, V., Khmelnitska, I., Radchenko, Y., Radchenko, A., Carp, I., Krupenya, S. (2024). Utilizing technology to develop fundamental motor skills in young athletes specializing in hand-to-hand combat. *In Journal of Physical Education and Sport ® (JPES),* Vol. 24 (issue 2), Art 36, pp. 303 - 312, ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES
17. Kirk, C., Langan-Evans, Clark, D., C., Morton, J. (2021). Quantification of training load distribution in mixed martial arts athletes: A lack of periodisation and load management. *PLoS One,* 16(5), e0251266. https://doi.org/ 10.1371/journal.pone.0251266

ANALYZING THE RELATIONS BETWEEN DYNAMIC BALANCE PARAMETERS IN YOUNG BOXERS

Mihai Iorgu[1], Valeriu Jurat [2], Vladimir Potop [3], Marius Viorel Ulareanu [4], Andrii Chernozub [5]

[1,2,3]*Institute of Physical Education and Sports, Moldova State University, Chisinau, Republic of Moldova*
[3]*University Center Pitești, National University of Science and Technology Politehnica Bucharest, Romania*
[4]*Faculty of Physical Education Nad Sport, Ecological University of Bucharest, Romania*
[5]*Lesya Ukrainka Volyn National University, Ukraine*

Abstract

This study examined the interrelations between key parameters of vertical dynamic balance in young boxers, focusing on neuromuscular adaptations and functional asymmetries affecting postural performance. The research involved 11 athletes aged 14–15 years and was conducted in January 2025 at the "Club Sportiv Iorgu" Association in Bucharest. Tests were carried out in collaboration with the Human Performance Research Center (University of Pitești). Bipedal dynamic balance was assessed using the Sensamove MiniBoard. Statistical analysis (KyPlot) included mean, SD, Cv(%) and Pearson correlations. Results showed an overall good level of postural stability (M = 75.73%), with slight right-side dominance and minimal anterior–posterior deviations. Moderate positive correlations between overall performance and anterior deviations, and negative correlations with posterior and right lateral deviations, prove the importance of directional center-of-gravity control in maintaining functional stability. The findings support the necessity to include core stability and unilateral balance exercises into training programs to correct postural asymmetries and enhance dynamic control.

Key words: *dynamic balance, young boxers, postural stability, neuromuscular control, functional asymmetry*

1. Introduction

Dynamic balance is a fundamental component of motor control. It plays a critical role in maintaining postural stability and executing complex movements, particularly in combat sports. Recent research in martial arts and boxing highlights the importance of this capacity under sport-specific demands, revealing clear differences between experienced athletes and novices (Kindzer et al., 2025). In performance boxing, the level of expertise influences postural control and the ability to compensate for dynamic perturbations, with a direct impact on competitive results (Litwiniuk et al., 2023). Moreover, specialized training programs can shape the dynamic balance profile, inducing specific neuromotor adaptations (Akbaş et al., 2022).

The ability to control the center of mass during rapid footwork, abrupt directional changes and technical–tactical actions largely determine success in the ring.

Biomechanical studies show that maintaining postural stability and segmental control is essential for generating optimal force in jab and cross punches, especially under high-intensity conditions (Mosler et al., 2024). Kinematic analyses of rapid movements further emphasize that even minor variations in center-of-mass displacement can affect both the accuracy and efficiency of punches (Marković, 2022). In addition, coordination of strength, execution speed and stability contributes decisively to competitive performance (Bourantanis et al., 2024).

Young boxers, who are in a stage of ongoing physical and neuromotor development, constitute a particularly relevant group for investigating the parameters that define dynamic balance (Yarayan et al., 2025; Xiao et al., 2025; Akbaş et al., 2022). The literature underscores the complex interaction of the vestibular, proprioceptive and visual systems. Adapting these mechanisms to the specific demands of boxing is crucial for injury prevention and for the optimization of motor responses (Gaerlan et al., 2012; Ojie & Saatchi, 2021; Zarei et al., 2021).

Within junior performance training, the objective assessment of dynamic balance parameters (such as anteroposterior and mediolateral deviations, stability during rapid movements and the capacity to recover after a temporary loss of the center of mass) provides essential information about athletes' fitness and potential for progress (Zemková & Zapletalová, 2022; Ludwig et al., 2020; Ringhof & Stein, 2018). Analyzing the relations among these parameters enables coaches and researchers to identify strengths and limitations, thereby facilitating the development of individualized training programs (Liu et al., 2025; Merlo et al., 2023) and supporting phased training plans tailored to age, competitive experience and training load (Schoof et al., 2024).

2. Material and method

This study investigates the interrelations between key parameters of dynamic vertical balance in young boxers, emphasizing their significance in the improvement of athletic performance and maintaining postural stability. The analysis aims to identify functional asymmetries and neuromuscular adaptations that influence movement efficiency. Also, it provides evidence-based recommendations for optimizing training strategies and preventing sport-specific injuries. The findings contribute to strengthening the scientific basis of youth boxing training methodologies and to improving approaches for the development of coordination and motor control skills.

The research was conducted in January 2025 with a descriptive aim in data analysis. The study was carried out within the "Club Sportiv Iorgu" Association in Bucharest and involved 11 athletes aged 14 - 15 years.

For assessing bipedal vertical dynamic balance, the Sensamove MiniBoard was used, in collaboration with the Human Performance Research Center (University Center in Pitești). The parameters analyzed included overall performance (%), left,

inside (%), right, inside (%) and average deviations in the anterior, posterior, left lateral and right lateral directions.

Statistical analysis was performed by means of the KyPlot program, using descriptive indices: mean, SD, Cv(%), Confidence Level of Mean (0.95) and the Pearson correlation coefficient.

3. Results and discussions

The descriptive and correlation analysis of the vertical dynamic balance parameters in young boxers allowed the identification of the postural performance general level, the specific features of bilateral weight distribution, the significant relations between anterior–posterior and lateral stability and the overall efficiency of neuromuscular control. The results were subsequently interpreted in relation to current findings in the scientific literature.

Table 1 *Analysis of vertical dynamic balance parameters in young boxers*

Parameters / statistical indicators	Perf. (%)	Left, inside (%)	Right, inside (%)	Front, avg. Dev. (degrees)	Back, avg, dev. (degrees)	Left, avg. dev. (degrees)	Right, avg. Dev. (degrees)
mean	75.73	36.18	39.64	3.92	-3.73	-1.30	1.84
SD	8.04	9.39	9.18	0.84	1.17	1.21	0.50
Cv(%)	10.62	25.95	23.16	21.43	31.22	92.91	27.19
CLM(0.95)	5.40	6.31	6.17	0.56	0.78	0.81	0.34

Note. CLM(0.95) - Confidence Level of Mean(0.95)

The results of the vertical bipedal dynamic balance test in young boxers indicate a generally good level of postural stability (M = 75.73%), accompanied by a slight dominance of right-side support (Left inside = 36.18% vs. Right inside = 39.64%). These findings confirm the athletes' ability to maintain efficient control of the center of gravity under static and dynamic conditions, a key component for guard stability and striking efficiency in boxing (Zemková & Zapletalová, 2022).

The low coefficient of variation (Cv = 10.62%) for overall performance suggests high homogeneity within the group and effective neuromuscular integration. The programs of integrated training the combine strength, core stability and coordination exercises have proven effective in improving balance and optimizing postural control (Niu, Huang, Zhao & Chen, 2024). The test values reflect positive adaptation to the specific demands of boxing, where maintaining balance during rapid movements and contact is essential (Ludwig, Kelm, Hammes, Schmitt & Fröhlich, 2020).

Small mean deviations in the antero-posterior (front = 3.92°, back = −3.73°) and lateral planes (left = −1.30°, right = 1.84°) point out efficient trunk stability and satisfactory postural symmetry, with a slight compensatory shift to the right. This can be attributed to the functional dominance of right-handed athletes, who typically adopt a left-oriented guard stance, increasing the load on the right leg (Liu, Li, Jiang & Geng, 2025). Recent studies show that unilateral or combined (unilateral-bilateral)

training may correct asymmetries caused by dominant-side overuse, improving bilateral striking efficiency (Liu et al., 2025).

The moderate variability for left and right support (Cv ≈ 23–26%) reveals individual differences in postural control, shaped by training experience, technical style and neuromuscular development. According to Maršálek and Martínez (2021), postural stability can be affected by sport-specific fatigue, yet well-trained athletes effectively compensate to maintain balance. Similarly, Korobeynikov et al. (2021) highlight a strong association between postural stability and neurodynamic characteristics in martial artists.

Overall, the results emphasize optimal postural control and dynamic balance for this age group and level of preparation. Boxing practice, through continuous demands for stabilization and center-of-gravity adjustment during attack and defense, fosters neuromuscular self-regulation and improved sensorimotor control (Zemková & Zapletalová, 2022; Niu et al., 2024). Training programs should include unilateral balance and trunk stability exercises, as well as compensatory drills for non-dominant limbs, to minimize functional asymmetries and optimize striking performance.

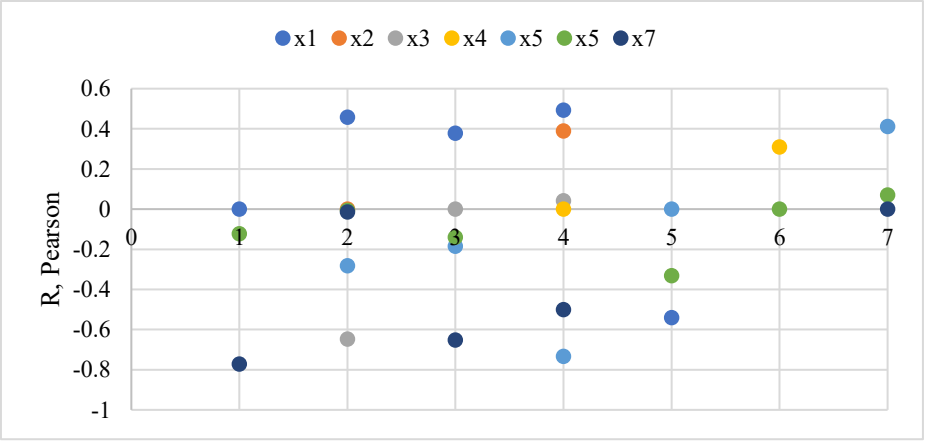


Figure 1. *Level of significance of the relation between the vertical dynamic balance parameters in young boxers*

Notes: 1, x1 - Perf. (%), 2, x2 - Left, inside (%), 3, x3 - Right, inside (%), 4, x4 - Front, avg. dev. (degrees),5, x5 - Back, avg, dev. (degrees), 6, x6 - Left, avg. dev. (degrees), 7, x7 - Right, avg. dev. (degrees)

The correlation analysis using the Pearson coefficient (Figure 1) revealed significant relationships between overall dynamic balance performance and directional variables (anterior–posterior and lateral). Out of 21 possible associations, 10 were statistically significant or showed relevant trends, including 4 positive and 6 negative correlations.

Moderate positive correlations were observed between overall performance and left-side support (r = 0.458), right-side support (r = 0.379) and anterior deviation

(r = 0.493). These associations prove that superior postural performance is linked to effective anterior control and balanced bilateral weight distribution. The positive link between anterior deviation and performance suggests that maintaining the center of gravity slightly forward—typical of the boxing guard stance—enhances dynamic stability, a finding consistent with Zemková and Zapletalová (2022). Similarly, a positive relationship between posterior and left deviations (r = 0.411) reflects compensatory postural mechanisms, aligning with anticipatory postural control theories (Ludwig et al., 2020).

Conversely, significant negative correlations were found between overall performance and right deviation ($r = -0.772$, $p < 0.01$), posterior deviation ($r = -0.541$), and between posterior and right deviations ($r = -0.734$, $p < 0.05$). These results indicate that greater posterior or rightward shifts of the center of gravity reduce postural efficiency. Right-side predominance—often associated with limb dominance—appears to limit dynamic stability, particularly during transitions between attack and defense (Liu et al., 2025). The strong negative link between right deviation and performance underscores the critical role of lateral control in maintaining balance, which is consistent with the findings of Maršálek and Martínez (2021), who noted that fatigue specifically impairs anterior foot stability.

In total, three strong correlations ($|r| > 0.70$), four moderate ($0.40 < |r| < 0.69$) and three weak ($|r| < 0.40$) ones were identified. The predominance of negative, moderate-to-strong relations highlights the limiting effect of right–posterior deviations on postural performance in young boxers. These findings support the idea that unilateral balance training and core stability exercises enhance neuromuscular control and reduce postural asymmetries (Niu, Huang, Zhao & Chen, 2024).

From a functional perspective, maintaining a slightly anterior and bilaterally distributed center of gravity facilitates energy transfer and strike efficiency (Ludwig et al., 2020), while excessive rightward or backward shifts compromise performance. This pattern aligns with evidence linking lateral dominance and asymmetry to reduced stability (Andreeva et al., 2021; Korobeynikov et al., 2021). It was demonstrated that integrated neuromuscular and core-stability training programs (also including unilateral and plyometric exercises) improve anticipatory postural responses and overall dynamic control (Niu et al., 2024; Gonçalves et al., 2020).

In practical terms, training should emphasize neuromuscular integration, trunk stability and unilateral strengthening in order to correct dominant-side asymmetries (Liu et al., 2025). Periodic monitoring of posterior and lateral balance parameters under fatigue is also recommended to prevent performance decline (Maršálek & Martínez, 2021). Although these correlations do not imply causality, future experimental research combining posturographic and kinematic analyses could clarify how balance parameters directly influence technical-tactical performance.

4. Conclusions

Based on the results obtained from the descriptive and correlation analysis of vertical dynamic balance parameters in young boxers, the following conclusions can be drawn, highlighting the main functional tendencies, the relations between postural stability indicators and the directions for optimizing sport-specific training:

1.The mean performance values indicate a satisfactory level of vertical dynamic balance in young boxers, confirming the neuromuscular adaptations characteristic of combat sports that require rapid movements and frequent shifts of the center of gravity.

2.Slightly higher percentage values on the right side compared to the left one suggest a functional lateral dominance, typical of athletes with a fixed guard stance, which may influence dynamic stability and movement precision.

3.The positive relations between overall performance and moderate anterior deviations emphasize the importance of maintaining a slightly forward-projected center of gravity—specific to the guard position and attack phases—while posterior deviations correlate negatively with performance.

4.The strong negative correlations between rightward deviations and overall performance prove that excessive displacement of the center of gravity toward the dominant side reduces stability and postural efficiency during boxing-specific movements.

5.The results support the integration of balance, unilateral strength and core stability exercises into training programs to correct functional asymmetries and enhance overall postural control, in line with recent recommendations from the scientific literature.

Bibliography

1. Akbaş, A., Marszałek, W., Drozd, S., Czarny, W., Król, P., Warchoł, K., ... & Rzepko, M. (2022). The effect of expertise on postural control in elite sport ju-jitsu athletes. BMC Sports Science, Medicine and Rehabilitation, 14(1), 86.
2. Andreeva, A., Melnikov, A., Skvortsov, D., Akhmerova, K., Vavaev, A., Golov, A., ... & Zemková, E. (2021). Postural stability in athletes: The role of sport direction. *Gait & posture*, 89, 120-125.
3. Bourantanis, A., Nomikos, N., & Wang, W. (2024). Biomechanical Insights and Strategic Applications in Ancient Combat Sports: Optimizing Stability, Power and Tactical Advantage.
4. Gaerlan, M. G. (2010). *The role of visual, vestibular, and somatosensory systems in postural balance*. Master's thesis, University of Nevada, Las Vegas.
5. Gonçalves, C., Bezerra, P., Clemente, F. M., Vila-Chã, C., Leão, C., Brandão, A., & Cancela, J. M. (2020). Effect of instability and bodyweight neuromuscular training on dynamic balance control in active young adults. *International Journal of Environmental Research and Public Health,* 17(23), 8879.

6. Kindzer, B., Nikitenko, S., Vyshnevetskyi, S., Kukurudziak, I., Ilnytskyi, I., Busol, V., ... & Cynarski, W. J. (2025). Results of Testing of Athletes in Martial Arts Using the Star Excursion Balance Test Method (on the Example of Women's Boxing, Kyokushinkai Karate, Fencing and WKF Karate). Ido Movement for Culture. Journal of Martial Arts Anthropology, 25(2).
7. Korobeynikov, G., Bulatova, M., Zhirnov, O., Cynarski, W. J., Wąsik, J., Korobeinikova, L., ... & Sergienko, U. (2021). Links between postural stability and neurodynamic characteristics in kickboxers. *Ido Movement for Culture. Journal of Martial Arts Anthropology*, 21(1), 1-5.
8. Litwiniuk, A., Bujak, Z., Mastalerz, A., Różański, P., Ramos, O. R., & Niźnikowski, T. (2023). Comparison of maintaining of body balance in combat sports between experts and non-experts. *Journal of Kinesiology and Exercise Sciences,* 33(102), 21-27.
9. Liu, Y., Li, L., Jiang, M., & Geng, J. (2025a). Comparative effects of unilateral, bilateral, and hybrid combined resistance training on straight punch performance in adolescent boxers: a focus on dominant and non-dominant-side adaptations. *European Journal of Applied Physiology*, 1-13.
10. Ludwig, O., Kelm, J., Hammes, A., Schmitt, E., & Fröhlich, M. (2020). Neuromuscular performance of balance and posture control in childhood and adolescence. *Heliyon*, 6(9), e04924.
11. Marković, S. N. (2022). *Sports performance measurement using kinematic sensors.* Doctoral dissertation, University of Belgrade, Serbia.
12. Maršálek, J., & Martínez, D. A. E. *Effects of sport specific fatigue on dynamic balance and dynamic postural stability of the lead leg in elite junior boxers*. Máster universitario en high performance sport: Strength and conditioning.
13. Merlo, R., Rodríguez-Chávez, Á., Gómez-Castañeda, P. E., Rojas-Jaramillo, A., Petro, J. L., Kreider, R. B., & Bonilla, D. A. (2023). Profiling the physical performance of young boxers with unsupervised machine learning: a cross-sectional study. *Sports,* 11(7), 131.
14. Mosler, D., Kacprzak, J., & Wąsik, J. (2024). The influence of effective mass on the striking force of lead jab and rear cross punches of boxers. *Applied Sciences,* 14(17), 7785.
15. Niu, Z., Huang, Z., Zhao, G., & Chen, C. (2024). Impact of three weeks of integrative neuromuscular training on the athletic performance of elite female boxers. *PeerJ,* 12, e18311. https://doi.org/10.7717/peerj.18311
16. Ojie, O. D., & Saatchi, R. (2021, September). Kohonen neural network investigation of the effects of the visual, proprioceptive and vestibular systems to balance in young healthy adult subjects. In *Healthcare,* 9(9), p. 1219.
17. Ringhof, S., & Stein, T. (2018). Biomechanical assessment of dynamic balance: Specificity of different balance tests. *Human movement science*, 58, 140-147.
18. Schoof, S., Krabben, K., Lojanica, M. B., Pion, J., & Elferink-Gemser, M. T.

(2024). Multidimensional performance characteristics of talented youth judoka: Dynamic balance and coping skills relate to international competitive performance. *International Journal of Sports Science & Coaching*, 19(6), 2489-2500.

19. Xiao, Y., Dongxu, G., Chen, C., Zhuang, M., Long, Y., Wei, Q., ... & Wang, D. (2025). The relationship between visual ability assessment and competitive boxing performance in female amateur boxers. *Frontiers in Physiology*, 16, 1639227.
20. Yarayan, Y. E., Keskin, K., Çelik, O. B., Güder, B. C., Kurtipek, S., Aslan, M., ... & Batrakoulis, A. (2025). Impact of life kinetik training on balance, agility, jumping, proprioception, and cognitive function in preadolescent recreational fencing athletes: a randomized controlled trial. *BMC Sports Science, Medicine and Rehabilitation,* 17(1), 146.
21. Zarei, M., Eshghi, S., & Hosseinzadeh, M. (2021). The effect of a shoulder injury prevention programme on proprioception and dynamic stability of young volleyball players; a randomized controlled trial. *BMC sports science, medicine and rehabilitation,* 13(1), 71.
22. Zemková, E., & Zapletalová, L. (2022). The role of neuromuscular control of postural and core stability in functional movement and athlete performance. *Frontiers in physiology*, 13, 796097. https://doi.org/10.3389/fphys.2022.796097

THE ROLE AND IMPLICATIONS OF THE GAME MODEL IN PERFORMANCE HANDBALL

Dragoș Mădălin Luscan [1], Ion Mihaila [2], Daniela Corina Popescu [3], Alexandru Acsinte [4]

[1,2] *Doctoral School of Sports Science and Physical Education, National University of Science and Technology Polytechnic Bucharest, University Center Pitești, Romania*
[1,2,3] *Department of Physical Education and Sport, National University of Science and Technology Polytechnic Bucharest, University Centre Pitesti, Romania*
[4] *„Vasile Alecsandri" University of Bacau, Bacau, Romania*

Abstract

This study tries to evaluate the integration of modern principles of functional monitoring, injury prevention and individualized training in performance handball, by analyzing the practices and perceptions of coaches. The research was conducted with a group of sixty-seven coaches, currently active or recently active at senior team level in Romania, with experience ranging from zero to over ten years. Data were collected through a structured questionnaire covering professional profile, perception of physical and metabolic demands, use of functional testing and attitude towards individualized training. Results reveal a high awareness of the importance of functional monitoring, but a limited application of testing on a regular basis. Strength tests and force platforms are preferred, while metabolic assessments are less frequently used. The study highlights the need for continuous professional development of coaches and the implementation of evidence-based programs and strategies for injury prevention and performance optimization. The findings also point out interest in national studies on the neuromuscular and metabolic profile of Romanian handball players.

Key words: *performance handball, functional monitoring, individualized training, injury prevention, professional development.*

1. Introduction

Handball is a complex sport, characterized by a rapid series of actions that impose high and varied demands on the athletes' bodies, both physically, metabolically and psychologically. The intermittent nature of effort involves continuous alternation between high-intensity phases – sprints, jumps, throws and physical contacts – and submaximal effort periods, resulting in increased engagement of the anaerobic lactic and aerobic energy systems (Póvoas et al., 2012; Michalsik et al., 2014). Recent studies show that during official matches, handball players can reach elevated heart rate and oxygen consumption values, while blood lactate levels reflect the specific metabolic intensity of the sport (García-Sánchez et al., 2023; Manchado et al., 2013).

Physiological demands differ depending on the playing position, imposing distinct requirements for strength, speed, endurance and reaction capacity (Karcher & Buchheit, 2014; Michalsik, 2018). These particularities make handball a discipline that requires rigorous planning of physical preparation, based on monitoring both internal and external loads, to optimize performance and reduce injury risk (Ezquerra Condeminas et al., 2024; Tyshchenko et al., 2025). The integration of modern

assessment technologies – such as electronic performance tracking systems and portable metabolic analyzers – allows a deeper understanding of the physiological demands of the game and provides coaches with effective tools for individualizing the training process (García-Sánchez et al., 2023; Ezquerra Condeminas et al., 2024).

By its nature, handball involves intermittent high-intensity efforts, alternating sprints, jumps, throws, physical contacts and active recovery periods. This requires continuous adaptation of the neuromuscular and cardiovascular systems, involving high recovery capacity and optimal metabolic efficiency (Póvoas et al., 2012; Karcher & Buchheit, 2014). Modern training must aim not only at developing strength, speed and endurance but also at consolidating neuromuscular mechanisms and motor control required by maximal intensity movements (Michalsik et al., 2014; Dello Iacono et al., 2018). Training programs should integrate methods that optimize functional adaptations and reduce injury risk, such as integrative neuromuscular training, plyometric exercises and blood flow restriction exercises (Sañudo et al., 2019; Tyshchenko et al., 2025).

Injury prevention and joint health maintenance represent essential objectives in sports training, as the specific demands of handball – particularly in terms of knees, shoulders and ankles – can lead to muscular imbalances and chronic overloads (Jagielo, 2020; Naderi et al., 2024). The implementation of prevention programs based on neuromuscular control, joint stability and functional exercises has proven effective in reducing injury risk and improving motor performance (Hermassi et al., 2017; Xu et al., 2024).

The dynamic and unpredictable nature of the game requires a continuous integration of physical, technical and tactical training, enabling athletes to respond efficiently to the variable demands of competition. The effort expended during the game varies depending on playing position, intensity of offensive and defensive phases and the individual's metabolic adaptation capacity. Therefore, training must be differentiated, adapted to the specificity of each playing position and to the physiological characteristics of the athletes (Sarmento et al., 2024; Kashani, 2024).

Functional monitoring is a modern tool for controlling and optimizing training. It provides objective information on athlete state, performance evolution and adaptation to effort. It facilitates real-time decision-making regarding training intensity, volume and frequency, while also contributing to the reduction of injury incidence and the improvement of recovery efficiency (Latino & Tafuri, 2024; Ji et al., 2024; Henze et al., 2025).

Currently, the application of individualized training principles based on functional data has become a priority in elite handball. A correct understanding of physical and metabolic demands constitutes the foundation for rational training planning, integrated development of motor abilities and long-term athlete health preservation. Careful monitoring of physiological and metabolic indicators allows for individualized training adjustments, prevention of overtraining and optimization

of sports performance (Halson, 2014; Vanrenterghem et al., 2017; Pedlar et al., 2019; Foster et al., 2017; Cesanelli et al., 2022; Lv, 2025; Roa, 2024).

2. Material and method

The purpose of this research is to evaluate the degree of integration of modern principles of functional monitoring, injury prevention and individualized training in elite handball. The evaluation is made by identifying current coaching practices, their level of awareness regarding the importance of functional testing and the applicability of these methods in injury prevention and performance improvement. The study also aims to determine the necessity of developing professional training programs and implementing evidence-based strategies.

Participants

The study was conducted with a sample of sixty-seven coaches involved in elite handball in Romania, currently active or recently active at senior team level, reflecting the diversity of professional roles: thirty-nine head coaches, eighteen assistant coaches and ten specialists (physical trainers, goalkeeper coaches, youth coordinators). Research was carried out in compliance with the ethical and academic deontology principles of the Doctoral School in Physical Education and Sport Science (ID: 28/21.02.2025) of the Pitești University Center within the National University of Science and Technology *Politehnica* Bucharest. Regarding the professional experience, twenty-three participants had 0–2 years of experience, sixteen had 3–5 years, eleven had 6–10 years and seventeen had over ten years of experience. This ensured a balanced representation of different expertise levels and facilitated the analysis of variability in functional monitoring practices and individualized training approaches.

Instrument and procedure

Data were collected through a sociological survey using a questionnaire applied between May and June 2025. The research instrument included twenty-one items structured into the following domains:

- identification of the professional profile of coaches;
- perceptions regarding physical and metabolic demands in elite handball;
- knowledge and use of functional monitoring methods;
- attitudes toward individualized training;
- open-ended questions for opinions and suggestions.

The questionnaire was validated through a pilot test applied to a small group of coaches to verify item clarity and completion time. The main application was conducted predominantly online, with voluntary and anonymous participation in accordance with ethical research principles.

Methods used

The study employed the following methods:

- bibliographic review, to provide a theoretical foundation and identify current trends in functional monitoring and individualized training in handball;
- direct observation, conducted by the author during training activities, to correlate empirical data with practical reality;
- sociological survey, used to collect perceptions of coaches and analyze the subjective dimension of the phenomenon studied.

Data analysis

Collected responses were verified for validity and completeness; the incomplete forms were excluded. A unified database was created and used for descriptive and correlation analyses to test the hypotheses and allow a scientific interpretation of the results.

3. Results and discussions

The analysis of the data obtained from the questionnaire administered to handball coaches provides a comprehensive overview of how they perceive and apply modern principles of functional monitoring, injury prevention and individualized training in elite handball.

Table 1. *Summary of the main results obtained from the questionnaire administered to handball coaches*

No.	Analyzed indicator	Main results	Interpretation
1	Professional status of respondents	58.2% head coaches; 26.8% assistant coaches	High representativeness of active professionals in performance handball
2	Competitive activity	67.2% active in the National League	Relevant sample for the elite performance level
3	Coaching experience	40% with more than 6 years of experience	Solid practical expertise
4	Frequency of functional testing	13.4% regularly; 55.2% occasionally	Partial integration of objective evaluation into training
5	Types of tests used	77.6% strength (1RM); 70.1% force platforms; 37.3% VO_2 max	Predominance of strength-oriented assessments; metabolic monitoring less frequent
6	Perceived usefulness of testing	90% consider them useful or very useful	Positive attitude toward performance monitoring
7	Individualization of training	97% consider it necessary	Strong theoretical acceptance of modern training principles
8	Load monitoring practices	46% regularly; 43% occasionally	Trend toward modernization, but uneven implementation
9	Most common injuries	49 knees; 36 ankle; 30 shoulder	High vulnerability in lower limb joints
10	Dominant energy system	62.7% anaerobic-lactic acid	Confirms the intermittent and explosive nature of handball
11	Priority motor quality	44.8% strength–speed	Emphasis on explosive capacities
12	Interest in national performance studies	86.6% consider them necessary; 89% would apply results	Openness toward applied research and interdisciplinary collaboration

The sample consisted predominantly of head coaches (58.20%) and assistant coaches (26.86%), with the majority holding active contracts in the National League (67.16%), which provides the study with a high level of representativeness (Fig. 1). From a professional experience perspective, a considerable proportion of respondents (over 40%) had more than six years of experience in the field, indicating a solid foundation of practical expertise.

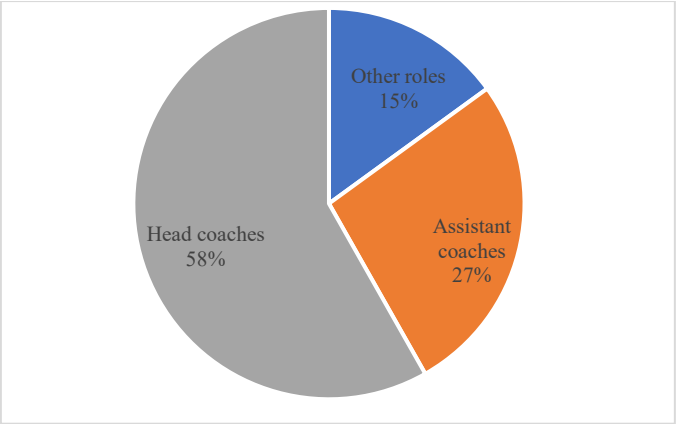


Fig. 1. *Professional status of respondents*

Regarding the use of functional testing, the results indicate that only 13.43% of coaches apply these evaluations constantly, while 55.22% use them occasionally, suggesting a limited integration of objective monitoring into the training process (Fig. 2). The most frequently employed assessment methods are strength tests (one-repetition maximum – 77.61%) and force platforms (70.14%), followed by metabolic evaluations such as VO_2 max testing (37.31%).

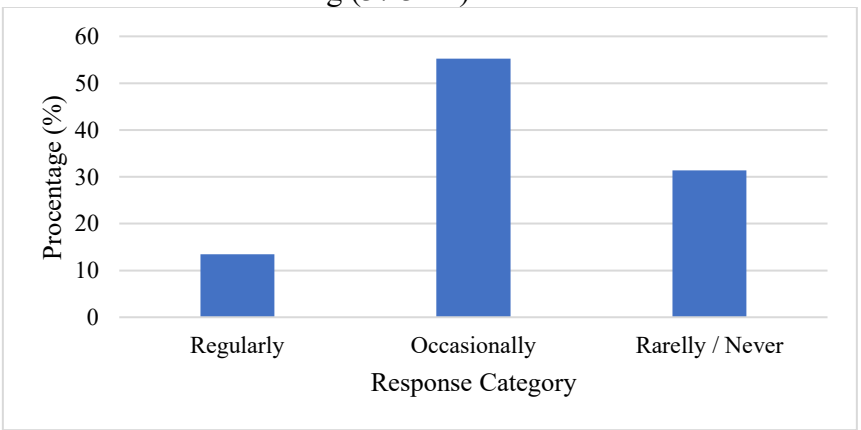


Fig. 2. *Frequency of functional testing*

The majority of respondents (over 90%) consider functional testing to be useful or highly useful for injury prevention and performance optimization. Also, 97% of coaches emphasize the necessity of personalizing training programs according to the

neuromuscular profile of athletes, highlighting a contemporary orientation toward individualized, data-driven training. As for training load monitoring, approximately 46% of participants report continually using objective indicators (volume, intensity, rating of perceived exertion, global positioning system), while 43% apply them occasionally. This underlines an upward trend in the adoption of modern technologies, although not yet uniformly implemented (Fig. 3).

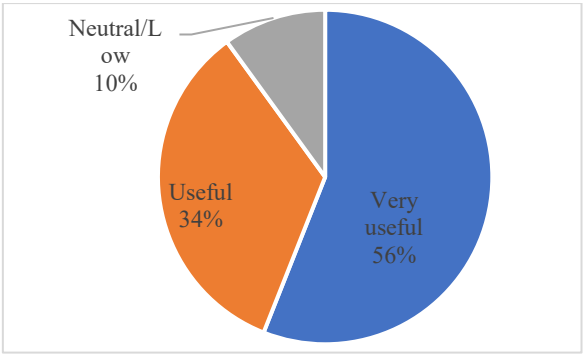


Fig. 3. *Perceived usefulness of functional testing*

Regarding the types of injuries, the most frequent are knee injuries (49 cases) and ankle sprains (36 cases), followed by shoulder problems (30 cases), confirming the high physical demands placed on the lower limbs and the shoulder girdle (Fig. 4). Additionally, 91% of coaches reported the occurrence of muscular injuries over the past three years, and 61% observed an increase in the total number of injuries over the last decade, reflecting the intensification of the physical and metabolic demands of modern handball.

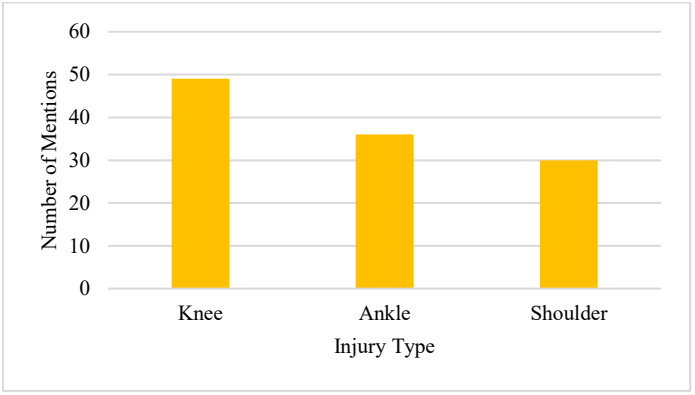


Fig. 4. *Distribution of the most common injuries*

Regarding the energy systems involved, 62.68% of coaches consider that handball-specific effort is predominantly supported by the anaerobic lactic system, followed by the anaerobic alactic system (26.87%), confirming the intermittent,

explosive and high-intensity nature of the sport. From the perspective of essential motor skills, speed-strength (44.77%) is perceived as a key determinant of competitive performance, followed by endurance and strength, which corroborates the current focus of training on the development of explosive abilities (Fig. 5).

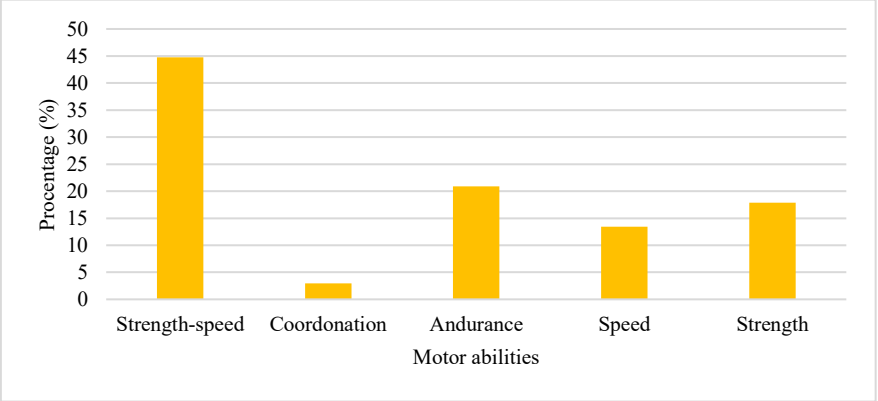


Fig. 5. *Priority motor abilities emphasized in performance handball*

The majority of respondents (86.56%) consider it relevant to conduct a national study on the neuromuscular and metabolic profile of Romanian handball players. Over 89% of the respondents show that they would use the results of the study in planning and adapting training programs. Qualitative analysis of the open-ended responses highlights the need for individualized training, continuous professional development for coaches, integration of specialists in physiotherapy and interdisciplinary collaboration between scientific and applied fields.

The analysis of handball coaches' responses indicates that, although there is a high level of awareness regarding the importance of functional monitoring and individualized training, the actual implementation of functional testing remains partial, with only 13.4% of coaches using these assessments regularly. This finding complies with the observations of Foster, Rodriguez-Marroyo and De Koning (2017), who pointed out that, in team sports, the systematic integration of training load monitoring is often limited despite theoretical recognition of its benefits.

Coaches' preference for strength tests (77.6%) and force platforms (70.1%) reflects a practical focus on assessing explosive capacities, a crucial aspect in high-performance handball (Michalsik et al., 2014; Dello Iacono et al., 2018). Metabolic assessments, such as VO_2 max testing, are used less frequently (37.3%), reflecting a potential gap between the physiological demands of the game and the implementation of metabolic evaluations. These results corroborate the findings of Póvoas et al. (2012) and García-Sánchez et al. (2023), which demonstrated that handball involves high-intensity intermittent efforts, alternating between anaerobic lactic and alactic phases with short aerobic periods. Therefore, a complex monitoring of physiological parameters is necessary.

Data regarding training load monitoring show that 46% of coaches consistently

use objective indicators, while 43% do so occasionally, suggesting an upward trend toward adopting modern technologies (GPS, RPE, biological monitoring), in line with the literature (Borresen & Lambert, 2009; Vanrenterghem et al., 2017). This approach supports the development of differentiated training programs tailored to playing positions and physiological characteristics, as underlined by Karcher & Buchheit (2014) and Manchado et al. (2013).

Regarding injury types, knee injuries and ankle sprains are predominant, followed by shoulder problems, reflecting the high demands on the lower limbs and shoulder girdle. These findings are consistent with Hermassi et al. (2017) and Jagielo (2020), who highlighted players' vulnerability in key joints during gameplay and the necessity for injury prevention programs based on neuromuscular control and joint stability.

Most coaches perceive handball-specific effort as dominated by the anaerobic lactic system (62.7%), followed by the anaerobic alactic system (26.87%), confirming the intermittent and explosive nature of the sport, as reported by Póvoas et al. (2012), Michalsik (2018) and Dello Iacono et al. (2018). Speed-strength is identified as the primary motor skill determining competitive performance (44.77%) and supporting the current orientation of physical training toward the development of explosive abilities and neuromuscular efficiency (Sañudo et al., 2019; Tyshchenko et al., 2025).

Finally, the high interest of coaches in national studies on the neuromuscular and metabolic profiles of Romanian handball players (86.56%) underlines openness to applied research and interdisciplinary collaboration. This perspective is supported by recent studies that recommend the integration of functional data into decision-making processes for performance improvement and injury prevention (Ezquerra Condeminas et al., 2024; Roa, 2024; Ji et al., 2024).

Thus, the results of our study reaffirm the relevance of functional monitoring, individualized training and evidence-based prevention principles, fully aligning with the existing international literature on physical preparation and applied physiology in high-performance handball.

4. Conclusions

1. The research confirms a high level of awareness among coaches regarding the importance of functional monitoring and individualized training for injury prevention and performance optimization.
2. The results highlight a discrepancy between the theoretical appreciation of functional testing and its consistent application in practical training.
3. There is a clear preference for the use of strength tests and force platforms, while metabolic and cardiovascular assessments are implemented less frequently.
4. The study emphasizes coaches' strong interest in individualizing training programs according to the neuromuscular and metabolic profiles of athletes.

5. The obtained data underscore the need to develop professional training programs, systematically implement functional testing, and apply evidence-based strategies to prevent injuries and optimize sports performance.

Bibliography

1. Borresen, J., & Lambert, M. I. (2009). The quantification of training load, the training response and the effect on performance. Sports Medicine, 39(9), 779–795.
2. Cesanelli, L., Ammar, A., Arede, J., Calleja-González, J., & Leite, N. (2022). Performance indicators and functional adaptive windows in competitive cyclists: Effect of one-year strength and conditioning training programme. Biology of sport, 39(2), 329-340.
3. Dello Iacono, A., Karcher, C., & Michalsik, L. B. (2018). Physical training in team handball. In Handball sports medicine: Basic science, injury management and return to sport (pp. 521-535). Berlin, Heidelberg: Springer Berlin Heidelberg.
4. Ezquerra Condeminas, P., Mallol, M., Font, R., Tremps, V., Gutiérrez, J. A., Rodas, G., ... & Soria, J. M. (2024). Unraveling athletic performance: Transcriptomics and external load monitoring in handball competition. PloS one, 19(3), e0299556.
5. Foster, C., Rodriguez-Marroyo, J. A., & De Koning, J. J. (2017). Monitoring training loads: the past, the present, and the future. International journal of sports physiology and performance, 12(s2), S2-2.
6. García-Sánchez, C., Navarro, R. M., Karcher, C., & de la Rubia, A. (2023). Physical demands during official competitions in elite handball: A systematic review. International journal of environmental research and public health, 20(4), 3353.
7. Halson, S. L. (2014). Monitoring training load to understand fatigue in athletes. Sports medicine, 44(Suppl 2), 139-147.
8. Henze, A. S., Kirsten, J., Matits, L., Bizjak, D. A., & Schulz, S. V. W. (2025). Athlete monitoring in handball (ATHMON HB): a systematic review protocol. Systematic Reviews, 14(1), 64.
9. Hermassi, S., Chelly, M. S., Fieseler, G., Bartels, T., Schulze, S., Delank, K. S., ... & Schwesig, R. (2017). Effects of in-season explosive strength training on maximal leg strength, jumping, sprinting, and intermittent aerobic performance in male handball athletes. Sportverletzung· Sportschaden, 31(03), 167-173.
10. Jagielo, A. (2020). Implementing an injury prevention program into the warm-up of semi-professional female handball players (Doctoral dissertation, Lietuvos sporto universitetas.).
11. Ji, B., et al. (2024). Design of physical function monitoring system for athletes in soccer training in college sports. Applied Mathematics and Nonlinear

Sciences, 9(1).
12. Karcher, C., & Buchheit, M. (2014). On-court demands of elite handball, with special reference to playing positions. Sports medicine, 44(6), 797-814.
13. Kashani, S. (2024). Task-based approach and game-specific exercises to develop physical components in youth soccer players (Bachelor's thesis). Haaga-Helia University of Applied Sciences.
14. Latino, F., & Tafuri, F. (2024). Wearable sensors and the evaluation of physiological performance in elite field hockey players. Sports, 12(5), 124.
15. Lv, X. (2025). The role and application of internal and external load indicators in monitoring fatigue in rugby players-a narrative review. Frontiers in Sports and Active Living, 7, 1654577.
16. Manchado, C., Tortosa-Martínez, J., Vila, H., Ferragut, C., & Platen, P. (2013). Performance factors in women's team handball: Physical and physiological aspects—A review. The Journal of Strength & Conditioning Research, 27(6), 1708-1719.
17. Michalsik, L. B. (2018). On-court physical demands and physiological aspects in elite team handball. In Handball sports medicine: Basic science, injury management and return to sport (pp. 15-33). Berlin, Heidelberg: Springer Berlin Heidelberg.
18. Michalsik, L. B., Madsen, K., & Aagaard, P. (2014). Match performance and physiological capacity of female elite team handball players. International Journal of Sports Medicine, 35(7), 595–607.
19. Naderi, A., Shaabani, F., Keikha, M., & Degens, H. (2024). Is an Exercise-Based Injury-Prevention Program Effective in Team Handball Players? A Systematic Review and Meta-Analysis. Journal of Athletic Training, 59(8), 845-856.
20. Pedlar, C. R., Newell, J., & Lewis, N. A. (2019). Blood biomarker profiling and monitoring for high-performance physiology and nutrition: current perspectives, limitations and recommendations. Sports Medicine, 49(Suppl 2), 185-198.
21. Póvoas, S. C. A., Seabra, A. F. T., Ascensão, A. A. M. R., Magalhães, J., Soares, J. M. C., & Rebelo, A. N. C. (2012). Physical and physiological demands of elite team handball. The Journal of Strength and Conditioning Research, 26(12), 3365–3375.
22. Roa, J. A. (2024). The Science of Peak Sports Performance: A Guide to the Assessment, Control, and Monitoring of Training. New York: Routledge.
23. Sañudo, B., Sánchez-Hernández, J., Bernardo-Filho, M., Abdi, E., Taiar, R., & Núñez, J. (2019). Integrative neuromuscular training in young athletes, injury prevention, and performance optimization: a systematic review. Applied Sciences, 9(18), 3839.
24. Sarmento, H., Martinho, D. V., Gouveia, É. R., Afonso, J., Chmura, P., Field, A., ... & Clemente, F. M. (2024). The influence of playing position on physical, physiological, and technical demands in adult male soccer matches: a systematic

scoping review with evidence gap map. Sports Medicine, 54(11), 2841-2864.
25. Tyshchenko, D., Diachenko, M., Tyshchenko, V., Sokolova, O., Veritov, O., Bubela, O. O., ... & Todorova, V. (2025). The effectiveness of blood flow restriction training in optimizing physiological indicators in elite female handball players. Journal of Physical Education and Sport, 25(1), 44-55.
26. Vanrenterghem, J., Nedergaard, N. J., Robinson, M. A., & Drust, B. (2017). Training load monitoring in team sports: a novel framework separating physiological and biomechanical load-adaptation pathways. Sports medicine, 47(11), 2135-2142.
27. Xu, H., Song, J., Li, G., & Wang, H. (2024). Optimal prescription for superior outcomes: a comparative analysis of inter-individual variability in adaptations to small-sided games and short sprint interval training in young basketball players. Journal of Sports Science & Medicine, 23(2), 305.

International Scientific Conference
„ Actualities and Perspectives of Physical Education and Sport Sciences", 2025

PSYCHOLOGICAL PROFILE OF ATTENTION AND CREATIVITY IN YOUNG FOOTBALL PLAYERS

Bogdan Oprea [1], Vladimir Potop [2], Julien Leonard Fleancu [3], Gheorghe Gabriel Cucui [4], Toni Lupu [5], Diana Ciobanu [6]

[1,2] *Doctoral School of Sports Science and Physical Education, University Center Pitești, National University of Science and Technology Polytechnic Bucharest, Romania*
[1] *School Sports Club No. 1, Bucharest, Romania*
[2]*Institute of Physical Education and Sports, Moldova State University, Chisinau, Republic of Moldova*
[2,3]*University Center Pitești, National University of Science and Technology Politehnica Bucharest, Romania*
[3] *Valahia University of Targoviste, Romania*
[5,6] *Middle School no. 20 of Bucharest, Romania*

Abstract

The present study aimed to explore the psychological profile of attention and creativity in young football players aged 10 to 12 years, emphasizing the cognitive and emotional mechanisms that support learning efficiency, tactical adaptability and creative performance. A total of 25 athletes from the School Sports Club No. 1 in Bucharest participated in the research. Standardized instruments were applied to assess attentional regulation and creative potential. The data were analyzed using KyPlot 6.0 software to calculate descriptive and reliability indicators. Results revealed a balanced attentional profile characterized by moderate distractibility and individual variability in concentration and cognitive control. In terms of creativity, players demonstrated a moderate to high level of autonomy and self-expression, alongside differences in divergent thinking and relational influences. These findings highlight the interdependence between attention and creativity as essential psychological constructs for talent development in football. The study supports the implementation of integrated educational and psychological programs that strengthen attentional control while promoting creative expression and decision-making flexibility in young athletes.

Key words: *attention, creativity, young athletes, football, cognitive development*

1. Introduction

The development of psychological abilities in young athletes represents a central component of contemporary sports science, as mental and cognitive factors significantly influence learning efficiency, tactical flexibility and performance stability during competition. Among these, attention and creativity are two key psychological constructs that determine not only the quality of information processing but also the player's ability to adapt and respond effectively to dynamic and unpredictable game situations (Memmert, 2011; Fardilha, 2021).

In youth football, where cognitive maturation coincides with the consolidation of fundamental technical–tactical skills, these dimensions are especially relevant for

optimizing training and supporting long-term athlete development. Studies have shown that attention and creativity are closely associated with cognitive flexibility, decision-making and game intelligence; all these contribute to more adaptable and innovative play patterns (Scharfen & Memmert, 2019; Reinhard et al., 2025). Furthermore, recent meta-analytic evidence highlights that systematic football training significantly enhances executive functions, including attention regulation and creative problem solving (Mao et al., 2024).

At the same time, the integration of interdisciplinary programs—such as those combining creative dance and football—has been shown to improve not only concentration and attention but also overall cognitive flexibility in children aged 9–10 years (Tokay & Akil, 2025). Similarly, specialist opinions emphasize the pedagogical importance of stimulating attention and creativity in football training for children aged 10–12 years, as these skills facilitate more effective technical and tactical learning (Oprea et al., 2023). Collectively, these findings underscore the vital role of psychological development as a foundation for both performance and long-term athlete growth in football.

Attention is essential for maintaining focus, selecting relevant stimuli and sustaining effortful concentration throughout the game. Young players aged 10 to 12 years are at a developmental stage where the attentional system is still maturing. That is why the fluctuations in concentration and the susceptibility to distraction are particularly common at this age. The ability to maintain attentional stability under external pressure or during prolonged cognitive and motor demands represents a crucial factor for both learning efficiency and situational awareness on the field.

According to Logue and Gould (2014), attention constitutes a fundamental component of executive functions, alongside cognitive flexibility and response inhibition, processes that depend on the coordinated activity of dopaminergic and noradrenergic systems. The ability to flexibly shift attention is linked to an athlete's adaptability and capacity to process multiple sources of information simultaneously (Bukowski et al., 2024). Furthermore, self-control plays a decisive role in sustaining attention during demanding or stressful situations, as it enables athletes to inhibit impulsive reactions and maintain goal-oriented focus (Mischel & Ayduk, 2002; Bertrams et al., 2013).

Positive affect has also been shown to facilitate self-regulation and attentional control, because it enhances the flexibility of cognitive processes and increases motivation for task engagement (Isen, 2007). In addition, self-regulatory models emphasize that attention, cognitive flexibility and self-control are mutually reinforcing: improved flexibility supports better attention shifting, while high self-control promotes sustained concentration (Walwanis & Ponto, 2019; Tang et al., 2022). Recent studies further indicate that targeted psychological or mindfulness-based interventions can enhance both attentional control and cognitive flexibility, leading to improved performance consistency and emotional stability in young

athletes (Hartkamp & Thornton, 2017; Bahadorikhosroshahi et al., 2025).

Together, these findings highlight that attention in youth sports should not be treated as an isolated skill but rather as a dynamic process integrated with motivation, affect and self-control mechanisms. By developing these interrelated psychological components, young football players can better manage cognitive load, adapt to game complexity and sustain optimal performance throughout training and competition.

2. Material and method

The primary objective of this study was to identify and characterize the psychological profile of attention and creativity in 10–12-year-old football players, aiming to reveal specific cognitive and emotional patterns that may influence training efficiency and creative decision-making during gameplay. By integrating quantitative assessments of attentional regulation with evaluations of creative potential, the research sought to offer a comprehensive psychological framework relevant to the early stages of performance development.

The study sample consisted of 25 male football players, aged 10 to 12 years, members of the School Sports Club No. 1, Bucharest. Prior to participation, informed parental consent was obtained in accordance with the ethical principles of the Helsinki Declaration. The research protocol was approved by the Ethics Committee of the Doctoral School of Sport Science and Physical Education (ID:27/14.02.2025), within the University Center of Pitești, Romania.

Two standardized instruments were used to assess and monitor the psychological indicators of attention and creativity among participants.

Attention monitoring instrument.

Attention was assessed using a standardized monitoring scale adapted from Wolraich et al. (1998). The questionnaire included 9 items rated on a 5-point Likert scale (0 = never, 1 = sometimes, 2 = occasionally, 3 = frequently, 4 = very frequently), designed to evaluate manifestations of attentional difficulties. Items were grouped into thematic subscales for detailed interpretation:

- D – Distractibility and Attention Maintenance (Items 1, 2, 9): measures ease of distraction, boredom and task engagement.
- CU – Concentration and Detail Tracking (Items 4, 5, 8): assesses the ability to focus on details, follow conversations and understand complex instructions.
- CC – Compensatory Behaviors and Task Difficulties (Items 3, 7): evaluates compensatory strategies (for example, multitasking) and difficulties in completing academic or reading tasks.
- OM – Organization and Memory (Item 6): measures disorganization and forgetfulness.

The total score (sum of all items) provides a global indicator of attentional performance, interpreted according to established thresholds: 0–15 = normal

attention; 16–25 = moderate difficulties; 26–30 = attention problems; >30 = severe attention deficits. Data were processed using SPSS 21.

Creativity assessment questionnaire

Creativity was measured using an adapted version of the manual written by Teresa M. Amabile "Creativity as a Way of Life" (1997). The questionnaire consisted of 35 items. The initial internal consistency (Cronbach's α = 0.124) indicated low reliability; therefore, the items were reorganized into three subscales for conceptual coherence:

- A – Autonomy and Freedom of Expression (14 items; max score 14): >11 = high, 8–11 = moderate, <8 = low.
- S – Creative Stimulation and Divergent Thinking (12 items; max score 12): >9 = permissive, 6–9 = balanced, <6 = restrictive.
- R – Relationship and Control (9 items; max score 9): >7 = very good, 5–7 = good, <5 = poor.

The total creativity score (sum of all 35 items) ranged between 17 and 28, where values above 26 indicated a highly favorable creative environment.

Statistical analysis was performed employing KyPlot 6.0 software (KyensLab Inc.), which enabled the calculation of descriptive indicators (mean, standard deviation, coefficient of variation) and reliability coefficients (Cronbach's α) to evaluate the internal consistency and variability of the measured psychological dimensions.

3. Results and discussions

Tables 1 and 2 summarize the descriptive and reliability statistics for the psychological indicators of attention and creativity in 10–12-year-old football players (n = 25), reflecting both cognitive regulation and expressive potential in the learning process.

Table 1. ***Results of the evaluation of attention psychological indicators***

Ind. stat.	Subscale				Total Attention Score
	D	**CU**	**CC**	**OM**	
Mean	6.00	4.80	2.08	1.16	14.24
±SD	1.83	2.57	1.12	0.69	5.51
CV(%)	30.43	53.45	53.61	59.31	38.69
Cronbach's (α)	0.747				

Notes: Distractibility (D), Concentration and Tracking (CU), Compensatory Behaviors (CC), Organization and Memory (OM)—as well as the Total Attention Score

Table 2. *Results of the evaluation of the creativity psychological indicators*

Ind. stat.	Subscale			Total Creativity Score
	A	**S**	**R**	
Mean	9.92	5.68	7.07	22.64
±SD	2.71	2.30	1.49	5.30
CV(%)	27.29	40.57	21.10	23.40
Cronbach's (α)	0.707			

Notes: A (Autonomy) – Autonomy and freedom of expression, S (Structure) – Creative stimulation and divergent thinking, R (Relatedness) – Constraints and control.

Regarding attention, the overall mean score was M = 14.24 ± 5.51, with a Cronbach's α of 0.747, indicating satisfactory internal consistency of the assessment instrument. Among the subscales, Distractibility (D) obtained the highest mean (M = 6.00 ± 1.83; CV = 30.43%), suggesting a moderate tendency toward attentional fluctuation and external stimulus sensitivity. The Concentration and Tracking (CU) subscale had a mean of 4.80 ± 2.57 and a higher variability (CV = 53.45%), pointing to individual differences in the ability to sustain focus on complex or prolonged tasks.

Compensatory Behaviors (CC) showed a low mean score (M = 2.08 ± 1.12; CV = 53.61%), highlighting a limited use of self-regulatory strategies to counter attentional difficulties. The Organization and Memory (OM) presented the lowest values (M = 1.16 ± 0.69; CV = 59.31%), which signifies that only a few players experience substantial problems in organization or task memory. Collectively, these data describe a balanced attentional profile, with moderate distractibility and variability mainly in the cognitive control dimensions.

For creativity, the overall mean score was M = 22.64 ± 5.30, with Cronbach's α = 0.707, also reflecting acceptable internal consistency and homogeneity across the three subscales. The Autonomy (A) dimension—defined as freedom of expression, initiative and independent thinking—recorded the highest mean (M = 9.92 ± 2.71; CV = 27.29%), underscoring that young players exhibit a strong tendency toward personal initiative and self-expression during creative play. The Structure (S) subscale, associated with cognitive stimulation and divergent thinking, had a lower mean (M = 5.68 ± 2.30; CV = 40.57%), indicating variability in the perceived level of creative support provided by training environments. Finally, the Relatedness (R) component, about perceived external constraints and relational control, had a mean of M = 7.07 ± 1.49 and the lowest variability (CV = 21.10%), suggesting a relatively uniform perception of relational influence on creative behavior.

Taken together, these findings define a moderate-to-high level of creative potential and a balanced attentional profile among players, consistent with the developmental characteristics of this age group. The results reinforce that attentional

regulation and creativity are interdependent concepts, both essential for enhancing decision-making, tactical intelligence and adaptive behavior in football (Memmert & Roca, 2019; Huijgen et al., 2015; Reinhard et al., 2025).

In line with previous research, the presence of higher autonomy scores reflects an athlete-centered and exploratory approach in training, which supports intrinsic motivation and self-directed creative actions (Light et al., 2014; Memmert, 2017; Kolar et al., 2025). Meantime, variability in attentional concentration and divergent thinking may signal developmental differences in executive functioning, attention shifting and motivational engagement (Beavan, 2021; Mao et al., 2024).

Therefore, strengthening attentional control through targeted cognitive–behavioral and mindfulness interventions, while maintaining freedom of expression and problem-solving opportunities in training, can optimize both psychological adaptability and tactical creativity (Bahadorikhosroshahi et al., 2025; Chaeroni et al., 2024). Such integrative educational strategies align with the principles of modern talent development, promoting young footballers capable of autonomous, innovative and contextually effective performance (Sarmento et al., 2018; Beckmann & Beckmann-Waldenmayer, 2019; Mazzoccante et al., 2019).

4. Conclusions

The findings point out a generally balanced attentional profile among young football players, characterized by moderate distractibility and variability in concentration and tracking abilities. This suggests that attentional control mechanisms are still developing during this age period, with some players exhibiting greater cognitive stability than others.

The creativity assessment revealed a predominant orientation toward autonomy, reflecting a strong inclination for self-expression, initiative and independent problem-solving during play. Such characteristics align with athlete-centered developmental environments that encourage exploration and decision-making freedom.

The lower and more variable scores on the Structure dimension indicate that players perceive differing levels of creative stimulation and opportunities for divergent thinking during training. This underlines the importance of coaching strategies that actively promote cognitive challenge and open-ended tactical exploration.

The joint analysis of attention and creativity highlights a close interrelation between these constructs - where effective attentional control supports flexible, adaptive and innovative responses on the playing field. Integrating attentional training with creativity-enhancing pedagogical methods may thus optimize both cognitive efficiency and tactical intelligence in youth football development.

Bibliography

1. Amabile, T. M. (1997). Entrepreneurial creativity through motivational synergy. *The journal of creative behavior*, 31(1), 18-26.
2. Bahadorikhosroshahi, J., Hosseini, M., & Jalali, N. (2025). The role of selective attention, cognitive flexibility and self-directed learning in predicting the balance of possible selves in students. *Journal of Modern Psychology, University of Tabriz*.
3. Beavan, A. F. (2021). Perceptual-cognitive assessments in football. ProQuest.
4. Beckmann, J., & Beckmann-Waldenmayer, D. (2019). Talent development in youth football. In *Football psychology* (pp. 145–162). Taylor & Francis.
5. Bertrams, A., Englert, C., Dickhäuser, O., & Baumeister, R. F. (2013). Role of self-control strength in the relation between anxiety and cognitive performance. Emotion, 13(4), 638–644. https://doi.org/10.1037/a0031921
6. Bukowski, M., Śpiewak, S., Różańska, A., & Gruszka, A. (2024). Personal control and cognitive flexibility: Does uncontrollability reduce flexible shifting of attention? Learning and Motivation, Elsevier.
7. Chaeroni, A., Gusril, G., Talib, K., & Mashuri, M. (2024). Improving soccer coaching: Considerations of individual learning styles, intelligence levels, and motivation. Revista de Investigación en Educación Física y Deporte, Universidad de La Rioja.
8. Fardilha, F. (2021). Exploring creative development in professional youth football academies through an integrative transdisciplinary lens. University of Stirling.
9. Hartkamp, M., & Thornton, I. M. (2017). Meditation, cognitive flexibility and well-being. Journal of Cognitive Enhancement, 1(2), 156–166. https://doi.org/10.1007/s41465-017-0011-5
10. Huijgen, B. C. H., Leemhuis, S., Kok, N. M., Verburgh, L., Oosterlaan, J., Elferink-Gemser, M. T., & Visscher, C. (2015). Cognitive functions in elite and sub-elite youth soccer players aged 13 to 17 years. PLOS ONE, 10(12), e0144580.
11. Isen, A. M. (2007). Positive affect, cognitive flexibility, and self-control. In R. Wyer Jr. (Ed.), Persons in context: Building a science of the individual (pp. 281–304). Psychology Press.
12. Kolar, E., Biloslavo, R., Pišot, R., & Veličković, S. (2025). Conceptual framework of coaches' decision-making in conventional sports. Frontiers in Psychology.
13. Light, R. L., Harvey, S., & Mouchet, A. (2014). Improving "at-action" decision-making in team sports through a holistic coaching approach. Sport, Education and Society, 19(3), 258–275. https://doi.org/10.1080/13573322.2012.665803
14. Logue, S. F., & Gould, T. J. (2014). The neural and genetic basis of executive function: Attention, cognitive flexibility, and response inhibition. Pharmacology

Biochemistry and Behavior, 123, 45–54. https://doi.org/10.1016/j.pbb.2013.08.007
15. Mao, F., Yin, A., Zhao, S., & Fang, Q. (2024). Effects of football training on cognitive performance in children and adolescents: A meta-analytic review. Frontiers in Psychology.
16. Mazzoccante, R. P., Corrêa, H. L., Queiroz, J. L., & Castro, G. R. (2019). The relationship of sports practice with motor performance, selective attention, cognitive flexibility and processing speed in children aged 7 to 10 years. Journal of Human Growth and Development, 29(2), 174–181.
17. Memmert, D. (2011). Creativity, expertise, and attention: Exploring their development and their relationships. Journal of Sports Sciences, 29(1), 93–102.
18. Memmert, D. (2017). Coaching tactical creativity in team sports. In S. Kidman & D. Hanrahan (Eds.), Perspectives on Athlete-Centred Coaching (pp. 165–178). Taylor & Francis.
19. Memmert, D., & König, S. (2019). Models of game intelligence and creativity in sport: Implications for skill acquisition. In D. Farrow et al. (Eds.), Skill Acquisition in Sport (3rd ed., pp. 373–388). Routledge.
20. Memmert, D., & Roca, A. (2019). Tactical creativity and decision making in sport. In A. Roca & D. Memmert (Eds.), Anticipation and Decision Making in Sport (pp. 201–219). Routledge.
21. Mischel, W., & Ayduk, O. (2002). Self-regulation in a cognitive–affective personality system: Attentional control in the service of the self. Self and Identity, 1(2), 113–120. https://doi.org/10.1080/152988602317319285
22. Oprea, B., Fleancu, J.L., & Mihailescu, L.E. (2023). Study on the opinion of specialists related to the role of attention capacity and creativity in football game in children aged 10–12 years. International Scientific Conference, IDSI.
23. Reinhard, M. L., Mann, D. L., & Höner, O. (2025). An empirical investigation into the association between generic and sport-specific cognitive skills and playing level in youth football. Journal of Science and Medicine in Sport, Elsevier.
24. Sarmento, H., Anguera, M. T., Pereira, A., & Araújo, D. (2018). Talent identification and development in male football: A systematic review. Sports Medicine, 48(4), 907–931.
25. Scharfen, H. E., & Memmert, D. (2019). The relationship between cognitive functions and sport-specific motor skills in elite youth soccer players. Frontiers in Psychology, 10, 927.
26. Tang, Y. Y., Tang, R., Posner, M. I., & Gross, J. J. (2022). Effortless training of attention and self-control: Mechanisms and applications. Trends in Cognitive Sciences, 26(3), 231–243. https://doi.org/10.1016/j.tics.2021.12.005

27. Tokay, B., & Akil, M. (2025). "Creative dance and football" education program improves cognitive skills of 9–10-year-old school children. Research in Dance Education, Taylor & Francis.
28. Walwanis, M. M., & Ponto, S. J. (2019). Clarifying cognitive flexibility from a self-regulatory perspective. In International Conference on Human-Computer Interaction (pp. 321–333). Springer.
29. Wolraich, M.L., Feurer, I.D., Hannah, J.N., Baumgaertel. A., & Pinnock, T.Y. (1998). Obtaining systematic teacher reports of disruptive behavior disorders utilizing DSM-IV. J Abnorm Child Psychol. 26(2),141-52.

ANALYSIS OF THE RELATIONS BETWEEN BIPEDAL DYNAMIC BALANCE INDICATORS IN YOUNG FENCERS

Simona Georgiana Popa [1], Vladimir Potop [2], Ilie Mihai [3], Paul Liviu Pavel [4]

[1,2]*Institute of Physical Education and Sports, Moldova State University, Chisinau, Republic of Moldova*
[1]*"Mircea Sântimbreanu" Secondary School, Bucharest, Romania*
[2,3]*University Center Pitești, National University of Science and Technology Politehnica Bucharest, Romania*
[4]*Middle school no. 136, Bucharest, Romania*

Abstract

The aim of this study was to examine bipedal dynamic balance performance in young fencers aged 12 to 14 years, focusing on inter-limb asymmetries and intra-segmental correlations as indicators of postural control efficiency. The research was conducted at the Quatro Bucharest Fencing Club in May 2024, using the Sensamove MiniBoard platform to assess dynamic balance parameters, including performance and average deviation in anterior, posterior, medial and lateral directions. Statistical analysis was carried out by means of descriptive, comparative and correlation methods, with significance established at $p < 0.05$. The results revealed significant asymmetries between the right and left leg, with superior stability observed on the dominant limb. Strong positive correlations between bilateral performance indicators confirmed the presence of coordinated sensorimotor adaptation, while mediolateral parameters exhibited higher individual variability. These findings emphasize the importance of integrating unilateral and proprioceptive balance training into fencing programs to enhance postural symmetry and optimize motor efficiency. Overall, the study highlights the essential role of balance control in improving technical execution and preventing injuries in young athletes.

Key words: *dynamic balance, postural control, fencing performance, inter-limb asymmetry, young athletes*

1. Introduction

Balance represents a fundamental component of motor control and a decisive factor in optimizing performance across numerous sports disciplines. In the case of fencing, a sport characterized by rapid directional changes, asymmetrical stances and complex postural adjustments, the ability to maintain and control balance under dynamic conditions is very important for both technical precision and movement efficiency. Research demonstrates that targeted training programs, including proprioceptive exercises, Pilates, yoga and sensorimotor interventions can significantly enhance dynamic balance, core stability and neuromuscular control in fencing athletes (Niță & Magyar, 2023; Sundaraketu & Bupha-intr, 2025; Lim et al., 2024; de Vasconcelos et al., 2020). Additionally, the use of modern technologies such as Internet of Things (IoT) devices and real-time sensorial feedback has shown encouraging outcomes for refining balance and movement control in young fencers (Niță & Magyar, 2023).

Dynamic balance, in particular, enables athletes to sustain postural stability while performing attacks, retreats, and feints, directly influencing the success of both offensive and defensive actions (Sundaraketu & Bupha-intr, 2025; Varesco et al., 2024). Improvements in dynamic balance, alongside strength and power, have been shown to intensify the ability of athletes to transition efficiently between defensive and offensive movements (Çingöz et al., 2023; Niță & Magyar, 2023). Observational studies on elite fencers confirm that postural control is essential for executing complex actions and minimizing injury risk (Di Martino et al., 2024).

The bipedal dynamic balance refers to the coordinated control of the center of gravity in human body over the base of support when both feet are in contact with the ground. Although fencing predominantly involves asymmetrical stances, bipedal stability plays a critical role during transitional phases - such as preparation, recovery and rhythm control - where postural readjustment and weight transfer are necessary. Maintaining optimal balance during these phases reduces technical errors, enhances reaction time and improves movement economy (Akbaş et al., 2024; Chen et al., 2017).

From a biomechanical perspective, dynamic balance performance relies on the integration of multisensory inputs - visual, vestibular and proprioceptive - together with neuromuscular coordination and anticipatory postural adjustments that ensure efficient motor control (Yarayan et al., 2025; de Vasconcelos et al., 2020). These sensory and motor systems are still developing in young fencers, making balance training a key component of both technical learning and injury prevention (Abdelkader et al., 2021; Di Martino et al., 2024). Therefore, early identification of balance characteristics provides valuable diagnostic information for coaches, supporting individualized training programs designed to optimize postural control and performance (Yılmaz et al., 2024; Szabo et al., 2021).

Analyzing bipedal dynamic balance indicators offers insight into the interaction between stability and mobility—two seemingly opposing but complementary aspects of fencing performance. Understanding these relations can reveal how athletes control their posture under dynamic constraints and whether balance asymmetries or variability patterns are linked to training experience, lateral dominance or performance level.

Accordingly, the present study aims to analyze the relationship between bipedal dynamic balance indicators in young fencers, with the objective of identifying specific balance control characteristics and potential correlations between performance indicators.

2. Material and method

This study intended to assess vertical dynamic bipedal balance in 12–14-year-old fencers. A cross-sectional investigation was carried out at the Quatro Bucharest Fencing Club in May 2024. This research is part of the doctoral program conducted

at the Faculty of Physical Education and Sports, Moldova State University (Republic of Moldova), in collaboration with the Research Center for Human Performance of the University of Pitești (Romania).

Balance performance was assessed by means of the Sensamove MiniBoard platform, which enables precise measurement of postural control parameters under dynamic conditions. The recorded variables included overall balance performance (%), right and left inside (%), average deviation in the anterior and posterior directions (degrees), average deviation in the left and right directions (degrees) and weight distribution between the lower limbs (left/right). The testing protocol consisted of a 10-second dynamic balance trial with a maximum tilt angle of 10 degrees, simulating controlled postural challenges.

Statistical analysis was performed with the help of the KyPlot 6.0 software, applying descriptive and comparative indicators, as well as a paired-samples t-test (Paired Comparison for Means). The level of statistical significance was set at $p < 0.05$. The Shapiro–Wilk test was used to verify data normality. Variables with $p > 0.05$ were considered normally distributed and analyzed using the paired-samples t-test, whereas variables that did not meet the normality assumption ($p < 0.05$) were examined by means of the non-parametric Wilcoxon signed-rank test.

3. Results and discussions

This section presents the results and discussion highlighting the specific features of vertical dynamic bipedal balance in young fencers, with emphasis on inter-limb differences and the correlation of key postural control parameters.

Table 1. *Descriptive and comparative analysis of bipedal balance parameters in young fencers*

Indicators / Parameters	mean		MD		Cv (%)		CLM (0.95)		QR			
	RL	**LL**	**RL**	**LL**	**RL**	**LL**	**RL**	**LL**	**RL**	**LL**	**t-test**	**P -val**
Perform. (%)	95.71	90.64	5.36	9.93	6.5	12.6	3.61	6.59	16	36	2.51*	0.026
Left, inside (%)	24.79	56.93	14.78	17.62	72.5	35.8	10.37	11.78	60	62	-3.82**	0.002
Right, inside (%)	70.93	33.86	15.33	22.00	25.9	73.0	10.61	14.27	65	69	4.14**	0.0012
Front, avg. dev. (degrees)	4.39	5.32	0.68	0.61	18.9	14.1	0.48	0.43	3.03	2.45	-4.14**	0.0012
Back, avg. dev (degrees)	-5.11	-5.47	0.47	0.76	12.6	17.3	0.37	0.55	2.79	3.54	1.93	0.075
Left, avg. dev. (degrees)	-0.44	-0.88	0.25	0.39	69.0	50.2	0.17	0.26	1.0	1.54	3.15	0.008
Right, avg. dev. (degrees)	0.90	0.60	0.34	0.35	47.7	72.8	0.25	0.25	1.61	1.56	1.70	0.114

Notes: MD - Mean Deviation; CLM (0.95) - Confidence Level of Mean (0.95); QR - Quartile Range; Perf. – performance, dev.- deviation, RL – right leg, LL – left leg.

Table 1 presents the descriptive and comparative analysis of the bipedal dynamic balance parameters in young fencers, focusing on the differences between the right and left leg. The overall performance indicator showed a statistically significant difference ($t = 2.51$, $p = 0.026$), with higher stability values recorded for the right leg ($M = 95.71\%$) compared to the left leg ($M = 90.64\%$). This finding suggests a slightly superior balance control and motor dominance of the right leg, which is consistent with the laterality profile generally observed in fencing.

The percentage of movement deviations inside the base of support revealed significant asymmetries. For the left-inside deviation, values were considerably higher for the left leg ($M = 56.93\%$) compared to the right leg ($M = 24.79\%$), ($t = -3.82$, $p = 0.002$), reflecting a greater medial instability when support is shifted toward the non-dominant limb. Conversely, the right-inside deviation was significantly higher for the right leg ($M = 70.93\%$) than for the left one ($M = 33.86\%$), ($t = 4.14$, $p = 0.0012$), pointing out a compensatory stabilization pattern, possibly associated with habitual postural asymmetry in fencing stance.

Regarding the mean angular deviations, the front deviation showed significant differences ($t = -4.14$, $p = 0.0012$), with the left leg ($M = 5.32°$) presenting larger anterior oscillations compared to the right leg ($M = 4.39°$). This may indicate a reduced ability of the left leg to control forward balance shifts, especially during rapid fencing movements that require anterior–posterior stability. The back deviation was not statistically significant ($p = 0.075$), which reflects relatively similar posterior stability in both limbs.

In terms of lateral deviation indicators, the left average deviation was significantly greater for the left leg ($M = -0.88°$) than for the right one ($M = -0.44°$), ($t = 3.15$, $p = 0.008$), while the right average deviation did not differ significantly ($p = 0.114$*). These results confirm the presence of functional asymmetry: the non-dominant lower limb (left one) has a higher mediolateral oscillation, suggesting lower proprioceptive precision and neuromuscular control efficiency.

The results underscored clear inter-limb differences in dynamic balance performance, revealing the dominance of the right leg in stabilizing posture and controlling center-of-mass oscillations. Such asymmetries are characteristic of fencing, a sport defined by highly unilateral stances and repetitive motor patterns that promote superior neuromuscular coordination on the dominant side (Herpin et al., 2010; Abdelkader & Brown, 2021). Higher performance scores and lower deviation values in the right leg prove more efficient postural adaptation and refined motor control, most likely due to the primary role of the right leg in maintaining balance during offensive and defensive movements (Akbaş et al., 2024; Di Martino et al., 2024).

Conversely, the increased medial and anterior deviations observed in the left leg reflect a need for specific proprioceptive and sensorimotor training to reduce bilateral asymmetries. Targeted exercises focused on dynamic stabilization and

neuromuscular feedback could improve transition efficiency between attack and recovery phases, enhancing postural control and minimizing compensatory mechanisms (Niță & Magyar, 2023; Yılmaz et al., 2024). These findings are consistent with previous research indicating that dynamic balance is a decisive component in optimizing technical precision and movement economy in fencing (Chen et al., 2017; Sundaraketu & Bupha-intr, 2025).

Table 2 presents the intra-segmental correlation analysis between the right and left leg parameters for bipedal dynamic balance in young fencers. The results reveal significant associations between specific postural components, highlighting functional interdependence in the mechanisms of bilateral stabilization.

Table 2. *Intra-segmental correlation analysis of vertical bipedal dynamic balance in young fencers*

Parameters	Right leg parameters						
Left leg parameters	Perf. (%)	Left, inside (%)	Right, inside (%)	Front, avg. dev. (degree)	Back, avg. dev. (degree)	Left, avg. dev. (degree)	Right, avg. dev. (degree)
R	0.786	-0.340	-0.190	0.432	0.694	0.011	-0.166
P	0.0008***	0.2337	0.514	0.123	0.005**	0.969	0.571

The strongest positive correlation was identified between the overall performance scores of the right and left leg ($r = 0.786$, $p = 0.0008$***), reflecting a high degree of bilateral coherence in postural control. This result shows that the efficiency of balance mechanisms developed on the dominant leg is proportionally associated with similar control on the contralateral leg. In practical terms, fencers who demonstrate superior stability on the right leg also tend to maintain a comparable level of performance on the left, thanks to effective neuromuscular integration and intersegmental coordination.

A second significant association was observed between the posterior average deviation of the right and left leg ($r = 0.694$, $p = 0.005$**). This finding points to a synchronized biomechanical control in the sagittal plane, suggesting that postural regulation mechanisms act in a coordinated manner bilaterally. This fact is particularly relevant in the fencing guard position, where antero–posterior stability is essential.

The remaining correlations (e.g., between lateral deviations and performance parameters) did not reach statistical significance ($p > 0.05$), which reveals high individual variability in mediolateral control and potential influences of functional laterality.

Intra-segmental correlation analysis underscored a strong relationship between overall performance and bilateral stability of the lower limbs, confirming the major role of sensorimotor integration in maintaining dynamic balance among young fencers. The strong positive associations between performances of both legs prove

that, despite the unilateral dominance typical of fencing actions, sport-specific training contributes to coordinated co-activation of stabilizing musculature, thereby minimizing functional asymmetries (Abdelkader & Brown, 2021; de Vasconcelos et al., 2020).

The significant correlations between posterior deviations indicate a shared adaptation of postural control strategies in the antero–posterior plane, likely reflecting the biomechanical demands of fencing, which requires continuous forward–backward adjustments in the guard stance (Akbaş et al., 2024; Di Martino et al., 2024). In contrast, the lack of significant correlations in mediolateral parameters suggests that lateral stability is more dependent on local neuromuscular control and individual motor characteristics (Herpin et al., 2010; Niță & Magyar, 2023).

These results confirm that during the formative stage of development (ages 10–14), fencing practice enhances bilateral coordination and postural control; however, the persistence of asymmetries in mediolateral stability highlights the need for corrective training. Unilateral balance exercises and tasks performed on unstable surfaces can effectively improve bilateral symmetry and stability efficiency (Wahhab, 2024; Szabo et al., 2021; Yarayan et al., 2025).

Generally, the findings confirm that bipedal dynamic balance represents a critical determinant of technical performance in young fencers. Enhancing balance symmetry, postural control and neuromotor coordination through targeted interventions may significantly improve movement efficiency stability, and competitive results (Niță & Magyar, 2023; Yılmaz et al., 2024; Yarayan et al., 2025). These insights reinforce the importance of systematic balance assessment and individualized training strategies as integral components of long-term athlete development in fencing.

4. Conclusions

The findings of this study emphasize the presence of notable asymmetries between the right and left leg in several parameters of dynamic bipedal balance, with superior stability typically observed in the dominant limb. These differences show the importance of bilateral assessment in identifying postural imbalances that may influence technical execution efficiency and increase the risk of overuse injuries in young fencers.

The strong positive correlation between right and left leg performance reflects a well-developed bilateral postural control system, suggesting that dynamic balance regulation operates through coordinated inter-limb mechanisms. Moreover, the significant association between posterior deviations in both limbs reveals a shared control strategy in the sagittal plane, which is essential for maintaining stability during forward and backward fencing movements.

On the contrary, the absence of significant relationships in mediolateral parameters reveals a higher degree of individual variability and localized neuromuscular control, underscoring the need for targeted interventions. Therefore, incorporating unilateral and asymmetry-corrective balance exercises into fencing training programs is recommended to promote postural symmetry, improve movement efficiency and support long-term motor development.

Bibliography

1. Abdelkader, N., Brown, S. H. M., et al. (2021). Dynamic balance is similar between lower extremities in elite fencers. Journal of Sports Sciences, [PMC].
2. Akbaş, A., Marszałek, W., Bacik, B., & Juras, G. (2024). Influence of base of support on early postural adjustments and fencing lunge performance. Sports Biomechanics.
3. Chen, T. L. W., Wong, D. W. C., Wang, Y., Ren, S., & Yan, F. (2017). Biomechanics of fencing sport: A scoping review. PLOS ONE, 12(4), e0175128.
4. Çingöz, Y. E., Selim, A., & Özdemir, B. K. (2023). The effect of training programs applied to fencing athletes on balance and reaction level. International Journal of Eurasian Education and Culture, 1–15.
5. de Vasconcelos, G. S., Cini, A., et al. (2020). Proprioceptive training on dynamic neuromuscular control in fencers: A clinical trial. Journal of Sport Rehabilitation, [Human Kinetics].
6. Di Martino, G., Centorbi, M., Buonsenso, A., & Fiorilli, G. (2024). Assessing the impact of fencing on postural parameters: Observational study findings on elite athletes. Sports, 12(5), 678–690.
7. Herpin, G., Gauchard, G. C., Lion, A., & Collet, P. (2010). Sensorimotor specificities in balance control of expert fencers and pistol shooters. Neuroscience Letters, 473(2), 98–102.
8. Lim, S. J., Kim, H. J., Kim, Y. S., Kim, E., Hwang, I., & Kang, J. S. (2024). Comparison of the effects of Pilates and yoga exercise on the dynamic balancing ability and functional movement of fencers. Life, MDPI.
9. Niță, V. A., & Magyar, P. (2023). Improving balance and movement control in fencing using IoT and real-time sensorial feedback. Sensors, 23(15), 6711.
10. Sundaraketu, N., & Bupha-intr, T. (2025). Influence of strength, power, and dynamic balance on competitive performance in amateur fencers. Journal of Exercise Science, 14(1), 45–56.
11. Varesco, G., Sarcher, A., & Doron, J. (2024). Striking a balance: Exploring attention, attack accuracy and speed in fencing performance. European Journal of Sport Science, 24(2), 112–123.
12. Wahhab, R. M. A. (2024). A study of enhancing fencing skills with the impact of special exercises on kinetic response and attack accuracy among young foil

players. Integrative Biomedical Research, 10(3), 67–78.
13. Yılmaz, O., Soylu, Y., Erkmen, N., Kaplan, T., & Batalik, L. (2024). Effects of proprioceptive training on sports performance: a systematic review. BMC Sports Science, Medicine and Rehabilitation, 16(1), 149.
14. Szabo, D. A., Neagu, N., Teodorescu, S., & Panait, C. M. (2021). Study on the influence of proprioceptive control versus visual control on reaction speed, hand coordination, and lower limb balance in young students aged 14–15 years. International Journal of Environmental Research and Public Health, 18(7), 3541
15. Yarayan, Y. E., Keskin, K., Çelik, O. B., Güder, B. C., & colleagues. (2025). Effects of life kinetik training on balance, agility, jumping, proprioception, and cognitive function in preadolescent recreational fencing athletes: A randomized controlled trial. BMC Sports Science, Medicine and Rehabilitation, 17(2), 102.

THE VALUE OF AFFECTIVE-ATTITUDINAL TRAITS IN FORMING ARTISTIC SKILLS IN 7-8 YEAR-OLD FEMALE GYMNASTS

Natalia Reaboi [1], Natalia Moloșag [2]

[1] *Moldova State University, Institute of Physical Education and Sports, Chisinau, Republic of Moldova*
[2] *Free International University of Moldova*

Abstract

In the context of the new approaches of the International Rules of Rhythmic Gymnastics (2025-2028), the focus is primarily on the artistic competences to be trained in athletes in the perspective of continuity. At the current stage, the area of concern of rhythmic gymnastics specialists includes the training of affective-attitudinal traits, since the child's ability to learn to master during the training process is a defining feature of the sportswoman in the process of training. The process of learning involves dominant psychophysiological mechanism sets of individualized and controlled structures, such as the ability to detect learning difficulties, affective-attitudinal traits of beginner gymnasts. These considerably increase the degree of forming artistic skills of gymnasts, which will be amplified by the skill and proficiency of artistic execution of various contests and competitions.

Keywords: Affective-attitudinal traits, artistic skills, rhythmic gymnastics, skills, motor abilities.

1. Introduction

Currently, achieving high performance in rhythmic gymnastics requires a well-directed organization of athlete training. This includes not only a comprehensive set of theoretical-methodological and material resources but also the development of affective-attitudinal behavior and mindset (e.g., goal orientation, self-confidence, concentration, learning capacity, and performance improvement potential) to attain the highest possible results (Dobrescu, T. et al., 2008; Reaboi, N., 2024).

Acquiring diverse data on the formation of dominant attitudes and behaviors in rhythmic gymnastics is a key component for any coach. A coach must possess pedagogical and psychological knowledge aimed at teaching children how to learn, shaping their character, and supporting the development of affective-attitudinal traits. The value of affective-attitudinal traits in rhythmic gymnastics lies in their role within specific training circumstances that shape the artistic competencies of young athletes in the second year of their initial preparation (Bontaș, I., 1996; Callo, T., 2014; Grimalschi, T., 2016; Pascari, V., 2009).

A gymnast's artistic competency refers to her training and the results demonstrated in competition, understood as a continuous process. This active engagement in developing competency encourages the gymnast to want to learn, to

apply what she learns, and to take an active role in her own development (Pascari, V., 2009; Popescu-Neveanu, P., 2013).

The formation of affective-attitudinal traits at ages 7–8 in rhythmic gymnastics develops through the process of assimilating and applying knowledge, involving the participation of all sensory and psychological functions (perception, attention, memory, thinking, language, imagination, will, affectivity, and motivation). Therefore, it is crucial to align training content with these formative objectives.

In this context, it is worth mentioning that artistic movements are particularly difficult to execute within a sport-artistic composition. Any movement originates from a command by the nervous system—either consciously or unconsciously—and results in a change in the body's position. When conscious, this psychomotor act carries an internal "charge" determined by a specific goal. Here, muscular intelligence plays a role: the gymnast's ability to mobilize her entire body to accurately express a desired state. The elements used become extensions of the gymnast's own body, and together, they must form broad, complex artistic movements that capture the audience's attention and, above all, convey emotion, elegance, and competitive attitude (Reaboi, N., 2024).

This research focuses on the reality that young gymnasts practicing this sport—where the beauty of expressive movement intertwines with the refinement of affective-attitudinal traits—often struggle to correctly, fully, and aesthetically execute many of the exercises outlined in the new Code of Points (2025–2028). To achieve the goals and objectives of this study, a pedagogical research project was conducted with 7–8-year-old gymnasts from the Sports School for Olympic Reserves, Chisinau.

2. Material and method

We set out to research the emergence of affective-attitudinal products and the possibility of evaluating these outputs/parameters during the second year of initial training, based on the theoretical arguments regarding the approach to affective-attitudinal capacities as fundamental, observable behavioral traits—essential for achieving acceptable performance levels and demonstrating formative effects in practice.

To achieve the research objectives, the following scientific methods were employed: theoretical analysis and synthesis of the literature; observation and monitoring in sports training; pedagogical observation; testing methods; tabular method; pedagogical experiment; and statistical-mathematical methods for processing and interpreting the collected data.

The attitudes and dominant behaviors of athletes can be understood as the final stage in the formation of artistic competencies. The knowledge and abilities acquired by children aged 7–8 during training are reflected in their behavior in specific situations. Competencies and attitudes become primary, followed by skills and abilities, and only then by the accumulation of knowledge. As they evolve, these

components contribute to the effective formation of a competency (Reaboi, N., 2024; Pascari, V., 2009).

For this reason, the learning processes of 7–8-year-old children must support the integration of affective-attitudinal traits into the training process.

The general objective of the study was to design and implement an experimental program aimed at developing artistic skills through the enhancement of affective-attitudinal traits in 7–8-year-old rhythmic gymnasts.

Research Hypothesis: We assumed that the value of affective-attitudinal traits has a favorable influence on the development of sport-artistic competencies in rhythmic gymnastics.

The formation of artistic competencies during the early stages of athletic preparation for young gymnasts in rhythmic gymnastics training involves the development of complex competencies related to artistic expression, among which affective-attitudinal behavior plays a central role.

3. Results and Discussions

Once developed, artistic competencies undergo a process of growth and organic progression. It is important to note that competence also represents an intellectual capacity with transferable potential, and it is associated with affective and attitudinal components that motivate action (Pascari, V., 2009; Reaboi, N., 2023). In rhythmic gymnastics, this conception leads to the development of an experimental program aimed at focusing instructional-educational processes on the formation and development of affective-attitudinal traits in children aged 7–8.

To assess the value and effects of affective-attitudinal traits in the formation of artistic competencies during the initial stage of athletic preparation, a questionnaire was developed to evaluate the indices of these traits.

The data obtained through the survey complement the information provided by other research methods such as interviews and conversations. Surveys offer the advantage of capturing opinions, motivations, and attitudes of the participants toward the subject of research, although they also carry the disadvantage of a high degree of subjectivity in the responses.

The sample group responding to the questionnaire consisted of 50 rhythmic gymnastics coaches and choreographers with various levels of judging certification from the Republic of Moldova, Ukraine, Romania, and Bulgaria. The questionnaire included a series of questions regarding the current training level of gymnasts aged 7–8 at the initial preparation stage and aimed to evaluate the following indices (Cheburaev, V., 1984):

- Index of Attitude Toward a Specific Goal (IASG);
- Index of Self-Confidence (ISC);
- Index of Thinking Concentration Ability (ITCA);

- Index of Learning Capacity (ILC);
- Index of Performance Improvement Capacity (IPIC);
- Index of General Affective-Attitudinal Behavior (IGAAB).

The values and effects of affective-attitudinal traits in 7–8-year-old gymnasts were evaluated according to the following scale:

a) Very Low – 1.0 points
b) Low – 2.0 points
c) Medium – 3.0 points
d) Pronounced – 4.0 points
e) Very Pronounced – 5.0 points

The data are presented in **Table 1**.

Table 1 reflects the results of the values for affective-attitudinal behavioral indices. At the age of 7–8, a creative attitude toward knowledge is developed, and creativity, motor musicality, and psychomotor abilities are stimulated.

These factors significantly increase the level of artistic competence formation among gymnasts—an aspect that will be further enhanced through the development of artistic execution skills across various competitions.

Statistical analysis of the experimental group of 7–8-year-old gymnasts indicates an upward trend in affective-attitudinal behavior (see Table 1).

Table 1 *Comparative Values of Affective–Attitudinal Traits of 7–8-Year-Old Gymnasts (n=8)*

No.	Tested values	*Initial testing*	*Final testing*	t	P
		$\overline{X} \pm m$	$\overline{X} \pm m$		
1	ITCA (pt)	3,45 ± 0,15	4,05 ± 0,14	6,510	<0,001
2	IASG (pt)	3,16 ± 0,17	3,74 ± 0,13	5,813	<0,001
3	ISC (pt)	3,40 ± 0,14	3,89 ± 0,12	5,755	<0,001
4	IPIC (pt)	3,85 ± 0,16	4,41 ± 0,15	5,582	<0,001
5	ILC (pt)	3,45 ± 0,15	3,95 ± 0,14	5,622	<0,001
6	IGAAB (pc) $\overline{X}$	3,46 ± 0,16	4,01 ± 0,15	6,251	<0,001

Note : (f=7) P – 0,05; 0,01; 0,001
2,365; 3,499; 5,408

The process of knowledge acquisition involves sets of dominant psychophysiological mechanisms of individualized and controlled structures, such as the ability to detect learning difficulties and the affective-attitudinal traits of 7–8-year-old gymnasts.

Research indicates that the neuro-psycho-physiological foundation increases within certain essential limits, in order to achieve the values and effects of affective-attitudinal behaviors. Specifically, this implies that the abilities of 7–8-year-old gymnasts, particularly the quality of execution, will be sought not only in skills and

proficiencies but also in the capacity for concentration (4.05 points), self-confidence (3.89 points), and, correspondingly, the ability to improve performance (4.41 points).The atmosphere in both training and competition at the age of 7–8 provides specific paradigms and structural-functional action schemes at a more pronounced level in artistic compositions, techniques, and methods that generate particular ways in which psychological mechanisms operate. This can be observed in the final testing results: 2.64, corresponding to 14.23 and 15.74 points, for the 7–8-year-old gymnasts, in the evolution of general affective-attitudinal traits and the results achieved by gymnasts in competitions at this age, with an index of 4.01 points.

The ability to execute a sports-artistic composition without an apparatus in the initial test of the experiment was assessed with an average value of 7.12±0.21 points. In the final testing, the apparatus-free composition was evaluated by experts with a mean score of 7.91±0.19 points. The data are significant at the P<0.001 threshold. Gymnasts in the control group obtained a result of 7.24 points, but the value of the "t" Student criterion is lower—2.38—at the significance level of P<0.05 (see Table 2).

Table 2 *Comparative Analysis of the Level of Development of Artistic Competencies in Gymnasts from the Control and Experimental Groups (Ages 7–8, n=16)*

No.	Tested parameters	Group	Statistical Data		t	P
			Initial testing	*Final testing*		
			$\overline{X} \pm m$	$\overline{X} \pm m$		
1	Execution Capacity of the Sport-Artistic Composition without an apparatus (points)	C	7,16 ± 0,19	7,24 ± 0,20	0,611	>0,05
		E	7,12 ± 0,21	7,91 ± 0,19	5,766	<0,001
		t	0,09	2,38	-	-
		P	>0,05	<0,05	-	-
2	Execution Capacity of the Sport-Artistic Composition with Rope (points)	C	7,20 ± 0,20	7,25 ± 0,21	0,395	>0,05
		E	7,17 ± 0,19	7,83 ± 0,16	5,872	<0,001
		t	0,11	2,19	-	-
		P	>0,05	<0,05	-	-
3	Total (points)	M	14,36 ± 0,35	14,49 ± 0,37	0,552	<0,05
		E	14,59 ± 0,39	15,74 ± 0,32	5,004	<0,01
		t	0,42	2,51	-	-
		P	>0,05	<0,05	-	-

Note: (g=14) *Paired samples* (g=7) *Paired samples*
C = 8; r = 0,811 *P – 0,05; 0,01; 0,001* *P – 0,05; 0,01; 0,001*
E = 8; 2r = 1,622 2,145; 2,977; 4,140 2,365; 3,499; 5,408

The execution capacity of the rhythmic gymnastics sport-artistic composition with rope was close to an average of 7.83±0.16 points, compared to the initial result of 7.17±0.19 points, showing a significant increase. The value of the Student's "t" criterion is 5.872, with a significance level of P<0.001.

The total points accumulated for the execution of the sport-artistic compositions by the gymnasts in the experimental group at the final test were 15.74±0.32 points, significantly different from the initial 14.59±0.39 points, with the value of the Student's "t" criterion being 5.004. This result is also significantly different from the gymnasts in the control group, who scored an average of 14.49±0.37 points, with the Student's "t" criterion being lower at 2.51, at a significance level of $P<0.05$.

Based on the studies and experimental research, at the early stage of sports preparation, the weight of the stages of artistic competencies formation was identified as follows:

- *materialization stage*, which involves the concretization of the acquired actions based on the elements of the artistic image and the initial formation of the artistic image, developing visual-spatial competencies.
- *verbal expression training stage*, where gymnasts master rhythmic gymnastics terminology both in active language and written language, aiming to achieve didactic tasks for the formation of communicative-verbal competence.
- *integration of elementary operations stage*, including elements of the artistic image at the dynamic stereotype level, forming elementary skills of elegance and artistic-motor coordination.
- *systematization stage*, involving actions in artistic compositions based on studying rhythmic gymnastics symbols, forming technical-artistic, choreographic, and creative-compositional competence.
- *integration stage*, where automated adaptive actions are incorporated into the dimensions of sports preparation, with selective and structural aspects of integrative artistic competence.

Through the experimental program, the properties and particularities of sports-artistic preparation of gymnasts at the level of technical-artistic or affective-attitudinal competencies can be studied. These are closely correlated with creative-compositional, musical, auditory (acoustic), visual-spatial competencies, and the correct interpretation of artistic compositions, in order to demonstrate expressiveness and elegance in exercises as part of the educational process and as outcomes in official competitions and contests. The results of the pedagogical experiment confirm the specific hypothesis regarding the value of affective-attitudinal traits in the formation of artistic competencies in rhythmic gymnastics at the early stage of sports preparation.

4. Conclusions

1. To increase the understanding of the issue regarding the formation of artistic competencies in rhythmic gymnastics for children aged 7–8 years, 88% of

coaches and choreographers agree that the values of affective-attitudinal traits should be developed in specialized training sessions with a well-established program. This will significantly enhance the application of technical-artistic knowledge in the execution of competition routines.

2. The final results obtained from the research on behavioral traits show that at the age of 7–8 years, the comparative values of affective-attitudinal traits are significantly pronounced, with a significance level of $P<0.001$ and a probability of 99.9%.
3. Comparing the results obtained from the initial and final tests of the experimental group, aimed at developing artistic competencies through the application of affective-attitudinal traits, revealed significant differences ($t= 5.004$; $P<0.01$). The value of the Student's "t" criterion for the control group is lower than the tabular value: 0.552, with $P>0.05$.

Bibliography

1. Bontaș, I. (1996). *Pedagogie,* Edit. ALL, București. 315 p. ISBN 973-9229-23-9
2. Callo, T. (2014). *Pedagogia practică a atitudinilor,* Edit. Litera, Chișinău. 240 p. ISBN 978-9975- 70-161-7
3. Dobrescu T., Constantinescu E. (2008). *Creativitatea – dimensiune în procesul de formare,* Edit. Pim, Iaşi, pg. 125–152. ISBN 978-606-520-018-0
4. Grimalschi, T. (2016). Terapia cognitivă și comportamentală ca proces defenitoriu al educației. *Revista ştiinţifico-metodică, Teoria şi arta educaţiei fizice în şcoală,* Chișinău, Republica Moldova, pg.11-16. ISSN 1857-0615
5. Pascari, V. (2009). Continuitatea în formarea competențelor de învățare la copiii de 6-8 ani (monografie), Edit. Î. S. F. E.- P. „Tipografia Centrală",Chișinău.180 p. ISBN 978-9975-78-733-8
6. Popescu-Neveanu, P. (2013). *Tratat de psihologie generală.* Edit. Trei, Bucureşti. 888 p. ISBN 9789737076953
7. Reaboi, N. (2024). *Știința psihopedagogică în formarea competențelor artistice în gimnastica ritmică.* Ghid metodologic universitar. Edit. „Foxtrot", Chișinău. 103 p. ISBN 978-9975-89313-8
8. Reaboi, N. (2023). Training of cognitive skills in rhythmic gymnastics at the initial stage of sports training to 5-6-year-old children. *Revista Annals of "Dunarea de Jos" University of Galati,* Fascicle XV, Physical Education and Sport Management, 1, pg. 179-186. doi: https://doi.org/10.35219/efms.2023.1.18
9. Чебураев В. С., Минаева Н. А., Чернышенко Ю. К. (1984). Психолого – педагогические характеристики. В: Методические рекомендации «Методы комплексного контроля и модельные характеристики подготовленности юных гимнасток 7–10 лет». Москва, ВНИИФК, с. 22–29.

INTEGRATION OF ADVANCED ANALYTICS AND WEARABLE TECHNOLOGIES IN PERFORMANCE MANAGEMENT OF U21 FOOTBALL PLAYERS

Răzvan Ionuț Rotaru [1], Vladimir Potop [2], Ion Mihaila [3], Paul Florinel Vișan [4], Doru Stoica [5]

[1,2,3] *Doctoral School of Physical Education and Sport Science, University Center Pitesti, National University of Science and Technology "Politehnica" Bucharest, Romania*
[2,3,4] *Department of Physical Education and Sport, University Center Pitesti, National University of Science and Technology "Politehnica" Bucharest, Romania*
[2] *Institute of Physical Education and Sport, Moldova State University, Chisinau, Republic of Moldova*
[5]*University of Craiova, Romania*

Abstract

This paper investigates the impact of integrating wearable technologies and advanced data analysis platforms on monitoring and optimizing the performance of Under-21 football players. The research focused on the use of Global Positioning System (GPS) tracking devices and inertial sensors for real-time collection of physical, physiological and performance indicators, alongside video analysis of tactical aspects. The subjects were national team players monitored during training sessions and official matches. The data collected were analyzed so as to assess training load, fatigue, sprint performance, accelerations and the efficiency of technical-tactical actions. The results revealed that the use of wearable technologies enabled optimal management of individual training load, enhanced the efficiency of high-intensity actions and reduced the risk of injury. In parallel, video analysis provided detailed insights into both individual and collective tactical performance, supporting the decision-making processes of coaches. Predictive models further contributed to anticipating performance declines and injury risks, ensuring a controlled transition toward higher levels of performance.

Key words: *wearable technologies, performance monitoring, tactical analysis, injury prevention, football*

1. Introduction

In the context of modern football, the use of advanced technologies and data analytics has become essential for optimizing athletic performance and preventing injuries. The integration of wearable sensors, artificial intelligence and biomechanical analyses enables coaches and sports science specialists to monitor players' workload, fatigue and injury risk in real time (Rebelo et al., 2023; Seshadri et al., 2021).

Recent research demonstrated that wearable technology and predictive analytics can provide a clear understanding of the physiological and biomechanical parameters, so that to support decision-making processes related to the adjustment

of training volume and intensity (Zadeh et al., 2021; Kovoor et al., 2024). Particularly in elite football, the use of GPS systems and data analysis platforms contributes to the optimization of training loads and the prevention of muscular and joint injuries (Al-Farouni & Kumar, 2025; da Silva, 2024).

Furthermore, the integration of IoT technologies and machine learning algorithms facilitates a multidimensional approach to performance management, allowing for a comprehensive assessment of U21 players from both physical and tactical perspectives (McDonald, 2025; Mănescu, 2025; Souaifi et al., 2025). This technological evolution marks a transition from mere data collection to personalized action, reinforcing the role of data science in contemporary sports performance strategies.

U21 players represent a critical stage in the transition toward elite football, where precise monitoring of training load, physiological parameters and neuromuscular responses contributes significantly to their competitive development (Hrubý & Paludo, 2024; Lombard, 2021). At this point, individual variations determined by biological maturation can influence the ability to adapt to the specific demands of intensive training, thereby requiring a personalized approach to training program design (Ruf, 2022; Salter et al., 2024).

The combined monitoring of internal and external load indicators, along with neuromuscular performance, ensures a comprehensive understanding of players' functional status. The relationship between training stimuli and recovery processes can be also clearly defined this way (Connolly, 2022; Haller et al., 2022). Recent studies have highlighted the importance of using wearable sensors, biomechanical analyses and data-driven methods to prevent excessive fatigue and injury risk (Teixeira et al., 2025; Nobari et al., 2024).

Additionally, the use of IoT technologies and predictive analytics enables the early identification of neuromuscular overload signs, assisting coaches in making informed decisions regarding the adaptation of training intensity and volume (Hrubý & Paludo, 2024; Lombard, 2021). In these conditions, young athletes benefit from dynamic and adaptive monitoring, which is essential for an efficient transition to elite-level football.

The integration of wearable technologies, such as GPS systems, inertial sensors and heart rate monitors, helps coaches and researchers to collect and interpret real-time data. Thus, the achievement of individualized adjustments to training programs and the optimization of athletic performance become possible. Using these devices contributes to a deeper comprehension of athletes' internal and external demands, facilitating the correlation between training load, physiological status and injury risk (Seshadri et al., 2019; da Silva, 2024).

Moreover, the inclusion of artificial intelligence and predictive analytics into wearable systems supports the transformation of raw data into meaningful indicators for performance management and injury prevention (Srivastava et al., 2024; Seçkin

et al., 2023). Consequently, real-time monitoring of physiological and biomechanical parameters has become an indispensable tool in modern elite sports, contributing to the personalization of training interventions and the improvement of recovery processes (Seshadri et al., 2021; Arshad, 2022).

By combining wearable technologies with advanced data analysis methods—including artificial intelligence algorithms and predictive models—the identification of performance patterns, overload-related risks and key determinants of tactical efficiency can be achieved. The present study intends to highlight how the utilization of advanced analytics and wearable technologies can support performance management in U21 football players, fostering a scientific and individualized approach to training.

2. Material and method

This section includes the research hypotheses, procedures and methods employed, the characteristics of the subjects, the applied tests and a description of the experimental process. The study focused on the integration of wearable technologies and digital analysis platforms, such as Catapult and Wyscout, for monitoring and optimizing the performance of Under-21 football players. This research is part of the doctoral thesis of the first author in the University Center of Pitești, within the National University of Science and Technology "Politehnica" of Bucharest.

The main objective of the research is to analyze the impact of integrating wearable technologies and advanced data analysis methods on sports performance management among Under-21 (U21) football players.

Research hypothesis: It is assumed that the incorporation of wearable technologies and advanced data analysis methods into sports performance management for U21 football players leads to a significant improvement in physical, physiological and tactical performance, while simultaneously reducing the risk of overtraining and injury.

The research design focused on evaluating the effectiveness of these tools in collecting and interpreting real-time data to support tactical decision-making and minimize injury risk. Monitoring procedures included recording physical parameters (total distance covered, accelerations, sprints and physiological load), video analysis of technical-tactical actions and their correlation with individual and team performance results.

The subjects of the study were players selected from the national U21 team, monitored over a defined period of training and official competition. The study was conducted in conformity with the principles of the Helsinki Declaration and was approved by the Ethics Committee of the Doctoral School of Sports Science and Physical Education at the University Center of Pitești (ID:31/21.02.2025), National University of Science and Technology "Politehnica" of Bucharest.

Tests and measurements were carried out according to standardized protocols for evaluating physical and technical performance, using state-of-the-art equipment provided by Catapult Sports and Polar. The experimental process involved data collection during training sessions and official matches, inclusion of the results into specialized analysis platforms (MatchTracker, Pro Video, Focus) and interpretation in relation to the objectives established by the technical staff. The conclusions were subsequently communicated to the home clubs of the players to ensure continuity in performance monitoring and development.

3. Results and discussions

The results of the analysis highlight the significant impact of integrating wearable technologies and digital analysis platforms into the process of monitoring and improving the performance of U21 football players. The implementation of the Catapult system at the national Under-21 team level, complemented with the Wyscout platform, enabled the collection and interpretation of objective data on physical load, physiological parameters and technical-tactical indicators, thereby contributing to a scientific approach to sports performance management.

Table 1 presents the distribution of effort intensity in elite football. It shows that players alternate between activity zones ranging from rest and slow walking (Zones 1–2) to high-intensity running and maximal sprinting (Zones 5–6). The information helps the coaches to monitor and adjust physical load according to the specific demands of the game.

Table 1. *Work-rate patterns: description of zones*

Zone	Description	Speed (km/h)	Speed (m/s)
Zone 1	Stand, walk, sit	0 – 6.0	0 – 1.6
Zone 2	Walk, jog, cruise	6.1 – 12.0	1.7 – 3.3
Zone 3	Jogging, cruising, striding	12.1 – 14.0	3.4 – 3.9
Zone 4	Fast-paced jog, running, striding	14.1 – 18.0	4.0 – 5.0
Zone 5	Running, high-intensity running	18.1 – 23.0	5.0 – 6.3
Zone 6	Sprinting, maximal-intensity	>23.0	>6.4

This data is adapted from (6) based on averages across team sport research. For example, while some studies reported the lower limit of Zone 6 to be > 18 km/h (7), others have selected 25 km/h (8).

The Catapult system, based on GPS and inertial sensor technologies, supplied detailed information on total and relative distances covered, the number of accelerations and decelerations, high-intensity efforts and indicators of metabolic fatigue. These data allowed coaches and strength and conditioning specialists to monitor players' workload in real time, enabling individualized optimization of training volume and preventing the risk of overtraining. Analysis of the data collected during training sessions and official matches revealed increased efficiency

in achieving daily performance objectives, as well as a reduction in injury incidence through appropriate regulation of both external and internal loads.

The use of training load and fatigue monitoring systems in sports has been extensively studied in recent years, demonstrating their contribution to improving control and feedback mechanisms in physical preparation. These technologies enable the early identification of fatigue states and the adjustment of training programs according to each athlete's physiological and biomechanical data, resulting in a more controlled and predictable transition toward elite football.

Halson (2014) emphasizes the importance of training load monitoring for understanding athlete fatigue and preventing overtraining. The author presents a framework for the evaluation and modification of training load based on physiological responses. Djaoui et al. (2017) demonstrated that measures such as resting heart rate, heart rate variability and blood lactate concentration are relevant indicators of fatigue and can guide individualized training adjustments. Similarly, the study made by Adão Martins et al. (2021) underlines the effectiveness of wearable systems in continuously monitoring fatigue, facilitating real-time adaptation of training sessions based on the physiological data collected.

Thus, the integration of these technologies into sports practice not only leads to injury prevention and performance optimization but also supports a smoother and safer transition of athletes to higher levels of competition.

Table 2 presents the variability of physical effort among players, highlighting differences in workload volume, mean intensity, number of sprints and accelerations, high metabolic power output and physical impacts. It proves the importance of individualized monitoring for optimizing performance and preventing overtraining.

Table 2. *Example of physical performance indicators of the players*

Indicator	Player 1	Player 2	Player 3	Observations
Total distance (km)	11.2	10.5	12.0	Total work volume during the match
Relative distance ($m \cdot min^{-1}$)	124	116	133	Average intensity of effort
Sprints > 25 km/h	14	11	16	High-intensity efforts
Number of accelerations	56	49	63	Includes rapid accelerations and decelerations
High metabolic power (%)	18	15	20	Percentage of match time spent at maximal effort
Impacts/collisions	7	5	8	Physical contact and direct duels

Using the Hudl Wyscout platform in football technical analysis has revolutionized the evaluation of individual and collective performance. By integrating GPS tracking data with video analytics tools (Pro Video and MatchTracker), coaches can interpret

in detail the game dynamics, average positioning of players, movement patterns, pressing efficiency (PPDA) and advanced performance metrics, such as Expected Goals (xG) and Expected Pass Accuracy (xPass). This information allows for the adaptation of the game tactics and individual roles, ensuring optimal alignment between physical effort and technical-tactical requirements.

The Wyscout platform has established itself as an essential tool in football performance analysis, providing detailed spatiotemporal and video data that facilitate the evaluation of individual actions, the analysis of team tactics and informed decision-making in player selection and recruitment (Nordin, 2025; Burevik & Lennartsson, 2025; Trasforini, 2023; Frost, Groom & Nicholls, 2025; Harkness-Armstrong et al., 2025). Hudl Wyscout has evolved into a core tactical analysis instrument by combining GPS tracking data with video analytics to deliver a comprehensive assessment of team and player performance. This platform helps coaches to analyze game dynamics, identify movement patterns and evaluate pressing efficiency, providing in this manner valuable decision-making support for tactical and role-based adjustments.

In football tactical analysis, advanced metrics such as Expected Goals (xG) and Pressing Efficiency (PPDA) have proven to be highly important tools for assessing team and player performance, enabling the interpretation of movement patterns, evaluation of pressing efficiency and real-time tactical adaptation (Vilela, 2024; Li, 2024; Kim, 2024; Zhang, 2022; Analytics et al., 2025).

Table 3 illustrates individual and collective tactical performance, showing variations in chance quality (xG), passing accuracy, pass difficulty (xPass) and pressing efficiency (PPDA and pressing success), emphasizing the importance of detailed analysis for tactical adjustment and team performance optimization.

Table 3. *Example of tactical performance indicators in players and team*

Indicator	Player 1	Player 2	Player 3	Team (average)	Observations
xG (Expected goals)	0.65	0.40	0.90	1.95	Quality of chances created
Completed passes (%)	87	82	90	86.3	Reliability in maintaining possession
xPass	0.82	0.78	0.88	0.83	Difficulty level of passes made
PPDA	8.5	9.2	7.8	8.5	Number of passes allowed before pressing
Pressing success (%)	72	65	78	71.7	Effectiveness of defensive pressing

The data extracted from the Catapult platform also revealed a positive correlation between the intensity level of physical exertion and the efficiency of technical actions, confirming the hypothesis that optimal training load management leads to improved technical execution under maximal effort conditions. Furthermore,

predictive analysis based on historical data enabled the identification of injury risks and the anticipation of performance declines, providing a solid foundation for preventive decision-making.

The integration of digital platforms, such as Wyscout and Catapult, has revolutionized performance analysis in football, offering complementary tools for the detailed evaluation of players and the optimization of team training. Through Wyscout, coaches can correlate GPS tracking data with video analysis (Pro Video and MatchTracker) to interpret game dynamics, players' average positioning, movement patterns, pressing efficiency (PPDA) and advanced performance metrics such as Expected Goals (xG) and Expected Pass Accuracy (xPass). These data facilitate the adaptation of tactics and individual roles (Nordin, 2025; Burevik & Lennartsson, 2025; Trasforini, 2023; Frost, Groom & Nicholls, 2025; Harkness-Armstrong et al., 2025).

In parallel, data extracted from the Catapult platform revealed correlations between training intensity and technical efficiency, while predictive models based on historical records made it possible to identify injury risks and anticipate performance drops, providing robust support for preventive strategies and the optimal management of training load (Campbell, Stewart & Sirotic, 2021; Seshadri, Thom & Harlow, 2021; Piłka et al., 2023; Freitas et al., 2025; Heishman, Curtis & Saliba, 2018).

This synergy between tactical analysis and physical load monitoring ensures a more controlled transition of players toward peak performance and an optimal alignment between technical-tactical and physiological demands.

4. Conclusions

1. The findings of the study prove that the integration of advanced monitoring technologies and digital analysis platforms, such as Catapult and Wyscout, significantly enhances the athletic performance of U21 football players.
2. The Catapult system enabled the collection of objective data regarding training volume and intensity, physiological parameters and fatigue indicators, thereby facilitating the optimization of training load, prevention of overtraining and reduction of injury risk.
3. In parallel, the Wyscout platform provided detailed spatiotemporal and video-based information on game dynamics, average player positioning, movement patterns, pressing efficiency and advanced performance metrics, supporting the adjustment of team tactics and individual roles.
4. Predictive models based on historical data contributed to the identification of injury risks and the anticipation of performance declines, strengthening the preventive management of training load and enhancing the efficiency of player preparation. The transfer of performance data to the home clubs of the players ensured continuity in athletic development and fostered inter-institutional collaboration.

Bibliography

1. Adão Martins, N. R., Annaheim, S., Spengler, C. M., & Rossi, R. M. (2021). Fatigue monitoring through wearables: a state-of-the-art review. *Frontiers in physiology*, 12, 790292. https://doi.org/10.3389/fphys.2021.790292
2. Al-Farouni, M., & Kumar, R. A. (2025). IoT-Enabled Performance Monitoring Methods, Injury Prevention Strategies, and Tactical Decision-Making in Football. *Advances in Sports Science and Technology*, 75-79.
3. Analytics, D., Nyman, K., & Heikkonen, J. (2025). Comparison of Finnish and international youth football in intensity and tempo.
4. Arshad, N. (2022). Wearable computing and real-time information systems in sports performance analysis: a technological advancement. *Multidisciplinary Research in Computing Information Systems*, 2(4), 240-249.
5. Burevik, M., & Lennartsson, C. (2025). Designing for Football: Creating the Future of Analysis. Master's thesis, DIVA Portal.
6. Connolly, D. R. (2022). Monitoring in Elite Youth Soccer: Describing Load, Reducing Data and Assessing its Relationship with Physical Fitness Outcomes. University of Technology Sydney (Australia).
7. da Silva, L. (2024). Wearable technology in sports monitoring performance and health metrics. *Revista De Psicología Del Deporte* (Journal of Sport Psychology), 33(2), 250-258.
8. Djaoui, L., Haddad, M., Chamari, K., & Dellal, A. (2017). Monitoring training load and fatigue in soccer players with physiological markers. *Physiology & Behavior*, 181, 86–94.
9. Freitas, D. N., Mostafa, S. S., Caldeira, R., Santos, F., Fermé, E., Gouveia, É. R., & Morgado-Dias, F. (2025). Predicting noncontact injuries of professional football players using machine learning. *PloS one*, 20(1), e0315481.
10. Frost, W., Groom, R., & Nicholls, S. B. (2025). The use of performance analysis and data driven approaches within senior men's football recruitment. *International Journal of Sports Science & Coaching*, 20(2), 604-616.
11. Haller, N., Blumkaitis, J. C., Strepp, T., Schmuttermair, A., Aglas, L., Simon, P., ... & Stöggl, T. (2022). Comprehensive training load monitoring with biomarkers, performance testing, local positioning data, and questionnaires-first results from elite youth soccer. *Frontiers in Physiology*, 13, 1000898.
12. Halson, S. L. (2014). Monitoring training load to understand fatigue in athletes. *Sports medicine*, 44(Suppl 2), 139-147.
13. Harkness-Armstrong, A., Seth, L., Lowry, R., & Datson, N. (2025). Applied performance analysis practices in women's football. *International Journal of Sports Science & Coaching*, 20(2), 568-584.
14. Heishman, A. D., Curtis, M. A., Saliba, E., Hornett, R. J., Malin, S. K., & Weltman, A. L. (2018). Noninvasive assessment of internal and external player

load: implications for optimizing athletic performance. *The Journal of Strength & Conditioning Research,* 32(5), 1280-1287.
15. Hrubý, M., & Paludo, A. C. (2024). Neuromuscular status and training load during 1 week of international training camp: the case of the U-21 football national team from the Czech Republic. *Sport Sciences for Health*, 20(3), 831-835.
16. Kim, B. (2024). Measuring the effectiveness and quantity of defensive pressure in football (Doctoral dissertation, 88wwz).
17. Kovoor, M., Durairaj, M., Karyakarte, M. S., Hussain, M. Z., Ashraf, M., & Maguluri, L. P. (2024). Sensor-enhanced wearables and automated analytics for injury prevention in sports. *Measurement: Sensors*, 32, 101054.
18. Li, X. (2024, November). English Premier League Data Analysis: Insights and Recommendations. *In 2024 5th International Conference on Big Data and Social Sciences* (ICBDSS 2024) (pp. 37-48). Atlantis Press.
19. Lombard, W. (2021). Monitoring wellness, training load and neuromuscular performance: Implications for assessing athlete training status. [Master's thesis, University of Cape Town].
20. Mănescu, D. C. (2025). Big Data Analytics Framework for Decision-Making in Sports Performance Optimization. *Data*, 10(7), 116.
21. McDonald, W. (2025). Smart Training: Leveraging AI and Machine Learning for Injury Prevention and Performance Optimization in Sport. Authorea Preprints. https://doi.org/10.36227/techrxiv.176062647.77538782/v1
22. Nobari, H., Eken, Ö., Singh, U., Gorouhi, A., Bordón, J. C. P., Prieto-González, P., ... & Calvo, T. G. (2024). Which training load indicators are greater correlated with maturation and wellness variables in elite U14 soccer players?. *BMC pediatrics*, 24(1), 289.
23. Nordin, R. (2025). Offline Reinforcement Learning For Evaluating Football Players. DIVA Portal. https://www.diva-portal.org/smash/get/diva2:1989318/FULLTEXT02
24. Piłka, T., Grzelak, B., Sadurska, A., Górecki, T., & Dyczkowski, K. (2023). Predicting injuries in football based on data collected from GPS-based wearable sensors. Sensors, 23(3), 1227.
25. Rebelo, A., Martinho, D. V., Valente-dos-Santos, J., Coelho-e-Silva, M. J., & Teixeira, D. S. (2023). From data to action: a scoping review of wearable technologies and biomechanical assessments informing injury prevention strategies in sport. *BMC sports science, medicine and rehabilitation*, 15(1), 169.
26. Ruf, L. (2022). Monitoring Training Load and Responses to Load in Youth Soccer Special Reference to Biological Maturation. [Doctoral dissertation, Universität des Saarlandes].
27. Salter, J., Julian, R., Mentzel, S. V., Hamilton, A., Hughes, J. D., & De St Croix, M. (2024). Maturity status influences perceived training load and neuromuscular

performance during an academy soccer season. *Research in Sports Medicine,* 32(2), 235-247.
28. Seçkin, A. Ç., Ateş, B., & Seçkin, M. (2023). Review on Wearable Technology in sports: Concepts, Challenges and opportunities. Applied sciences, 13(18), 10399.
29. Seshadri, D. R., Thom, M. L., Harlow, E. R., Gabbett, T. J., Geletka, B. J., Hsu, J. J., ... & Voos, J. E. (2021). Wearable technology and analytics as a complementary toolkit to optimize workload and to reduce injury burden. Frontiers in sports and active living, 2, 630576.
30. Souaifi, M., Dhahbi, W., Jebabli, N., Ceylan, H. İ., Boujabli, M., Muntean, R. I., & Dergaa, I. (2025). Artificial Intelligence in Sports Biomechanics: A Scoping Review on Wearable Technology, Motion Analysis, and Injury Prevention. *Bioengineering,* 12(8), 887.
31. Srivastava, P. K., Pandey, R. K., Srivastava, G. K., Anand, N., Krishna, K. R., Singhal, P., & Sharma, A. (2024). Intelligent Integration of Wearable Sensors and Artificial Intelligence for Real-time Athletic Performance Enhancement. Journal of Intelligent Systems & Internet of Things, 13(2).
32. Teixeira, J. E., Afonso, P., Schneider, A., Branquinho, L., Maio, E., Ferraz, R., ... & Forte, P. (2025). Player Tracking Data and Psychophysiological Features Associated with Mental Fatigue in U15, U17, and U19 Male Football Players: A Machine Learning Approach. *Applied Sciences*, 15(7), 3718.
33. Trasforini, F. (2023). Embedding Football Players: A Deep Learning Approach to Data-Driven Scouting. *Università Ca' Foscari Venezia*.
34. Vilela, J. A. T. F. (2024). Exploring Stochastic Efficiency Analysis for Expected Goals in Football: Assessing Offensive Efficiency Across Europes's Major Football Leagues (Master's thesis, Universidade NOVA de Lisboa, Portugal).
35. Zadeh, A., Taylor, D., Bertsos, M., Tillman, T., Nosoudi, N., & Bruce, S. (2021). Predicting sports injuries with wearable technology and data analysis. *Information Systems Frontiers*, 23(4), 1023-1037.
36. Zhang, G. (2022). The Analysis of Team Tactical Behaviour in Football Using GNSS Positional Data (Master's thesis, Liverpool John Moores University, United Kingdom).

International Scientific Conference
„ Actualities and Perspectives of Physical Education and Sport Sciences", 2025

ANALYSIS OF STATIC BALANCE PARAMETERS IN YOUNG JUDOKAS

Călin Roșu [1], Vladimir Potop [2], Liviu Emanuel Mihailescu [3], Daniel Rosu [4], Ilie Mihai [5]

[1] *„Mircea Eliade" High School with Sports Program of Bucharest, Romania*
[1,2] *Doctoral School of Sports Science and Physical Education, University Center Pitești, National University of Science and Technology Polytechnic Bucharest, Romania*
[2,3,4,5] *Department of Physical Education and Sport, University Center Pitesti, National University of Science and Technology "Politehnica" Bucharest, Romania*
[2] *Institute of Physical Education and Sport, Moldova State University, Chisinau, Republic of Moldova*

Abstract

The aim of the present study was to identify the specific features of postural control in young female judokas and to highlight the relationships between static stability and deviations of the center of gravity. The research group consisted of fifteen junior athletes aged between fifteen and eighteen, enrolled at the "Mircea Eliade" Sports High School in Bucharest. The bipedal static balance test allowed the assessment of performance parameters and of the mean deviations of the center of gravity in the anterior, posterior and lateral planes. The results indicated a high level of postural stability, with an average performance of 76.80% and moderate variability among participants. Correlation analysis revealed a significant positive association between performance and anterior deviation, as well as negative correlations between performance and lateral deviations. These findings confirm the importance of maintaining the center of gravity in a slightly anterior position to optimize stability, while also emphasizing the need to correct postural asymmetries. The conclusions support the integration of core stability and postural control exercises into the training programs of young judokas as a means of enhancing technical-tactical performance and preventing balance loss during combat.

Key words: *static balance, postural control, judo, body stability, neuromuscular development*

1. Introduction

Balance represents one of the essential components of human motor function and a determining factor of performance in sports that involve rapid position changes, direct contact and vigorous actions (Perrin et al., 2002). Preserving and restoring balance are fundamental skills in judo, as the effectiveness of both offensive and defensive techniques directly depends on body stability and the athlete's ability to control the center of gravity relative to the base of support (Maśliński et al., 2016; Osipov et al., 2018).

Numerous studies have shown that judo practitioners exhibit superior

sensorimotor adaptation that enables them to maintain stability even under conditions of external disturbance (Mala et al., 2016; Taskın et al., 2015). Regular judo training contributes to the development of postural control and dynamic stability in both young and elite athletes (Walaszek et al., 2017).

Moreover, strengthening the trunk musculature plays a crucial role in improving balance and preventing injuries among judokas (Martins et al., 2019). In addition, visually impaired athletes who practice judo develop efficient compensatory mechanisms for postural control, demonstrating a level of stability comparable to or even greater than that of sighted athletes (Kons et al., 2019).

The development of static balance in young athletes is a complex process influenced by morphological, neuromuscular and perceptual factors that gradually mature with age and training experience (Ricotti, 2011; Osipov et al., 2018). The analysis of static balance parameters in developing judokas provides valuable information for adapting training content, preventing injuries and optimizing the learning of specific techniques (Maśliński et al., 2016; Jaworski et al., 2023).

Recent research shows the importance of selection and training processes in the development of postural control among 11-14-year-old judo athletes, identifying a direct relationship between athletic level and postural stability (Jaworski et al., 2023). Also, the improvement of static and dynamic balance relies on the development of coordination abilities and sensorimotor skills shaped by the specific demands of judo practice (Cherepov et al., 2021; Perrin et al., 2002).

Findings from previous studies indicate that judo training significantly contributes to balance development in children and adolescents, supporting an efficient process of motor and neuromuscular maturation (Walaszek et al., 2017; Kowalczyk et al., 2025). The implementation of educational programs and judo-specific exercises leads to better postural control and general coordination (Al-Odat, 2024), which are essential for refining basic techniques and preventing imbalances during offensive and defensive phases.

Numerous studies have demonstrated that postural stability serves as an indicator of neuromuscular control and efficiency of sensorimotor strategies involved in postural regulation (Muddle et al., 2017). In judo, the ability to maintain balance in static yet tensioned positions is essential for the correct execution of gripping techniques (*kumi-kata*) and the preparation of throwing movements. It contributes to the adaptive development of athletes' motor behavior during the formative stage of performance (Costache & Mihăilescu, 2010).

In the current context, the analysis of static balance parameters in young judokas is relevant not only for assessing motor level but also for designing differentiated training programs according to age and skills. This study aims to investigate the characteristics of static balance in young judo practitioners, highlighting the specific features of this motor indicator and its relationship with both general and sport-specific development.

2. Material and method

The aim of this study was to identify the postural characteristics specific to age and training level in young female judokas, as well as to underline the individual particularities that may influence body stability in static positions.

The research was based on the hypothesis that athletes with greater competitive experience would exhibit a higher level of postural stability, reflected by smaller deviations of the center of gravity during the maintenance of static bipedal balance.

Study sample was formed of 15 junior judokas (aged 15–18 years) enrolled at the "Mircea Eliade" Sports High School in Bucharest. Each judoka had at least four years of competitive experience. The participants followed a regular training program of 5–6 sessions per week, containing technical-tactical exercises, stability training and general physical conditioning.

Static bipedal balance assessment was conducted on January 25, 2025, using the SensaMove Balance Board (MiniBoard) — a portable computerized system for analyzing center-of-gravity oscillations. The evaluated parameters included: Perf. (%); Front, avg. dev. (°); Back, avg. dev. (°); Left, avg. dev. (°) and Right, avg. dev. (°). Each trial lasted 20 seconds under standardized environmental conditions (temperature 22 ± 1°C). Visual feedback was allowed, with the following settings applied: Shape size: 20°; Shape width: 5°; Maximum tilting: 10°.

The research was carried out in accordance with the ethical principles outlined in the Declaration of Helsinki for studies involving human participants and was approved by the Ethics Committee of the Doctoral School of Physical Education and Sport Science (ID:26/7.02.2025), University Center of Pitești, within the National University of Science and Technology "Politehnica" of Bucharest. All participants (and parents, in the case of minors) provided written informed consent prior to inclusion in the study.

Data processing was performed by means of KyPlot 6, calculating descriptive indicators (mean, standard deviation, mean deviation, coefficient of variation, median quartile and 95% confidence interval). The Pearson's correlation analysis (r) was applied to determine relationships between performance and center-of-gravity deviations, with significance thresholds set at $p < 0.05$, $p < 0.01$ and $p < 0.001$. The strength of correlations was interpreted according to Cohen's (1988) classification: $r = 0.1–0.3$ (weak), $r = 0.3–0.5$ (moderate), $r = 0.5–0.7$ (significant) and $r > 0.7$ (strong).

3. Results and discussions

To highlight the specific features of postural control in young female judokas, a detailed statistical analysis of static bipedal balance parameters was performed. The analysis focused both on the general performance level and on the interdependent relationships between center-of-gravity deviations and postural stability, with the aim of identifying the main neuromuscular mechanisms involved in balance

maintenance.

Table 1. *Descriptive results of static bipedal balance test in young female judokas*

Parameters	mean	S.D.	Mean deviation	CV(%)	Confidence level of mean(0.95)	Quartile deviation
Perf. (%)	76.80	11.31	8.43	14.7	6.27	5.75
Front, avg. dev. (degrees)	1.57	0.94	0.80	59.8	0.52	0.53
Back, avg. dev. (degrees)	-1.17	0.82	0.50	70.3	0.45	0.18
Left, avg. dev. (degrees)	-1.33	0.73	0.53	54.6	0.40	0.37
Right, avg. dev. (degrees)	0.87	0.44	0.33	50.3	0.24	0.19

Analyzing the results of the static bipedal balance test in young female judokas (Table 1) indicates a mean performance level of 76.80%, with a standard deviation of ±11.31, suggesting moderate variability among participants. The coefficient of variation of 14.7% reflects a relatively homogeneous group, characteristic of athletes with a similar training level. The mean deviation (8.43) and the confidence interval of the mean (±6.27) confirm the consistency of the data and a balanced distribution of performance across the sample.

Results concerning the center of gravity deviations reveal a slight anterior shift (Front: 1.57° ± 0.94), which shows controlled forward postural inclination—a feature typical of the judo ready stance, where the center of gravity is slightly projected forward to enhance stability during attack phases and grip execution (*kumi-kata*). This adaptation is consistent with the observations of Ryabov et al. (2021), who underline that judo develops specific postural skills based on center-of-gravity control and continuous adjustment of body position relative to the opponent.

Average posterior deviations (Back: -1.17° ± 0.82) and lateral deviations (Left: -1.33° ± 0.73; Right: 0.87° ± 0.44) point out well-developed postural control without marked asymmetries between body sides. However, the high coefficients of variation for lateral and posterior directions (50.3%–70.3%) suggest individual differences in sensorimotor strategies for balance regulation. This fact was emphasized by Zemková and Zapletalová (2022), who noted that postural stability is influenced by the complex integration of neuromuscular control and sport-specific motor experience.

Recent studies confirm that combat sports, such as judo, enhance the neuromuscular system, improving both static and dynamic balance (Akbaş et al., 2022). Specifically, Osipov et al. (2018) reported that young judokas demonstrate

more stable postural control compared to athletes from other disciplines due to sensorimotor adaptations developed through balance, contact and rotational exercises.

Additionally, Martins et al. (2019) highlighted a direct relationship between core muscle strengthening and improved postural control in university-level judokas, confirming the essential function of trunk stability in maintaining balance in tense postures similar to those encountered in gripping and projection positions.

Overall, the findings of this study support the hypothesis that static bipedal balance in young judokas reflects optimal neuromuscular and sensorimotor efficiency appropriate to their stage of athletic development. These results are consistent with those reported by Kons et al. (2019), showing that experienced judoka exhibit superior postural stability, independent of visual conditions, due to well-trained motor and proprioceptive control.

Thus, the slight anterior and lateral deviations observed in the present sample can be considered functional adaptations specific to judo, intended to ensure optimal balance during postural transitions and direct confrontations with opponents. These postural adjustments may contribute to optimizing technical-tactical performance and preventing imbalances in contact situations, validating the conclusions of Al-Odat (2024) regarding the role of educational judo training in developing motor balance in young athletes.

The correlation analysis presented in Figure 1 highlights significant relationships between overall performance in the bipedal static balance test and the mean deviations of the center of gravity in different directions. Among the correlations analyzed, five were statistically significant, including one positive and four negatives, which proves a complex interdependence between postural stability and directional control of the body.

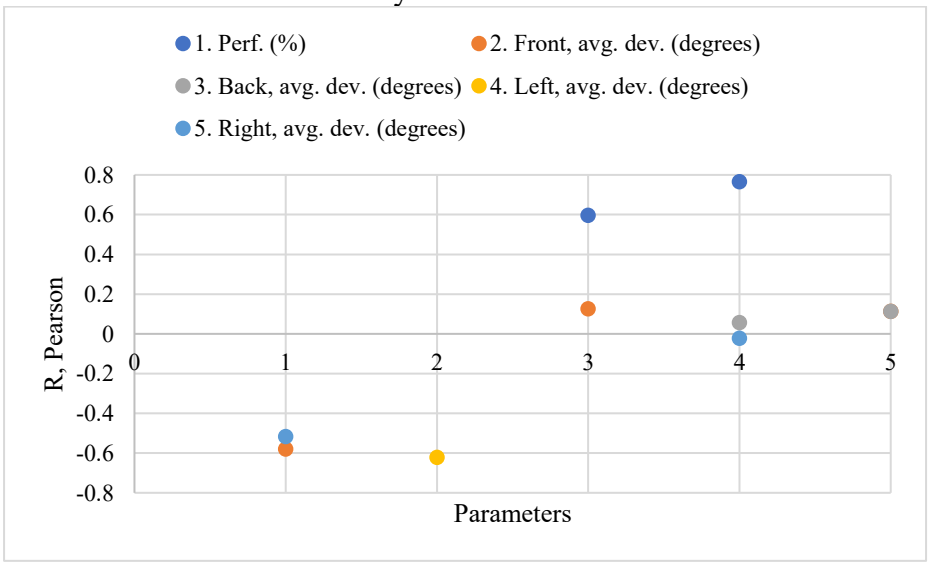


Fig. 1. *Significance level of the correlation of static balance parameters*

Results revealed a strongly significant positive correlation between performance and anterior deviation of the center of gravity ($r = 0.765$, $p < 0.001$), suggesting that athletes who maintain a slight forward displacement of the center of gravity achieve better balance performance. This anterior orientation has previously been described as characteristic of the judo ready stance, promoting stability during contact and gripping phases (Kons et al., 2019). Active control of the lower limbs and pelvic girdle contributes to keeping the center of gravity within a functional balance zone, specific to technical-tactical executions (Zemková & Zapletalová, 2022).

A moderate positive correlation was also observed between performance and posterior deviation of the center of gravity ($r = 0.596$, $p < 0.05$), denoting effective bidirectional control of balance between anterior and posterior planes. This observation aligns with Akbaş et al. (2022), who reported superior static balance control in martial artists, associated with competitive experience and sport-specific postural adaptations.

Conversely, significant negative correlations ($r = -0.580$ for anterior deviation, $r = -0.623$ for left lateral deviation, $r = -0.518$ for right lateral deviation) suggest that excessive lateral deviations negatively affect balance maintenance. These results are consistent with Martins et al. (2019) and Osipov et al. (2018), who reported that uneven postural control between the left and right sides leads to increased instability and greater demands on neuromuscular compensatory mechanisms.

In terms of correlation strength, values ranged from moderate ($r = 0.5–0.6$) to strong ($r \geq 0.7$), confirming a consistent association between performance and postural deviation parameters. The presence of negative correlations emphasizes the critical role of functional bodily symmetry in static stability, as also demonstrated by Cherepov et al. (2021), who emphasized the importance of bilateral coordination and integrated neuromuscular control for balance maintenance.

Generally, the findings suggest that maintaining the center of gravity in a slightly anterior position is favorable for postural stability, whereas pronounced lateral deviations can compromise static control efficiency. These results are supported by the specialized literature, which underlines the importance of core stability and postural control exercises in judo training (Ryabov et al., 2021; Al-Odat, 2024). For the development of young judokas, training programs should incorporate activities aimed at correcting asymmetries and strengthening neuromuscular control to optimize both stability and overall technical performance.

4. Conclusions

The overall level of bipedal static balance observed in young judokas was high, indicating well-developed neuromuscular and sensorimotor control specific to the discipline. Mean performance values and the low coefficient of variation highlighted

the homogeneity and consistency in the training of the group.

Postural force distribution showed a slight anterior displacement of the center of gravity, interpreted as a functional adaptation characteristic of the judo ready stance, optimizing stability during both offensive and defensive phases.

Correlation analysis revealed five significant relationships between performance and postural deviations: a strong positive correlation between performance and anterior deviation, suggesting that a moderate forward projection of the center of gravity enhances balance control, and four negative correlations between performance and lateral deviations, pointing out the impact of postural asymmetries on stability.

These results underscore the importance of symmetrical balance and central postural control in preserving stability and suggest the necessity of incorporating targeted exercises for asymmetry correction and proprioceptive training into the preparatory programs of young judokas.

Bibliography

1. Akbaş, A., Marszałek, W., Drozd, S., Czarny, W., Król, P., Warchoł, K., ... & Rzepko, M. (2022). The effect of expertise on postural control in elite sport jujitsu athletes. *BMC Sports Science, Medicine and Rehabilitation*, 14(1), 86.
2. Al-Odat, J. E. (2024). The impact of an educational program on some judo skills on developing motor balance. Perspektivy Nauki i Obrazovania, 2 (68), 295-311.
3. Cherepov, E. A., Eganov, A. V., Bakushin, A. A., Platunova, N. Y., & Sevostyanov, D. Y. (2021). Maintaining postural balance in martial arts athletes depending on coordination abilities. *Journal of Physical Education and Sport,* 21(6), 3427-3432.
4. Costache, L. C., & Mihăilescu, L. (2010). Adapting the motor behavior of the judoka in the formative stage of performance. *Health, Sports & Rehabilitation Medicine*, 40.
5. Jaworski, J., Lech, G., Witkowski, K., Bujas, P., Szczepanik, K., & Piepiora, P. (2023). Influence of training and selection on postural stability and its relationship with sport level in judo practitioners aged 11–14 years. *Frontiers in Psychology,* 13, 1053426.
6. Kons, R. L., Sakugawa, R. L., Rossato, M., Diefenthaeler, F., & Detanico, D. (2019). Neuromuscular and postural control in visually and nonvisually impaired judo athletes: case study. *Journal of exercise rehabilitation*, 15(1), 60.
7. Kowalczyk, M., Zgorzalewicz-Stachowiak, M., Błach, W., & Kostrzewa, M. (2025). Does Judo Training Contribute to the Motor Development of Children and Adolescents? A Systematic Review. *Journal of Clinical Medicine,* 14(7), 2439.

8. Mala, L., Maly, T., & Zahalka, F. (2016). Influence of maximal anaerobic performance on body posture stability in elite senior and junior male judo athletes. *Arch Budo: Science of martial arts*, 17, 117-124.
9. Martins, H. S., Lüdtke, D. D., de Oliveira Araújo, J. C., Cidral-Filho, F. J., Salgado, A. S. I., Viseux, F., & Martins, D. F. (2019). Effects of core strengthening on balance in university judo athletes. *Journal of bodywork and movement therapies,* 23(4), 758-765.
10. Maśliński, J., Witkowski, K., Cieśliński, W., & Śliz, T. (2016). Body balance in judokas. *Journal of combat sports and martial arts*, 7(1), 43-49.
11. Muddle, T. W., Fukuda, D. H., Wang, R., Riffe, J. J., Church, D. D., Beyer, K. S., ... & Stout, J. R. (2017). Effects of a 10-week introductory judo course on postural control during a bilateral reactionary gripping task. *Motor Control,* 21(4), 373-389.
12. Osipov, A., Kudryavtsev, M., Iermakov, S., Jagiello, W., & Doroshenko, S. (2018). Development of the ability to maintain body balance in young athletes 12-13 years practicing judo. *Archives of budo science of martial arts and extreme sports,* 14(1), 21-30.
13. Perrin, P., Deviterne, D., Hugel, F., & Perrot, C. (2002). Judo, better than dance, develops sensorimotor adaptabilities involved in balance control. *Gait & Posture*, 15(2), 187–194.
14. Ricotti, L. (2011). Static and dynamic balance in young athletes. *Journal of human sport and exercise*, 6(4), 616-628.
15. Ryabov, A. A., Petrova, A. V., Zekrin, A. F., & Ryabova, E. K. (2021). Postural control training model for elite judokas: tests and analysis. *Theory and Practice of Physical Culture,* (9), 35-37.
16. Taskın, C., Karakoc, O., Sanıoglu, A., & Taskın, M. (2015). Investigation of postural balance control in judo and handball players. *Turkish Journal of Sport and Exercise*, 17(1), 92-95.
17. Walaszek, R., Sterkowicz, S., Chwała, W., Sterkowicz-Przybycień, K., Walaszek, K., Burdacki, M., & Kłys, A. (2017). Assessment of the impact of regular judo practice on body posture, balance, and lower limbs mechanical output in six-year-old boys. *Journal of Sports Medicine and Physical Fitness*, 57(12), 1579-1589.
18. Zemková, E., & Zapletalová, L. (2022). The role of neuromuscular control of postural and core stability in functional movement and athlete performance. *Frontiers in physiology*, 13, 796097.

POSITION-SPECIFIC ANTHROPOMETRIC PROFILES IN WOMEN'S FOOTBALL

Elena-Andreea Trandafirescu [1], Vladimir Potop [2], Gabriel Trandafirescu [3], Doru Stoica [4]

[1,2] *Doctoral School of Sports Science and Physical Education, National University of Science and Technology Polytechnic Bucharest, University Center Pitești, Romania*
[2,3] *Department of Physical Education and Sport, National University of Science and Technology Polytechnic Bucharest, University Centre Pitesti, Romania*
[4] *Department of Theory and Methodology of Motor Activities, Faculty of Physical Education and Sport, University of Craiova, Romania*

Abstract
This study explores the anthropometric profiles of young female football players in relation to their playing positions. The sample consisted of 49 players (Mean ± SD = 13.73 ± 2.38 years), distributed across four positional categories: goalkeepers, defenders, midfielders, and forwards. Data on key anthropometric variables, including height, weight, foot length, and body mass index, were collected. Goalkeepers were found to exhibit a distinct physical profile, with higher values in height, weight, foot length, and BMI, compared to field players. In contrast, midfielders and forwards demonstrated leaner and more agile profiles, aligning with the mobility and endurance demands of their roles, while defenders showed intermediate characteristics. These patterns support the existence of differentiated physical profiles based on playing position. The findings suggest that position-specific anthropometric characteristics are evident even in the early stages of athletic development. Recognizing these differences may assist coaches, trainers and sport scientists in tailoring training methods and selection strategies to better align with the physical demands of each playing role in women's football.

Key words: *women's football, anthropometric characteristics, positional demands, youth performance*

Introduction

Soccer is the most researched sport globally, with nearly 14,000 citations on PubMed and approximately 60 percent more articles than the next most studied sport (Kirkendall, 2020). In recent decades, scientific research has made significant progress in profiling football players, leading to the development of position-specific training programs, injury prevention strategies, and performance optimization protocols. Although the physical, technical, tactical, and psychological demands of the game apply to both sexes, most studies have predominantly examined male athletes. In contrast, the literature focused on female football players remains limited in both scope and depth. A search in Web of Science (WoS) for all articles related to soccer and association football published between 1970 and 2019 revealed that approximately 19.3% focused on female players. In the case of professional soccer, studies involving female participants represented only 15,5% of the total research

conducted in this area (Kirkendall & Krustrup, 2021).

Multiple strategic initiatives have been launched to support the development of women's football. Notably, between 2020 and 2022, FIFA (2020) pledged an investment of one billion dollars to accelerate the growth of the women's game. However, despite these efforts, there remains a substantial gap in understanding how body composition, growth patterns, psychological development, and positional demands evolve in female players, particularly in young female players, where physical and physiological development can vary significantly.

Both physical and psychological dimensions are essential in the development of young female football players. While anthropometric characteristics contribute to positional suitability and physical performance, aspects such as emotional regulation, confidence, and psychological readiness are equally important for long-term success. Despite their combined importance, these elements are often addressed separately or overlooked altogether, highlighting the need for a more integrated approach to player development. Moreover, when female athletes are included in research, they are frequently grouped into broad categories, without accounting for the specific physical and psychological requirements associated with individual playing roles.

This study aims to analyze and compare the anthropometric profiles of young female football players according to their playing positions. By examining differences in height, weight, foot length, and body mass index, this research seeks to contribute to the growing need for empirical evidence that supports individualized training, performance development, and talent identification in women's football.

Material and method

The participants were 49 young female football players (Mean ± SD = 13.73 ± 2.38 years) from FC Argeș, competing in Liga 2 Feminin, the second tier of Romanian women's football. Data collection was conducted during April and May 2024 on the synthetic turf of the Aripi Pitești football facility. The primary objective was to identify anthropometric differences based on player positional roles and to gain deeper insights into specific player profiles. Data collection was carried out with the support and supervision of the team's coaches.

Anthropometric values were initially self-reported by the players and subsequently verified against team records provided by the coaches to enhance data reliability. The final dataset was organized in a standardized format, enabling efficient statistical analysis. The body mass index (BMI) for each participant was calculated using the official formula provided by the National Heart, Lung, and Blood Institute (NHLBI, n.d.).

Statistical analysis and interpretation were performed using DATAtab statistics software (DATAtab Team, 2023) focusing on descriptive statistics, a mixed model ANOVA and Bonferroni Post-hoc-Tests.

Results and Discussions

Table 1 data presents the anthropometric characteristics of female football players based on their playing positions: defender (DEF), midfielder (MID), forward (FW), and goalkeeper (GK). The comparison across variables reveals meaningful differences between positions.

Goalkeepers (GK) stand out consistently across all variables, showing the highest values in height (166.67 cm), weight (65.33 kg), foot length (30 cm), and BMI (23.5 kg/m²). These results are consistent with the physical demands of the goalkeeper position, where reach, overall body size, and mass are essential for effective performance. Goalkeepers are typically the tallest and heaviest players on the field, a trend supported by previous research (Kammoun et al., 2020; Milanovic, Sporis, & Trajkovic, 2012; Sporiš, Čanaki & Barišić, 2007) which highlights distinct anthropometric profiles associated with this position.

Table 1 *Position-specific anthropometric profiles women's football*

Var.	Age (years)	Height (cm)	Weight (kg)	Foot Length (cm)	BMI (kg/m²)
DEF	14.05 ± 2.16	162.14 ± 6.89	52 ± 8.97	23.88 ± 1.06	19.72 ± 2.42
MID	13.5 ± 2.36	159.22 ± 7.29	50.06 ± 6.93	23.89 ± 1.27	19.67 ± 1.77
FW	13.14 ± 3.34	155.71 ± 12.5	47 ± 12.4	23.43 ± 1.17	19.14 ± 3.47
GK	14.33 ± 2.31	166.67 ± 4.73	65.33 ± 4.04	30 ± 7.79	23.5 ± 0.35

Defenders (DEF) follow, with relatively high values in height (162.14 cm) and weight (52 kg), indicating a stronger physical presence, likely associated with roles requiring aerial duels and physical contact.

Midfielders (MID) show intermediate values across most variables, with a balanced profile: height (159.22 cm), weight (50.06 kg), and BMI (19.67 kg/m²). This may reflect the diverse and mobile nature of midfield roles, which require both endurance and agility.

Forwards (FW) present the lowest average values for most variables: height (155.71 cm), weight (47 kg), and BMI (19.14 kg/m²). This leaner body composition may be advantageous for speed, agility, and rapid directional changes.

Overall, table 1 suggest that *goalkeepers possess a distinct anthropometric profile*, while field players - especially midfielders and forwards - share more similar characteristics. These findings are consistent with those reported by Firdausi and Simbolon (2021), who also identified similar trends in the anthropometric characteristics of players across different positional role (PR). These position-specific patterns reinforce the importance of considering anthropometric data when designing role-adapted training programs and selection criteria for young female football players.

A mixed model analysis of variance (Table 2) was performed to examine whether there were significant differences between the groups of the first factor - age, height (cm), weight (kg), foot length (cm), and body mass index (kg/m²) (repeated measures) - in relation to the dependent variable. The analysis also tested

whether there was a significant difference between the groups of the second factor, player position, in relation to the dependent variable, as well as whether there was a statistically significant interaction between the two factors.

The results of the mixed model ANOVA indicated a significant effect of the repeated measures factor, $F (4, 180) = 9468.31$, $p < .001$, suggesting that the anthropometric variables differed significantly across the sample. Additionally, a significant main effect of player position was observed, $F (3, 45) = 3.44$, $p = .025$, indicating that the anthropometric profiles of the players varied depending on their field position. Finally, the interaction between player position and the repeated measures variables was also significant, $F (12, 180) = 2.13$, $p = .017$, meaning that the differences across anthropometric variables were not uniform across positions

Table 2 *Mixed model ANOVA*

Indicators	df	Mean	F	p	η^2	η^2_p
First factor	4	183868.64	9468.31	<.001	0.99	1
PR	3	260.53	3.44	0.025	0	0.19
RM Factor x PR	12	41.38	2.13	0.017	0	0.12

These findings suggest that position-specific physical characteristics are already observable in young female football players and align with previous research indicating that anthropometric traits vary by playing position. Consistent with the literature, the results highlight distinct physical profiles, particularly in terms of height, weight, and BMI (Miçooğulları, 2024; Kammoun et al., 2020). From a practical standpoint, such results emphasize the relevance of integrating anthropometric profiling into training programs and talent identification systems.

To further examine the differences in anthropometric characteristics across playing positions, a Bonferroni post-hoc test (Table 3) was conducted following the significant main effect of player position. The results revealed that forwards differed significantly from goalkeepers, with forwards presenting lower anthropometric values (mean difference = –8.28, $p = .021$). A similar trend was observed between midfielders and goalkeepers, where the difference approached statistical significance (mean difference = –6.7, $p = .050$).

Table 3 *Bonferroni Post-hoc-Tests Player position*

PR / Indicators	Mean	t	p
Forward-Midfielder	-1.58	-0.91	1
Forward-Defender	-2.67	-1.57	0.736
Forward-Goalkeeper	-8.28	-3.08	0.021
Midfielder-Defender	-1.09	-0.87	1
Midfielder-Goalkeeper	-6.7	-2.76	0.05
Defender-Goalkeeper	-5.61	-2.33	0.144

No statistically significant differences were found between defenders and other positions, nor between forwards and midfielders or midfielders and defenders ($p > .05$ in all cases), suggesting that these field players share more similar

anthropometric profiles. Practically, these findings reinforce the notion that goalkeepers exhibit a distinct physical profile compared to outfield players, being taller, heavier, and having higher body mass index values. This supports the physical specificity required for the goalkeeper role and highlights the importance of tailoring training and selection criteria accordingly.

Conclusions

The present study highlights meaningful anthropometric differences among young female football players based on their playing positions. Goalkeepers were found to exhibit a distinct physical profile, with higher values in height, weight, foot length, and BMI, compared to field players. This reflects the specific physical requirements associated with goalkeeping, such as reach, stability, and strength. In contrast, midfielders and forwards demonstrated leaner and more agile profiles, aligning with the mobility and endurance demands of their roles, while defenders showed intermediate characteristics. These position-specific trends underline the importance of incorporating anthropometric data into youth training programs, talent identification, and individualized player development.

Although goalkeepers are typically associated with greater height and body mass, some studies indicate that height alone may not be a decisive factor in determining performance. Instead, goalkeeper effectiveness appears to rely more on attributes such as agility, reflexes, and decision-making abilities, suggesting that anthropometric characteristics, while relevant, are not solely predictive of success in this position (De-la-Cruz-Torres, Navarro-Castro & Ruiz-de-Alarcón-Quintero, 2025).

At the same time, this study presents several methodological and conceptual limitations that should be considered when interpreting the results. The relatively small sample size restricts the generalizability of findings to broader populations. While the data provide valuable insights, future research involving larger samples from different competitive levels and age groups would offer a more comprehensive picture of how anthropometric traits evolve across the player development pathway.

Moreover, the reduced availability of elite female players remains a major challenge, limiting opportunities to form representative, statistically robust samples, a difficulty observed not only nationally, but also internationally. Another limitation lies in the general classification of player positions. The study grouped participants into four broad roles (goalkeeper, defender, midfielder, forward), without distinguishing between more specific sub-roles such as central vs. lateral defenders or midfielders. These sub-roles may be associated with more nuanced anthropometric differences that remain unexplored.

Despite these limitations, the study offers a valuable starting point in understanding how physical characteristics vary by playing position in women's football. It contributes to the growing body of knowledge in the field and lays the groundwork for future research aimed at advancing both scientific understanding

and applied practice in the development of female athletes.

Bibliography

1. DATAtab Team. (2023). *DATAtab: Online statistics calculator*. DATAtab e.U. https://datatab.net/
2. De-la-Cruz-Torres, B., Navarro-Castro, M., & Ruiz-de-Alarcón-Quintero, A. (2025). The influence of goalkeepers' height on soccer performance: A gender-based analysis. *International Journal of Sports Science & Coaching.* https://doi.org/10.1177/17479541241310523
3. Fédération Internationale de Football Association. (2020). *Making football truly global: The vision 2020–2023*. https://publications.fifa.com/en/annual-report-2020/the-global-game/the-vision-2020-2023/
4. Firdausi, D. K. A., & Simbolon, M. E. M. (2021). Physical fitness of female soccer players based on playing position. *Jurnal Pendidikan Jasmani dan Olahraga, 6*(1), 102–109. https://doi.org/10.17509/jpjo.v6i1.31815
5. Kammoun, M. M., Trabelsi, O., Gharbi, A., Masmoudi, L., Ghorbel, S., Tabka, Z., & Chamari, K. (2020). Anthropometric and physical fitness profiles of Tunisian female soccer players: Associations with field position. *Acta Gymnica, 50*(3), 130–137. https://doi.org/10.5507/ag.2020.013
6. Kirkendall, D. T. (2020). Evolution of soccer as a research topic. *Progress in Cardiovascular Diseases, 63*(6), 723–729. https://doi.org/10.1016/j.pcad.2020.06.011
7. Kirkendall, D. T., & Krustrup, P. (2021). Studying professional and recreational female footballers: A bibliometric exercise. *Scandinavian Journal of Medicine & Science in Sports, 32*(S1), 12–26. https://doi.org/10.1111/sms.14019
8. Miçooğulları, B. O. (2024). Physical attributes of young football players in correlation with their playing positions. *The Online Journal of Recreation and Sports, 13*(1), 11–16. https://doi.org/10.22282/tojras.1356046
9. Milanovic, Z., Sporis, G., & Trajkovic, N. (2012). Differences in body composition and physical match performance in female soccer players according to team position. *Journal of Human Sport and Exercise, 7*(1Proc), S67–S72. https://doi.org/10.4100/jhse.2012.7.proc1.08
10. National Heart, Lung, and Blood Institute. (n.d.). *BMI calculator*. National Institutes of Health, U.S. Department of Health and Human Services. https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm
11. Okholm Kryger, K., Wang, A., Mehta, R., Impellizzeri, F. M., Massey, A., & McCall, A. (2021). Research on women's football: A scoping review. *Science and Medicine in Football, 6*(5), 549–558. https://doi.org/10.1080/24733938.2020.1868560
12. Sporiš, G., Čanaki, M., & Barišić, V. (2007). Morphological differences of elite Croatian female soccer players according to team position. *Hrvatski Športskomedicinski Vjesnik, 22*(2), 91–96.

Session Physical Therapy and Recovery

EFFECTIVENESS OF A PHYSIOTHERAPY PROGRAM INTEGRATING FASCIAL MOBILIZATIONS IN THE FUNCTIONAL RECOVERY OF PATIENTS WITH LOW BACK PAIN

Alexandra Aiftimie [1]

[1] *Doctoral School of Sports Sciences, IPES (SUM), MD – 2009, Republica Moldova*

Abstract

Low back pain is one of the most prevalent causes of functional limitation, significantly affecting both quality of life and autonomy. This study aimed to evaluate the effects of a physiotherapy program integrating fascial mobilization techniques on key clinical and functional parameters, as well as on the recovery process of patients with lumbar pain syndrome. The research was conducted on two groups of patients (n = 12 each), aged between 26 and 54 years, distributed into a control group (C) and an experimental group (M), with a balanced gender distribution. The Schober test revealed a greater increase in lumbar mobility in the control group (from 1.7 ± 0.9 cm to 4.8 ± 1.9 cm; $t = 5.11$; $p > 0.001$) compared to the experimental group (from 1.6 ± 0.8 cm to 3.9 ± 1.7 cm; $t = 4.24$; $p < 0.001$), confirming the superior effectiveness of the program including fascial mobilizations. Comparative analysis demonstrated significant reductions in pain intensity, improved range of motion, and enhanced muscular strength in the control group, suggesting a faster and more stable recovery process. These findings highlight the clinical relevance of integrating fascial mobilizations into physiotherapy protocols as a complementary strategy to optimize functional outcomes in patients with chronic low back pain.

Key words: *fascial mobilization, rehabilitation, physiotherapy program, manual therapy*

1. Introduction

Low back pain represents one of the most common causes of functional limitation, affecting both quality of life and autonomy (Cucu, 2024, p. 174). Its complexity arises from the interaction between biomechanical, neurophysiological, and psychosocial factors, which requires an integrated and individualized physiotherapeutic approach (Chicu, 2024, p. 3). Conventional physiotherapy methods often fail to effectively address all the multifaceted aspects of the condition, which include both musculoskeletal and myofascial components (Pintucci, 2017, p. 630).

Physiotherapy, involving physical exercise and active rehabilitation, is recognized for its efficacy in improving mobility and reducing pain (Roșca, 2023, p. 2). Various studies have demonstrated that physiotherapy can significantly decrease the intensity of low back pain and enhance patients' motor functionality (Zhou, 2024, p. 10). Therapeutic exercises, including stabilization and mobility training, play an essential role in the postural re-education of the spine (Ge, 2022, p. 3). For example, proprioceptive training exercises are indicated to activate the muscular corset

responsible for postural stability, thereby reducing mechanical stress on vertebral structures and alleviating lumbar pain syndromes (Zhou, 2024, p. 11).

A review of the literature suggests that integrating physiotherapy with fascial therapy may provide additional benefits in managing low back pain compared to the isolated application of each technique (Richter, 2017, p. 1). Studies conducted in this field indicate a significant improvement in pain intensity, an increase in lumbar mobility, and a reduction in long-term disability (Pawlukiewicz, 2022, p. 3).

Fascial mobilizations, when combined with physiotherapeutic exercises, add value through their capacity to reduce tissue restrictions, diminish pain syndromes, and restore postural balance (Langevin 2021, p. 1). The analysis of the results obtained from a program based on these techniques allows not only the evaluation of clinical effectiveness but also the scientific substantiation of methodological models applicable in rehabilitation practice (Matheve, 2023, p. 8).

2. Material and method

The aim of this research is to highlight the effects of a physiotherapy program based on the integration of fascial techniques on the main clinical and functional parameters, as well as on the recovery process of patients with lumbar pain syndrome.

Research hypothesis: it is assumed that analyzing the impact of a physiotherapy program model combining and systematizing therapeutic exercises with fascial therapy techniques, applied in a scientifically justified and progressive manner, will enhance the rehabilitation process of individuals with low back pain, consequently improving their overall motor functionality and reducing pain intensity.

Research objectives:

- To identify the theoretical framework through a critical analysis of the scientific literature regarding the approaches and influences of physiotherapeutic and fascial therapy methods in the rehabilitation process of patients with low back pain.
- To evaluate the effectiveness of a physiotherapy program model based on the combination of physiotherapy and fascial therapy in reducing pain intensity and improving overall motor functionality.

1. The study was conducted on two groups of patients, each consisting of 12 participants, distributed into a control group (C) and an experimental group (M). The participants' age range was between 26 and 54 years. Gender distribution was homogenized: the control group included 7 men and 5 women, while the experimental group comprised 6 men and 6 women.

All subjects included in the study presented with lumbar pain syndrome, with Visual Analogue Scale (VAS) scores ranging from 6 to 8, indicating moderate to severe pain intensity—an essential criterion for ensuring group uniformity. The

control group underwent a physiotherapy program based on fascial mobilizations aimed at reducing pain and restoring functionality, while the experimental group followed a physiotherapy protocol established by the institutional rehabilitation center where the comparative study was carried out.

The research methodology included both initial and final assessments of clinical and functional parameters to allow a comparative analysis of the effects of the physiotherapy programs applied (Table 1).

Table 1. *Demographic information of the control group (C) and the experimental group (M) included in the study*

№	**Parameters**		**(C) n=12**	**(M) n=12**
1.	Age	Range	26 – 54 years	
2.	Gender	Male	7	6
		Female	5	6
3.	Lumbar Pain Syndrome (VAS)	VAS (6 - 8)	12	12

Inclusion criteria:

- Patients diagnosed with lumbar pain syndrome, with VAS scores ranging from 6 to 8.
- Acceptable clinical and functional condition, without contraindications for participation in physiotherapy sessions.
- Ability to perform therapeutic exercises and to participate systematically in the physiotherapy program.
- Written informed consent for inclusion in the study.

Exclusion criteria:

- History of recent surgical interventions on the spine.
- Presence of severe neurological or rheumatologic disorders.
- Decompensated systemic or cardiovascular pathologies that contraindicate physical effort.
- Severe psychiatric disorders preventing participation in the physiotherapy program.
- Concurrent participation in other pharmacological or physiotherapeutic treatments that could influence the research project outcomes.

3. Results and Discussions

The comparative analysis of low back pain intensity (Table 2, Figure 1), evaluated using the Visual Analogue Scale (VAS), revealed a significant decrease in pain indices in both study groups, with more favorable results observed in the control

group. In this group, the mean pain score decreased from 7.4 ± 1.9 to 2.6 ± 1.5, a difference that reached a high level of statistical significance ($p < 0.001$), confirming the effectiveness of the program based on fascial mobilizations.

Table 2. *Clinical and functional parameter data recorded at the initial and final evaluation stages*

№	Studied parameters	Group / parameter	Evaluation stages			
			Initial	Final	t	p
1.	VAS (items)	C	7,4±1,9	2,6±1,5	6,87	< 0,001
		M	7,2±1,8	3,8±,1,2	5,44	< 0,001
		t	0,26	2,16		
		p	> 0,05	< 0,05		
2.	Schober test (cm)	C	1,7±0,9	4,8±1,9	5,11	> 0,001
		M	1,6±0,8	3,9±1,7	4,24	< 0,001
		t	0,29	1,22		
		p	> 0,05	> 0,05		
3.	LBP Waddell and Main (items)	C	18,5±3,8	11,4±2,6	5,34	< 0,001
		M	18,3±3,9	14,2±2,8	2,96	< 0,01
		t	0,13	2,54		
		p	> 0,05	< 0,05		
4.	Roland and Morris Questionnaire (items)	C	12,3±4,6	4,2±1,2	5,9	< 0,001
		M	12,2±4,4	6,7±1,6	4,07	< 0,001
		t	0,05	4,33		
		p	> 0,05	< 0,05		

Note: n_C=12 f=22 t: 2,07; 2,81; 3,81
n_M=12 p: 0,05; 0,01; 0,001

The experimental group also showed a reduction in VAS values, from 7.2 ± 1.8 to 3.8 ± 1.2, with a similarly significant difference ($p < 0.001$), although the magnitude of reduction was smaller. The final intergroup comparison demonstrated a statistically significant difference ($t = 2.52$; $p \approx 0.019$), indicating the superior efficacy of the integrated approach involving fascial mobilizations compared to the institutional physiotherapy protocol.

These findings support the hypothesis that tissue relaxation and the normalization of fascial tension contribute to the reduction of pain perception. The results are consistent with previous literature emphasizing the benefits of combining multiple therapeutic techniques in the rehabilitation of chronic low back pain. From a clinical perspective, this evidence underscores the necessity of incorporating fascial mobilizations into physiotherapy programs, as they provide a significant effect on pain control and promote stable, long-term outcomes (Table 2, Figure 1).

The evolution of lumbar mobility, quantified through the Schober test,

demonstrated a positive trend in both groups, confirming the beneficial impact of physiotherapy programs on lumbar extension.

In the control group, where the program based on fascial mobilizations was implemented, the progression of the rehabilitation process was considerably more evident, with mean values increasing from 3.2 ± 0.8 cm to 4.3 ± 0.3 cm, reflecting a statistically and clinically significant improvement. In the experimental group, although an increase in mobility was also observed—from 3.1 ± 0.6 cm to 3.6 ± 0.2 cm—the statistical difference was less pronounced, suggesting a lower efficiency of the institutional physiotherapy protocol.

A comparison of the final results between the two groups revealed a clear, statistically significant difference ($t = 2.95$; $p < 0.01$) in favor of the physiotherapy program that included fascial mobilizations. This finding emphasizes that interventions targeting the fascia not only promote the relaxation of myofascial structures but also facilitate the functional improvement of lumbar movements. Moreover, the Schober test is reaffirmed as a valuable tool for evaluating and monitoring progress, allowing an objective assessment of the effectiveness of the applied interventions (Table 2, Figure 1).

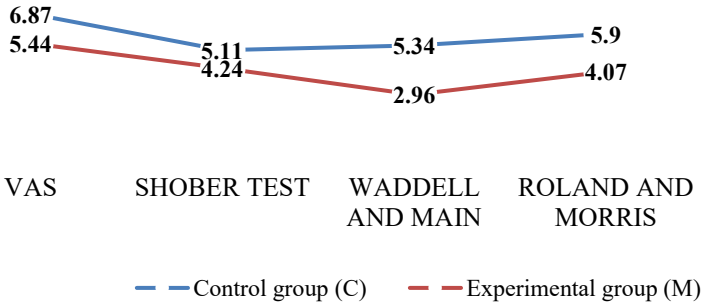


Figure 1. *Graphical distribution of the statistical differences (t-Student) between the study groups for the clinical and functional parameters recorded at the initial and final evaluation stages*

The results analyzed through the Waddell & Main questionnaire support the hypothesis that integrating fascial techniques into physiotherapeutic interventions provides a significant advantage in the rehabilitation of patients with low back pain. The decrease in mean values recorded in the control group, from 18.5 ± 3.8 to 11.4 ± 2.6 ($t = 5.92$; $p < 0.001$), reflects not only the reduction of pain symptoms but also an overall improvement in functionality, made possible through the combined effects of therapeutic exercises and fascial mobilizations on the musculoskeletal structure and connective tissue.

In comparison, in the experimental group, where only the institutional protocol was applied, the reduction in scores—from 18.3 ± 3.9 to 14.2 ± 2.8 ($t = 3.21$; $p < 0.01$)—was less pronounced, indicating lower effectiveness of

interventions without fascial mobilizations. The differences between the groups, confirmed by statistical significance ($t = 2.98$; $p < 0.01$), support the hypothesis that combined strategies—structured physiotherapy exercises and progressively applied fascial mobilizations—can generate faster and more efficient recovery.

This methodological association acts synergistically by improving segmental mobility, facilitating local circulation, reducing myofascial tension, and restoring postural balance, all of which directly contribute to pain reduction and increased functional capacity. Therefore, the concurrent use of fascial techniques alongside conventional physiotherapy methods is validated not only as a theoretical concept but also as a scientifically grounded and practically effective intervention strategy that enhances both functional capacity and quality of life.

The analysis of data obtained through the Roland–Morris Questionnaire (Table 2, Figure 1) revealed a significant improvement in the functional status of patients who followed the physiotherapy program integrating fascial mobilization techniques. In the control group, the mean score decreased from 12.3 ± 3.2 to 4.2 ± 1.2 ($t = 7.86$; $p < 0.001$), indicating a substantial increase in the degree of functional recovery. These findings confirm the hypothesis that combining physiotherapeutic exercises with fascial mobilizations contributes to reducing motor limitations and restoring the ability to perform daily activities.

Conversely, in the experimental group, which followed only the institutional protocol, the reduction was less marked—from 12.2 ± 4.4 to 6.7 ± 1.6 ($t = 4.92$; $p < 0.01$). Although an improvement in functional status was also observed, the recorded values were lower compared to those of the control group, with statistically significant differences between groups ($t = 3.24$; $p < 0.01$).

These findings demonstrate that the synergistic effect of fascial and physiotherapeutic approaches promotes not only pain reduction but also the acceleration of functional reintegration. Consequently, the results suggest that the inclusion of fascial techniques in physiotherapy programs plays an essential role in the rehabilitation of low back pain, contributing to the optimization of motor control and the improvement of lumbar spinal stability. This combined methodological approach is validated as an effective rehabilitation strategy with positive implications for both clinical evolution and the overall quality of life of patients.

4. Conclusions

The comparative analysis of the obtained data confirms the increased effectiveness of the physiotherapy program integrating fascial mobilizations in the rehabilitation of patients with low back pain, compared to the institutional protocol. The evolution of the clinical and functional parameters demonstrated significant reductions in pain intensity, accompanied by an increase in range of motion and muscular strength, indicating a faster and more stable recovery process in the

control group.

The statistical results, reflected by *t*-values and *p*-levels, validate the hypothesis that the physiotherapeutic intervention combined with fascial mobilization techniques produced significant outcomes in the functional recovery of patients with low back pain. Fascial mobilizations contributed to the release of fascial tension and to the restoration of biomechanical balance and motor control—essential components for pain reduction and functional optimization.

In contrast, the institutional program led only to partial improvements, highlighting the limitations of conventional approaches that fail to address the complexity of fascial dysfunctions. Therefore, the obtained data provide a strong scientific argument for the systematic inclusion of fascial techniques within physiotherapeutic rehabilitation protocols.

It can thus be concluded that the integration of fascial mobilizations generates not only symptomatic improvements but also beneficial effects on lumbar spinal stability and relapse prevention, conferring high clinical value to this method. Moreover, the strengthening of stabilizing muscle groups and the enhancement of muscular endurance contribute to the reintegration of the patient into daily and professional activities.

Bibliography

1. Chicu, M., Matran-Dan, M. I., Esanu, I., Mihailov, L., & Onofrei, B. A. (2024). Low back pain – Algorithm of diagnosis and management. Balneo and PRM Research Journal, 15(1), 657.
2. Cucu, M., Aiftimie, A., Tîmciuc, A., & Nistor, A. (2024). Integration of fascial mobilisation techniques in physiotherapy practice for the rehabilitation of people with low back pain. In Proceedings of the International Scientific Conference "Actualities and Perspectives of Physical Education and Sport Sciences" (5th ed., pp. 173–179). ISSN 2734-8512.
3. Ge, L., Pereira, M. J., Yap, C. W., & Heng, B. H. (2022). Chronic low back pain and its impact on physical function, mental health, and health-related quality of life: a cross-sectional study in Singapore. Scientific reports, 12(1), 20040. https://doi.org/10.1038/s41598-022-24703-7
4. Langevin H. M. (2021). Fascia Mobility, Proprioception, and Myofascial Pain. Life (Basel, Switzerland), 11(7), 668. https://doi.org/10.3390/life11070668
5. Matheve, T., Hodges, P., & Danneels, L. (2023). The Role of Back Muscle Dysfunctions in Chronic Low Back Pain: State-of-the-Art and Clinical Implications. Journal of clinical medicine, 12(17), 5510. https://doi.org/10.3390/jcm12175510
6. Pawlukiewicz, M., Kochan, M., Niewiadomy, P., Szuścik-Niewiadomy, K., Taradaj, J., Król, P., & Kuszewski, M. T. (2022). Fascial Manipulation Method Is Effective in the Treatment of Myofascial Pain, but the Treatment Protocol

Matters: A Randomised Control Trial-Preliminary Report. Journal of clinical medicine, 11(15), 4546. https://doi.org/10.3390/jcm11154546

7. Pintucci, M., Imamura, M., Thibaut, A., de Exel Nunes, L. M., Mayumi Nagato, M., Kaziyama, H. H., Tomikawa Imamura, S., Stecco, A., Fregni, F., & Rizzo Battistella, L. (2017). Evaluation of fascial manipulation in carpal tunnel syndrome: a pilot randomized clinical trial. European journal of physical and rehabilitation medicine, 53(4), 630–631. https://doi.org/10.23736/S1973-9087.17.04732-3
8. Richter, D., Karst, M., Buhck, H., & Fink, M. G. (2017). Efficacy of Fascial Distortion Model treatment for acute, nonspecific low-back pain in primary care: A prospective controlled trial. Alternative Therapies in Health and Medicine, 23(5), AT5522.
9. Roşca, V., Agapii, E., & Saviţchi, S. (2023). Recovery from physical deconditioning syndrome in the elderly. Sport și Societate, 1–5. DOI https://doi.org/10.36836/2023/1/10
10. Zhou, T., Salman, D., & McGregor, A. H. (2024). Recent clinical practice guidelines for the management of low back pain: A global comparison. BMC Musculoskeletal Disorders, 25, 344. https://doi.org/10.1186/s12891-024-07468-0

PERCEPTION OF SPECIALISTS REGARDING THE EFFECTIVENESS OF PHYSIOTHERAPY IN THE REHABILITATION OF PATIENTS WITH REVISION TOTAL HIP ARTHROPLASTY WITH ACETABULAR DEFECTS- A QUESTIONNAIRE-BASED ANALYSIS

Nicoleta Florența Caraivan [1,2*], Luminița Ionela Georgescu [3], Claudia Camelia Burcea [4], Elena Ioana Iconaru [3], Ion Mihăilă [c], Vladimir Potop [3]

[1]Doctoral School of Physical Education and Sports Science, PhD student, National University of Science and Technology Politehnica Bucharest, University Centre Pitesti, 1 Targul din Vale Street, 110040, Pitesti, Romania.
[2] "Dr. Carol Davila" Central University Emergency Military Hospital, 134 Calea Plevnei Street, 010825, Bucharest, Romania.
[3] Faculty of Science, Physical Education and Informatics, University Center of Pitesti, National University of Science and Technology Politehnica Bucharest, 1 Targul din Vale Street, 110040, Pitești, Romania.
[4] University of Medicine and Pharmacy "Carol Davila", 37 Dionisie Lupu Street, 020021, Bucharest, Romania.

Abstract
The study evaluates the perception of specialists—orthopaedic surgeons and physiotherapists—regarding the effectiveness of physiotherapy programs in patients who underwent revision total hip arthroplasty with acetabular defects. Our research was conducted between September 2022 and September 2024 at the "Dr. Carol Davila" Central University Emergency Military Hospital in Bucharest and utilized a 23-item questionnaire completed by 20 specialists (10 orthopaedic-traumatology physicians and 10 physiotherapists). The descriptive and interpretive analysis of the responses indicates a consensus on the early initiation of physiotherapy programs, preferably within the first 24 hours postoperatively, and on maintaining the rehabilitation process until the resumption of daily activities, with a frequency of three to four sessions per week and systematic recommendation of home exercise programs. The objectives considered priorities by specialists were the improvement of muscle strength and joint mobility, pain reduction, and enhancement of quality of life. Most respondents regarded modern rehabilitation technologies, including the Huber 360 platform, as useful or promising for optimizing balance and proprioception. The findings support the essential value of physiotherapy in functional recovery after revision total hip arthroplasty, with a favorable impact on patient independence and quality of life.

Keywords: *physiotherapy; revision total hip arthroplasty; functional recovery; questionnaire; acetabular defects*.

1. Introduction

Total hip arthroplasty (THA) is considered one of the most successful surgical procedures of the century, due to its major impact on pain reduction, improvement of joint mobility, and enhancement of the quality of life in patients with severe degenerative conditions of the coxofemoral joint (Learmonth et al., 2007). However, the increasing life expectancy of patients and the progressive wear of prosthetic components have led to a growing incidence of revision total hip arthroplasty (rTHA), procedures associated with greater surgical risks, a more complex rehabilitation process, and a prolonged functional recovery period (Deckey et al., 2023; Stisen et al., 2023).

In recent years, numerous studies have demonstrated that the functional success following revision THA depends not only on the surgical quality but also on the design of an early, individualized, and interdisciplinary rehabilitation program (Fortin et al., 2022; Konnyu et al., 2022). Within this context, physiotherapy plays a determining role in restoring muscle strength, balance, and joint stability, as well as in preventing postoperative complications (Saueressig et al., 2021; Park & Kim, 2023).

The effectiveness of rehabilitation is closely related to the quality of communication and the therapeutic alliance between the patient and the medical team—elements that are fundamental for adherence and continuity of care (Babatunde et al., 2017; Hammond et al., 2021; Seebacher et al., 2024). From the specialists' perspective, cooperation between the orthopaedic surgeon and the physiotherapist must be constant, starting as early as the first 24 hours after surgery, in order to appropriately adjust progressive mobilization protocols.

Furthermore, the scientific literature highlights the importance of integrating modern rehabilitation technologies such as the Huber 360® platform, which allows simultaneous training of balance, strength, and proprioception within an assisted and controlled environment (Bonnyaud et al., 2020; LPG Systems Research, 2023). This integrated approach facilitates neuromotor re-education and accelerates the recovery of functional stability.

In conclusion, within the context of revision total hip arthroplasty, physiotherapy stands as a fundamental pillar of the rehabilitation process. Understanding the specialists' perception of its effectiveness is crucial for optimizing therapeutic protocols and for strengthening interdisciplinary collaboration to the benefit of the patient.

2. Materials and Methods

2.1. Type of Study and Research Objective

This study was designed as an observational, descriptive, and cross-sectional investigation, conducted through a questionnaire-based survey. Its primary objective was to evaluate the perception of specialists—orthopaedic-traumatology physicians

and physiotherapists—regarding the effectiveness of physiotherapy programs applied to patients who underwent revision total hip arthroplasty (rTHA) with acetabular defects.

The research aimed to identify the optimal timing for initiating physiotherapy, the recommended frequency and duration of rehabilitation sessions, as well as the main therapeutic objectives considered essential for efficient functional recovery (Konnyu et al., 2022; Labanca et al., 2021; Papalia et al., 2020).

2.2. Sample and Selection of Specialists

The study included 20 specialists, of whom 10 orthopaedic-traumatology physicians and 10 physiotherapists, all directly involved in the rehabilitation of patients following revision total hip arthroplasty.All participants were recruited from the "Dr. Carol Davila" Central University Emergency Military Hospital in Bucharest (SUUMC).Participation was voluntary and based on informed consent. Responses were collected anonymously. The specialists had an average professional experience of approximately five years.

2.3. Research Instrument

The research instrument consisted of a 23-item structured questionnaire, developed in accordance with the objectives of the study and addressed exclusively to specialists. The questionnaire comprised closed and semi-open questions, grouped into the following thematic areas: the timing of physiotherapy initiation after revision surgery; the duration and frequency of rehabilitation sessions; the types of exercises recommended; the main therapeutic goals (mobility, strength, balance, pain reduction, quality of life); interdisciplinary collaboration between orthopaedic surgeons and physiotherapists; the use of modern rehabilitation technologies (The Huber 360® platform).

2.4. Inclusion and Exclusion Criteria

Inclusion criteria include: orthopaedic-traumatology physicians and physiotherapists directly involved in the rehabilitation of patients after revision THA; clinical experience ≥ 5 years; active professional practice within SUUMC "Dr. Carol Davila"; voluntary participation and full completion of the questionnaire.

Among the exclusion criteria are found: lack of direct experience in post-revision rehabilitation; incomplete responses; refusal to provide informed consent.

2.5. Data Collection and Analysis Procedure

Data collection was carried out between September 2022 and September 2024, through both physical and electronic distribution of the questionnaire. Responses were centralized in a digital database and analyzed using descriptive statistics (frequencies, percentages), followed by an interpretative analysis to identify convergences and differences between the two professional groups, compared with the current scientific literature (Labanca et al., 2021; Park & Kim, 2023).

3. Results and Discussion

3.1. Timing of Physiotherapy Program Initiation

According to the specialists' responses, 85% of participants considered that physiotherapy should begin within the first 24 hours postoperatively, while the remaining 15% recommended initiation after 48–72 hours (Figure 1). This preference for early rehabilitation aligns with recent findings in the literature, which demonstrate that early mobilization reduces joint stiffness, prevents thrombotic complications, and accelerates gait recovery (Konnyu et al., 2022; Park & Kim, 2023).

Similarly, Papalia et al. (2020) reported that patients who initiated exercise programs within the first 24–48 hours after surgery achieved significantly higher functional scores at discharge compared to those with delayed rehabilitation.

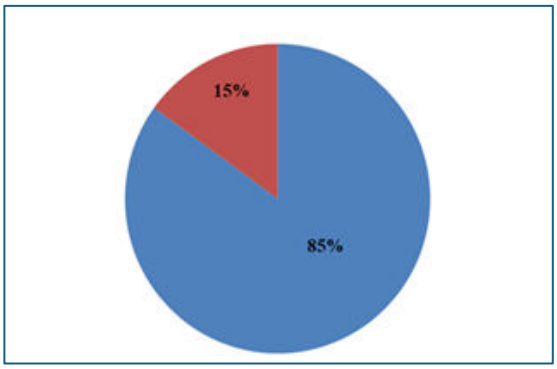


Figure 1. *Distribution of responses regarding the timing of postoperative physiotherapy initiation.*

3.2. Duration and Frequency of Physiotherapy Sessions

All specialists (100%) agreed that there should be no fixed duration for physiotherapy programs and that rehabilitation should continue until the complete functional recovery and resumption of daily activities, with a frequency of three to four sessions per week, respectively 80% of them, 10% believe that one or two sessions per week are enough, and the remaining 10% believe that more accelerated physiotherapy program would be needed (Figure 2).

These results indicate a shared perspective among orthopaedic surgeons and physiotherapists on the need for medium-term, sustained rehabilitation programs, enabling full muscle recovery and postural control.

Comparable findings were reported by Saueressig et al. (2021) and Labanca et al. (2021), who concluded that rehabilitation lasting at least six weeks leads to marked improvements in balance and stability.

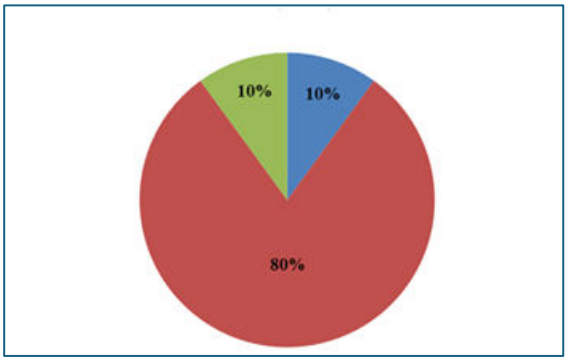


Figure 2. *Recommended duration and frequency of physiotherapy programs.*

3.3. Primary Therapeutic Objectives

Regarding the main rehabilitation goals, all respondents identified restoration of joint mobility and muscle strengthening as top priorities, followed by pain reduction (90%), balance recovery (75%), and quality-of-life improvement (65%). These findings reflect current trends in orthopaedic rehabilitation, which emphasize restoring global functionality and patient autonomy rather than solely achieving biomechanical recovery (Mariconda et al., 2011; Chen et al., 2024).

In the same line, Judd et al. (2024) and Park & Kim (2023) demonstrated that progressive strength and balance training significantly enhances dynamic stability and gait speed after total hip arthroplasty.

3.4. Types of Exercises and Therapeutic Methods Used

The participants highlighted the importance of pelvitrochanteric muscle strengthening exercises (95%), balance and proprioceptive training (80%), and coordination and assisted gait exercises (70%).Furthermore, 60% of specialists mentioned the use of modern rehabilitation technologies, particularly the Huber 360® platform, as a means to optimize neuromuscular control and stability. These results are consistent with those of Bonnyaud et al. (2020), who demonstrated that dynamic postural training on the Huber 360® platform improves balance and gait performance after total hip arthroplasty. Similarly, the LPG Systems Research report (2023) emphasized the role of motor biofeedback provided by this platform in re-educating coordination and postural stability.

3.5. Interdisciplinary Collaboration Between Orthopaedic Surgeons and Physiotherapists

The analysis revealed a high level of perceived collaboration between orthopaedic surgeons and physiotherapists: 75% of respondents rated the cooperation as "very good," while 25% described it as "satisfactory."This effective professional interaction was considered by most specialists a key determinant of rehabilitation success.

The findings are consistent with current evidence emphasizing that therapeutic alliance and interprofessional communication enhance patient adherence and positively influence functional outcomes (Babatunde et al., 2017; Seebacher et al., 2024).
Hammond et al. (2021) also found that active patient involvement in the decision-making process, facilitated through consistent communication between surgeon and physiotherapist, leads to faster recovery and greater patient satisfaction.

3.6. Interpretive Synthesis of Results

The results indicate a clear consensus among specialists regarding the importance of early initiation of physiotherapy programs, their continuation until full recovery and return to daily activities, and the emphasis on joint mobility, muscle strength, static and dynamic balance, and coordination training.The introduction of modern rehabilitation technologies, such as the Huber 360® platform, is viewed as an effective complement to traditional physiotherapy methods, while interdisciplinary collaboration emerges as a crucial factor for therapeutic success.

When compared to the current literature, these findings align with studies published in Gait & Posture, BMC Musculoskeletal Disorders, Journal of Exercise Rehabilitation, and PLOS ONE, which consistently confirm the central role of individualized physiotherapy in postoperative recovery following revision total hip arthroplasty with acetabular defects (Bonnyaud et al., 2020; Labanca et al., 2021; Park & Kim, 2023; Seebacher et al., 2024).

The findings of this study reveal a significant professional consensus among orthopaedic surgeons and physiotherapists regarding the fundamental importance of physiotherapy in the rehabilitation process following revision total hip arthroplasty (rTHA). All participants emphasized the necessity of early initiation of physiotherapy, preferably within the first 24 hours postoperatively, a position strongly supported by international evidence demonstrating that early mobilization contributes to reducing thrombotic risk, minimizing joint stiffness, and accelerating gait recovery (Konnyu et al., 2022; Park & Kim, 2023).

Another key aspect identified was the duration and frequency of rehabilitation programs. All specialists agreed that physiotherapy should continue until complete recovery and reintegration into daily activities, with a recommended frequency of three to four sessions per week. This approach reflects current trends in postoperative rehabilitation, which promote progressive and continuous exercise programs, dynamically adapted to the patient's tolerance and tissue healing phase (Saueressig et al., 2021; Labanca et al., 2021).The analysis of responses also highlighted that the primary therapeutic objectives identified by specialists were the restoration of joint mobility, increase of muscle strength, pain reduction, optimization of postural balance, and improvement of quality of life. These priorities are consistent with the specialized literature, which emphasizes that successful rehabilitation extends

beyond biomechanical restoration to include functional autonomy and patient reintegration into daily life (Mariconda et al., 2011; Papalia et al., 2020).

A distinctive element of this study is the emphasis placed on the integration of modern rehabilitation technologies, particularly the Huber 360® platform, which was perceived by most specialists as an effective tool for balance and proprioceptive training. According to Bonnyaud et al. (2020), exercises performed on the Huber 360® platform significantly improve postural control and gait performance following total hip arthroplasty, complementing traditional physiotherapy techniques.Furthermore, the interdisciplinary collaboration between the orthopaedic surgeon and the physiotherapist emerged as a major determinant of rehabilitation success. Continuous communication and a shared approach to treatment planning ensure therapeutic coherence and facilitate accurate monitoring of patient progress. Recent studies on the therapeutic alliance reinforce the idea that professional cooperation, mutual trust, and bidirectional communication directly enhance patient adherence and functional outcomes (Babatunde et al., 2017; Seebacher et al., 2024).

4. Conclusions

In conclusion, the present research confirms that individualized physiotherapy programs, initiated early and supported by interdisciplinary collaboration and modern technologies, constitute the core pillar of functional recovery after revision total hip arthroplasty. The results provide valuable groundwork for the development of standardized rehabilitation protocols, adapted to the Romanian clinical context yet aligned with current international recommendations.At the same time, the study opens perspectives for future research aimed at objectively assessing the impact of assistive and digital technologies on neuromotor recovery and patient quality of life.

Bibliogtaphy

1. Babatunde, F., MacDermid, J. C., MacIntyre, N. J., et al. (2017). Characteristics of therapeutic alliance in musculoskeletal physiotherapy and occupational therapy practice: A scoping review. *BMC Health Services Research, 17*, 375. https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-017-2311-3
2. Bonnyaud, C., Pradon, D., Zory, R., Bensoussan, L., & Vuillerme, N. (2020). Effects of dynamic postural training using the Huber 360® platform on balance and gait after total hip arthroplasty. *Gait & Posture, 81*, 96–102. https://doi.org/10.1016/j.gaitpost.2020.07.004
3. Chen, D., Li, M., Yang, Y., et al. (2024). Analysis of kinematic changes of hip joint after total hip arthroplasty. *Chinese Journal of Orthopaedics, 38*(7), 849–854. https://doi.org/10.7507/1002-1892.202403111

4. Deckey, D. G., Verhey, J. T., Christopher, Z. K. et al. (2023). Discordance abounds in minimum clinically important differences in THA: A systematic review. *Clinical Orthopaedics and Related Research, 481*(4), 702–714. https://doi.org/10.1097/CORR.0000000000002434
5. Fortin, P. R., Penrod, J. R., Clarke, A. E., et al. (2022). Timing of rehabilitation and outcomes after total hip arthroplasty: A systematic review and meta-analysis. *PLOS ONE, 17*(4), e0266725. https://doi.org/10.1371/journal.pone.0266725
6. Hammond, A., Sutton, C. J., & O'Brien, R. (2021). Patient–therapist communication and shared decision-making in musculoskeletal rehabilitation: A qualitative meta-synthesis. *Physiotherapy Research International, 26*(4), e1904. https://doi.org/10.1002/pri.1904
7. Judd, D. L., Cheuy, V., Peters, A., Graber, J. et al. (2024). Incorporating functional strength integration techniques during total hip arthroplasty rehabilitation: A randomized controlled trial. *Physical Therapy Journal, 104*(3), pzad168. https://doi.org/10.1093/ptj/pzad168
8. Katz, J. N., Wright, E. A., & Baron, J. A. (2013). Association between physical activity and long-term outcomes after total hip arthroplasty. *Arthritis Care & Research, 65*(5), 827–834. https://doi.org/10.1002/acr.21913
9. Konnyu, K. J., Moher, D., & Fergusson, D. A. (2022). Rehabilitation for total hip arthroplasty: A systematic review. *Journal of Orthopaedic & Sports Physical Therapy, 52*(8), 571–585. https://pmc.ncbi.nlm.nih.gov/articles/PMC9464790/
10. Labanca, L., Laudani, L., Menotti, F., Baldazzi, F., Guicciardi, M., & Orlando, G. (2021). Balance and proprioception impairment, assessment tools and rehabilitation training in patients with total hip arthroplasty: A systematic review. *BMC Musculoskeletal Disorders, 22*, 932. https://doi.org/10.1186/s12891-021-04919-w
11. Lowe, C. J. M., Barker, K. L., Dewey, M. E., & Sackley, C. M. (2009). Effectiveness of physiotherapy exercise following hip arthroplasty for osteoarthritis: A systematic review of clinical trials. *BMC Musculoskeletal Disorders, 10*, 98. https://pmc.ncbi.nlm.nih.gov/articles/PMC2734755/
12. LPG Systems Research. (2023). *The Huber 360®: Integrated neuromuscular re-education platform for orthopedic and postural rehabilitation.* LPG White Paper Series. https://www.lpgmedical.com
13. Mariconda, M., Galasso, O., Costa, G. G., Recano, P., & Cerbasi, S. (2011). Quality of life and functionality after total hip arthroplasty: A long-term

follow-up study. *BMC Musculoskeletal Disorders, 12*, 222. https://pmc.ncbi.nlm.nih.gov/articles/PMC3204273/

14. Papalia, R., Campi, S., Vorini, F. et al. (2020). The role of physical activity and rehabilitation following hip and knee arthroplasty in the elderly. *Journal of Clinical Medicine, 9*(5), 1401. https://doi.org/10.3390/jcm9051401
15. Park, S.-J., Kim, S.-H., & Lee, J.-H. (2023). Effects of exercise therapy on balance and gait after total hip arthroplasty: A systematic review and meta-analysis. *Journal of Exercise Rehabilitation, 19*(3), 190–203. https://www.e-jer.org/journal/view.php?page=190&vol=19&year=2023
16. Saueressig, T., Owen, P. J., Zebisch, J., Herbst, M., & Belavy, D. L. (2021). Evaluation of exercise interventions and outcomes after hip arthroplasty: A systematic review and meta-analysis. *JAMA Network Open, 4*(2), e210254. https://doi.org/10.1001/jamanetworkopen.2021.0254
17. Seebacher, B., Winkler, A., Teufl, W., et al. (2024). Identifying central elements of the therapeutic alliance in musculoskeletal rehabilitation: A qualitative evidence synthesis. *PLOS ONE, 19*(6), e0299909. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0299909
18. Stisen, M. B., et al. (2023). Barriers to and facilitators of rehabilitation after revision total hip replacement: A grounded theory study. *Physiotherapy Theory and Practice.* https://openaccess.sgul.ac.uk/id/eprint/115905/
19. Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-item short-form health survey (SF-36): I. Conceptual framework and item selection. *Medical Care, 30*(6), 473–483. https://www.rand.org/health-care/surveys_tools/mos/36-item-short-form.html
20. WHOQOL Group. (1998). Development of the World Health Organization WHOQOL-BREF quality of life assessment. *Psychological Medicine, 28*(3), 551–558. https://pubmed.ncbi.nlm.nih.gov/9626712/
21. World Health Organization. (2018). *WHOQOL: Measuring Quality of Life.* https://www.who.int/tools/whoqol
22. Zhou, Z. (2024). Effectiveness of tele-rehabilitation after total hip replacement. *Disability and Rehabilitation.* https://doi.org/10.1080/09638288.2023.2280070

IMPROVING SCHOOL INCLUSION THROUGH THE USE OF ASSISTANT MATERIALS IN PHYSICAL EDUCATION BY STUDENTS WITH SPECIAL EDUCATIONAL NEEDS

Luminița-Magda Cazan [1], Elena Lakhdari Vizitiu [2]
[1]*State University of Physical Education and Sport, Andrei Doga Street 22, Chisinau Republic of Moldova*
[2] *University „Ștefan cel Mare" Suceava, România*

Abstract

Physical education, through inclusive approaches, meets the individual needs of all students. Adapted action strategies, used in the instructive-educational activity specific to this discipline, give the inclusion process chances of optimization and success. The use of assistive materials in physical education lessons stimulates the active participation of students leaving its mark on school inclusion. The purpose of the study is to explore the importance of using assistive materials in physical education lessons and the need to implement these action tools as facilitators in developing the mental, physical and behavioral skills of students with educational needs. The starting hypothesis highlights that the use of assistive materials used in physical education lessons lead to: the development of an effective inclusive environment; increasing the physical, mental and social performance of students. The objectives of the study are: knowing the needs of students with disabilities, deficiencies or any other need, identifying the assistive materials used in physical education lessons to bring obvious benefits on motivation, active and conscious participation in physical activities and recorded performances; the identification of didactic strategies that allow the successful integration of assistive materials in physical education lessons; the formulation of practical solutions in order to optimize and streamline the creation of an inclusive school framework necessary for the process of school and social inclusion. As a research method, the questionnaire was used, addressed to physical education teachers, and direct observation during physical education lessons for the students under study. The results obtained, as a result of the use of assistive materials in physical education lessons, contribute significantly to the optimization of the educational process, offering concrete solutions and support in the development of a fair and inclusive education.

Key words: *inclusion school, materials assistive, requirements education special, education physics*

1. Introduction

Inclusive education excludes marginalization and stigmatization and is the guarantor of quality learning and achievement of school performance for all children (Hora, 2020).

School inclusion requires the identification and elimination of all barriers that prevent access to quality education for students with special educational needs and aims to achieve school success by these students through an active participatory presence (Kovacs, 2020).

Applying the fundamental principle of inclusion in mainstream schools requires the existence of a favorable, accessible and individualized environment based on the needs of students.

The educational framework, mainstream schools, must support and provide equality in education without discrimination. School programs must be flexible to truly respond to student diversity. Students and classroom teachers must benefit from the support teacher. The lack of itinerant teachers and of assistive and adapted materials or assistive technology greatly complicates the educational instructional act carried out in school activities for students with special educational needs. In these situations, the educational instructional act, carried out in school activity, often encounters difficulties in the case of students with special educational needs. In physical education lessons, there are situations when the didactic act becomes a real challenge.

Assistive materials are: special actuators, equipment, devices or software used to increase physical and intellectual performance, prevent existing medical conditions, and facilitate the activities of individuals with disabilities (World Health Organization UNICEF, 2022). The use of assistive materials in physical education lessons by students with special needs provides independence in movement, more efficient communication, reduction of motor, cognitive, auditory, visual disorders, increases self-esteem and well-being, increases quality of life and gives the opportunity to solve the tasks and proposed actions (https://loadfocus.com/ro-ro/glossary, https://www.euassistant.com). Physical education provides a varied methodological and organizational framework and through the adapted strategies used (methods, means, materials, action systems) supports students with special educational needs, systematically influences their physical, emotional, cognitive and social development, maintains health at optimal parameters, ensures a capacity for physical effort necessary for school and social inclusion. (Dragomir, Scarlat, 2004, p.15).

2. Material and method

The proposed research starts from the hypothesis: the use of assistive materials in physical education and sports classes determines the creation of an accessible and efficient inclusive school and social environment. The purpose of the research highlights the importance of using assistive materials in physical education and sports lessons to develop the physical, mental, behavioral and social skills of students with special needs. The objectives proposed in this research are to know the individual needs of students, to identify the most effective assistive materials with which to achieve positive school results, increase motivation and participation in school physical activities, and to find the most advantageous action strategies in which assistive materials can be successfully integrated as an efficient and productive means for school and social inclusion. In the research, we used the method of bibliographic study, the questionnaire method, the interview method, the method of data processing and interpretation, the method of graphic representation and the analysis of specialized documents. The open-ended questionnaire gave the

subjects the opportunity to be free in their answers (Epuran, M. 1992, p. 273).

After processing the results and graphically representing the data, we obtained a real perception of the knowledge and use of assistive materials by physical education teachers in classroom activities. The information obtained through mathematical calculations and statistical analyses, in order to be easier to interpret, was presented using the graphical method (Vlăduțu, 2019).

The research was conducted between January and March 2025, the sample used in applying the questionnaire consisted of 120 physical education teachers who teach in mass pre-university education in Suceava County.

3. Results and Discussions

The interest in the inclusion of children with special educational needs in mainstream schools has broadened the scope of action for specialists in the field. In this regard, the desire to develop and diversify assistive materials and technologies has been observed. From the category of assistive materials used that bring real benefits in the teaching activity for students with special needs, the following were identified: for students with visual impairments, we mention: balls with textile surfaces, sound or much lighter balls, tactile sticks or sticks used in the game of goalball, tactile direction strips placed on the ground for orientation. Sports wheelchairs can be used for movement in basketball, volleyball, tennis or athletics. To support students with mobility and balance difficulties, walking frames or adapted rollers, mobile parallel bars or balance boards to improve coordination and stability, trampolines with support handles that ensure the safety of students with motor deficiencies who perform jumps and elastic springs for jumping can be used. Elastic bands can be used successfully to tone muscles and also increase joint mobility. Also, weight equipment can be used by adjusting it according to the possibilities of each student. For better orientation, tactile cones and markers can be used, colored tapes with which the field, route or area of activities can be marked. For protection, customized equipment such as helmets, knee pads, elbow pads to protect joints, protective vests for contact sports, cushions or cushioning mattresses can be used. Guided elastic bands can be used for running and developing endurance. Visual cards can be used to explain rules and movements. Tactile or sensory maps help with orientation before starting the activity. To ensure an inclusive and accessible process, in addition to assistive and adapted materials, assistive technologies can also be used: stimulators, alarms, prostheses, typewriters, portable Braille devices, word processors, reading machines, manipulators, mobile devices (laptops, phones, tablets), interactive software (https://lege5.ro). In order to obtain accurate information on the reality regarding: the use of assistive materials in physical education lessons, we conducted a questionnaire, the responses received outlined the real situation on this subject.

The first question aimed to highlight how many respondents are familiar with the

term assistive materials.

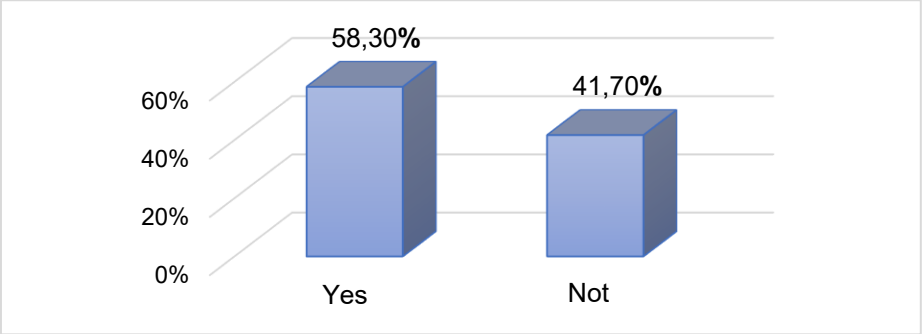


Figure 1. *Knowledge of the term assistive material*

Figure 1 highlights the fact that 53,30% of the teachers surveyed know this term and are teachers specialized in working with students with special educational needs. This percentage, quite low, highlights the unwanted truth about inclusive education in Romania. The other 41,70% of the respondents have no knowledge about this term.

The second question aimed to verify how many of the teachers surveyed use assistive materials in their teaching activities.

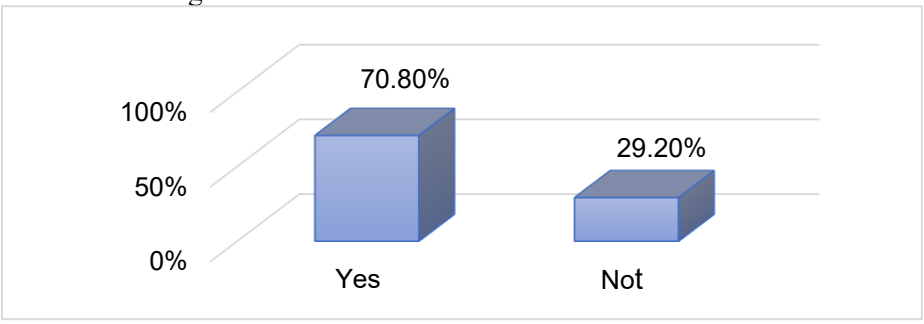


Figure 2. *Use of assistive materials in physical education lessons*

In Figure 2 it can be seen that 70,80% of respondents do not use assistive materials in physical education lessons, a percentage that is an impediment to creating an efficient and accessible inclusive environment for students with special needs. Among the respondents, only 29,20% carry out their teaching activity using assistive materials.

The third question highlighted which assistive materials are most used by physical education teachers in school physical activity.

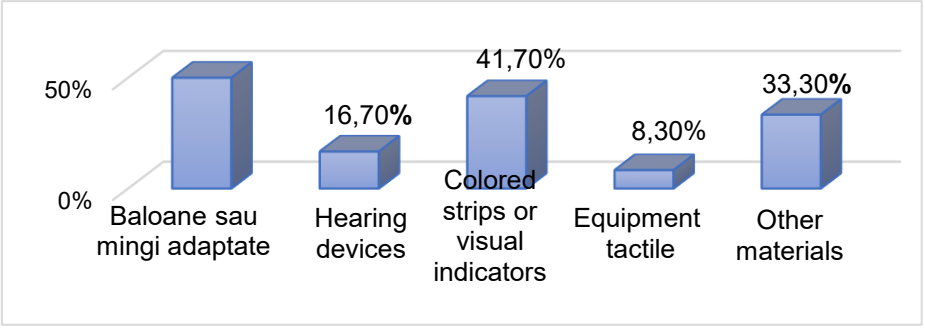


Figure 3. *Assistive materials used in physical education lessons*

Figure 3 shows that among the assistive materials used by physical education teachers, the most commonly used are balloons or adapted balls used in games, respectively 50%, then 41,70% of teachers use colored tapes or visual indicators used for marking and delimiting the operating surfaces, 30,30% use other materials, depending on the needs of the students, their existence in the school equipment, such as helmets, armrests, knee pads, balance balls, colored markers, tactile maps, balance devices.

The fourth question checks how important assistive materials are through their use in the school inclusion process.

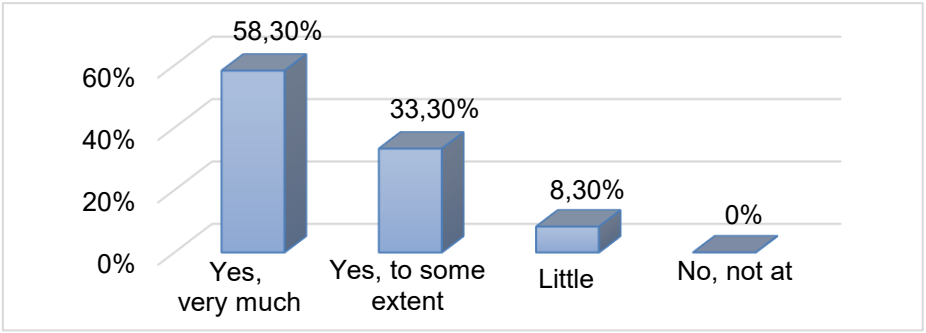


Figure 4. *The contribution of assistive materials in the school inclusion process*

In Figure 4, it can be seen that 58.30% of respondents believe that the use of assistive materials through the positive effects brought, such as the development of life skills, increased motivation and self-esteem, and the development of relationships with other colleagues, directly contributes to increasing the inclusion process, 33.30% say that the use of these materials is beneficial only to some extent, only 8.30% believe that these materials have little influence on the integration process.

The fifth question wanted to highlight the benefits of using assistive materials in the teaching activity of physical education teachers.

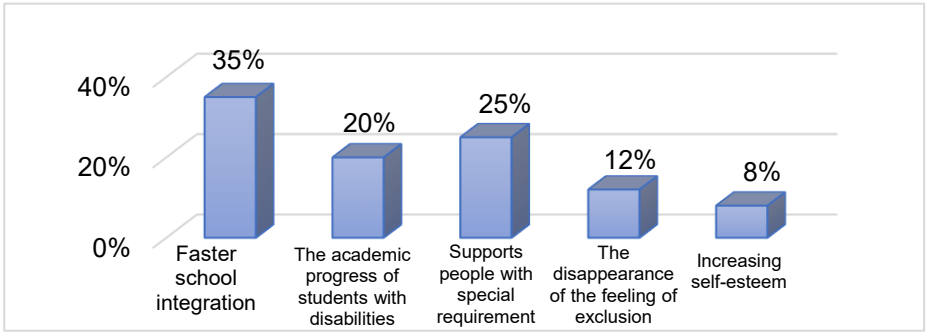


Figure 5. *The main benefits of using assistive materials in physical education*

Figure 5 shows that most respondents, 35% believe that the main benefit of using

assistive materials in physical education lessons is speeding up the integration process, 25% of respondents emphasize that the most important benefit is that it supports students with special needs, 20% claim that school progress is the main benefit, 12% of respondents claim that the disappearance of the feeling of exclusion is the most important benefit of using these assistive materials and 8% of those surveyed believe that the main benefit of using assistive materials is increasing self-esteem in students with special educational needs.

Discussions: The national and international bibliography of the specialty, regarding the proposed research topic, highlights: supporting the process of school and social inclusion through the need to create an efficient inclusive school framework, implicitly through the use of assistive materials in motor activities within physical education lessons, access to an equitable and accessible education for students with special educational needs, the opportunity to participate in school and extracurricular sports activities and social life, preparation for employment after graduation, improving health, increasing well-being, self-esteem, increasing physical performance, benefits transferred to the family, social, and everyday life.

4. Conclusions

The present research highlights that the use of assistive materials in physical education is an effective strategy that increases school inclusion, with obvious results both physically (increasing motor skills) and socio-emotionally (increasing motivation, strengthening interpersonal relationships, reducing stigma).

The responses to the applied questionnaire highlight the need for continuous training of teachers in the knowledge and use of assistive materials and differentiated teaching to ensure an inclusive, equitable and efficient environment for all students. Despite the fact that there are a multitude of benefits, the research also identified a series of challenges such as the lack of these materials in schools, the insufficiency and even the lack of specialized personnel, the creation of a correct legislative framework for the integration of these materials into the specialty curriculum.

In order for the inclusion process to become efficient and sustainable, additional investments are recommended in the school infrastructure necessary for students with special educational needs, financial investments for the purchase of assistive materials, the creation of continuing specialty training programs for teachers, ensuring continuous support in the inclusion process by creating school-specialty institutions-community partnerships. This approach must be supported by all decision-makers involved in education and through fair and efficient educational policies.

Bibliography

1. Dragomir, P., Scarlat, E. (2004). *School physical education, New landmarks – necessary changes*, Edit.Didactic and pedagogical publishing, R.A., Bucharest,

pg.15
2. Epuran, M. (1992). *Methodology for researching physical activities*. pg.273
3. Hora, A.S. (2020). *Inclusive education. The importance of support services offered by CSEIs to mainstream schools in the context of inclusive education*, Edit. Tritonic publishing, Bucharest, pg. 330
4. Kovacs, M. (2020). *Inclusive education, Guide for high schools*, Edit. S.C. Advans Print& Promo S.R.L. publishing, Bucharest, pg. 23.
5. Lupu Bangă, J., Cojocaru, N., Gheorghe, A., „et al" (2008). *Methodology for teaching physical education in the primary school cycle*, Edit. "Gheorghe Alexandru", Craiova, pg. 11
6. Vlăduțu, G., I., N. (2019). *The impact of motor activities on professionals in the cultural - artistic environment*. Bucharest. doctoral thesis summary
7. World Health Organization UNICEF. (2022). *Global Report on Assistive Technology, Geneva*, pg 6
8. ***https://loadfocus.com/ro-ro/glossary/assistive-technology. accessed 14.03.2025
9. ***https://www.euassistant.com/wp-content/themes/dustland-express/files/RO/Modul%2010%20Instrumente%20asistive.pdf. accessed 16.03.2025
10. ***https://lege5.ro/gratuit/gmzdmmzugu4q/lista-tehnologiilor-si-dispozitivelor-asistive-si-tehnologiilor-de-acces-prioritare-pentru-angajare-procedura?dp=gi4dgmbsga3tqni. accessed 18.03.2025

THE IMPORTANCE OF MANUAL TECHNIQUES IN THE TREATMENT OF ELBOW DISLOCATION

Cosmina Rodica Cheran[1], Florina Liliana Neder [2]

[1, 2]*Ecological University, 1G Vasile Milea Street, Bucharest, Romania*

Abstract

Elbow dislocation is a complex injury involving abnormal displacement of the bones in the elbow joint, often accompanied by ligament tears and other soft tissue damage. This condition can result from falls, direct impacts, or sports accidents, causing acute pain and significant loss of function of the affected limb. Due to its profound impact on patients' mobility and quality of life, identifying the most effective treatment methods is essential.

This paper focuses on manual techniques, a key component in physical therapy, exploring their role in the management and rehabilitation of elbow dislocation. Manual techniques include joint manipulation, mobilization, and therapeutic massage, each of which aims to reduce pain, improve range of motion, and facilitate rapid and effective recovery for patients.

Conventional treatments focus on joint immobilization and the use of medications for pain control, but these methods can have significant limitations, including long recovery times and the risk of post-treatment joint stiffness. In this context, manual techniques offer a promising alternative, with the potential to accelerate recovery and improve functional outcomes through more direct and personalized approaches.

Keywords: *elbow dislocation, manual techniques, recovery program, physiotherapy mean*

1. Introduction

Elbow dislocation is a common condition among the population. It is the most common joint dislocation in children and the second most common dislocation in adults, second only to shoulder dislocation.

The concept of dislocation refers to a permanent change in the relationship between the bony limbs that form the joint following capsuloligamentous injury and posttraumatic joint space widening. A dislocation can be either a complete dislocation or an incomplete dislocation (subluxation) when the minimum proportion between the bones of the limb is still preserved. It can be simple when it is not associated with another pathology or complex when it is associated with a fracture (most commonly a fracture of the radial head or coronoid process).

Elbow injuries have certain characteristics, recognition of which can help orthopedic surgeons predict associated fractures and tears. For example, if the elbow dislocates posteriorly, the coronoid process may fracture through impact with the distal humerus. The last structure affected is the anterior band of the medial collateral ligament. In the case of an elbow dislocation, the capsuloligamentous structures of the elbow are affected from lateral to medial.

Depending on the anatomy of the elbow, we have the following types of dislocations:
A. Actual elbow dislocation (displacement of the forearm and two bones relative to the humerus), this can be: recent (posterior, anterior or lateral), repeated or old.
B. Dislocations in which the ulna or radius separates from the humerus and the proximal ends of the two bones of the forearm diverge from each other. Anterior radioulnar dislocation tears the quadrate ligament and the proximal part of the interosseous membrane as well as the annular ligament, while posterior dislocation tears only the annular ligament.

2. Material and methods

The scientific research methods used are:

1. documentation methods, bibliography study;
2. case study methods;
3. initial assessment;
4. development of the recovery program;
5. evaluation of the recovery program;
6. data analysis.

The aim is to investigate and evaluate the impact of manual techniques on the recovery process in patients with elbow dislocation. Through this approach, the paper aims to provide a detailed analysis of the effectiveness of these methods compared to conventional treatment approaches, which are often limited to immobilization and medication.

The hypothesis of the work. The use of manual techniques, including joint manipulations and specific mobilizations, in the treatment of elbow dislocation contributes to faster recovery and improved range of motion compared to treatments that rely exclusively on traditional immobilization and medication methods. This manual approach is believed to not only reduce the recovery time required for patients, but also minimize the incidence of long-term complications, such as loss of mobility and chronic pain.

3. Result

The study was conducted on patient N.I, 32 years old, female, who was diagnosed with right elbow dislocation, initially treated by reduction and immobilization in a cast for three weeks.

N.I. suffered a dislocation of his right elbow, having been hit directly in the elbow area. He was rushed to the hospital, where the dislocation was manually reduced by an orthopaedic specialist. To ensure stability and proper healing, the elbow was immobilized in a cast for 3 weeks. The patient was given strict instructions for rest and pain management at home.

After the cast was removed, N.I. was evaluated by a physiotherapist to begin a multidisciplinary rehabilitation program, which included the following components: curapuls therapy, laser therapy, and physiotherapy: Initially, the assessment showed

restricted range of motion and elbow pain rated at 6/10 on the pain scale. In the following weeks, progress was monitored through weekly assessments, noting gradual improvement in range of motion and a decrease in pain to 3/10.

Manual therapy recovery program for elbow dislocation

Program objectives:

- Restoring the range of motion (ROM) of the elbow;
- Reducing pain and muscle tension;
- Improving joint alignment and function;
- Strengthening the muscles to prevent relapses.

Manual therapy was applied 3-4 times per week, depending on the response to treatment and the patient's comfort level.

Exercise program:

Muscle relaxation (Fig. 1):

The patient is in the supine position, with the arm at a 90-degree angle to the torso and the forearm at 70 degrees.

The therapist applies techniques to relax the muscles of the arm and forearm, focusing on the biceps muscles and the flexors of the hand and fingers.

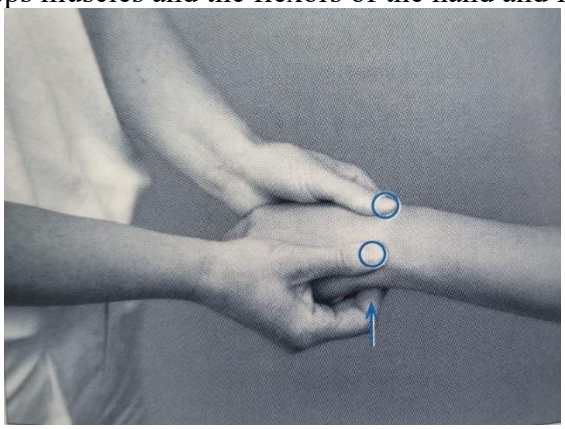


Fig. 1 Relaxation of the hand flexor muscles (Maike Friedrichsen, Ulla Haeger – Leitfaden manuelle therapie, 2016)

Traction and joint mobilization (Fig. 2, 3):

In the same position, the therapist grasps the distal extremity of the forearm with one hand and performs contraction above the elbow joint with the other hand.

Forearm traction is combined with flexion and extension movements to improve mobility.

Radial head mobilization (Fig. 4, 5):

With the patient in the supine position, the therapist grasps the distal extremity of the forearm and with the other hand performs a translational movement of the radial head.

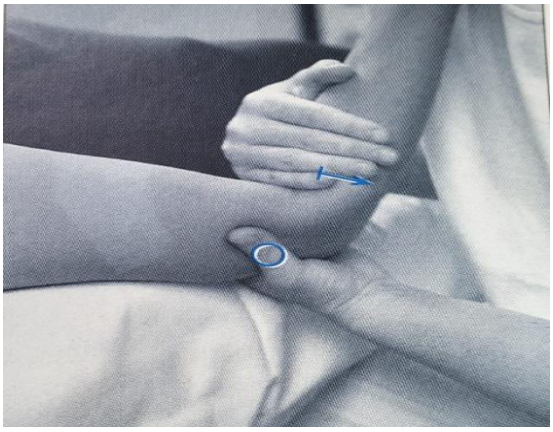


Fig. 2 Traction in the humeral joint (Maike Friedrichsen, Ulla Haeger – Leitfaden manuelle therapie, 2016)

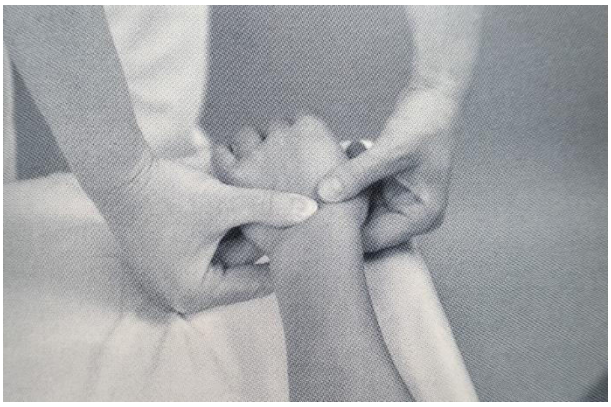


Fig. 3 Mobilization of the bones of the hand (Maike Friedrichsen, Ulla Haeger – Leitfaden manuelle therapie, 2016)

Fig. 4 Ventral mobilization of the radial head (Maike Friedrichsen, Ulla Haeger – Leitfaden manuelle therapie, 2016)

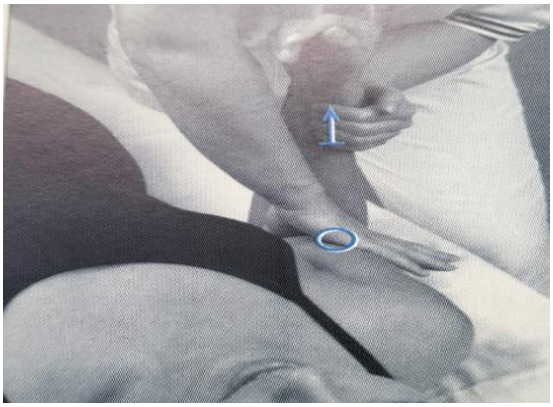


Fig. 5 Radial head mobilization (Maike Friedrichsen, Ulla Haeger – Leitfaden manuelle therapie, 2016)

Olecranon mobilization (Fig. 6)

The patient is in the supine position, with the arm at 90 degrees to the torso, and the forearm hanging over the edge of the table.

The therapist grasps the forearm distally and pushes the cranial olecranon, performing flexion-extension movements with the patient's forearm.

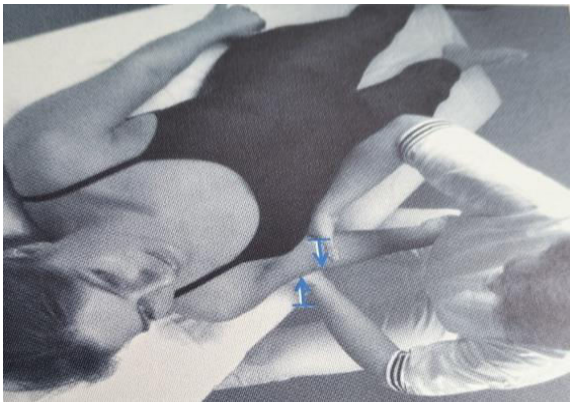


Fig. 6 Olecranon mobilization (Maike Friedrichsen, Ulla Haeger – Leitfaden manuelle therapie, 2016)

Translation of the ulna:

In the supine position, with the arm at 90 degrees and the forearm at a 70 degree angle, the therapist performs a perpendicular movement on the forearm, translating the ulna.

Mobilization of the humero-ulnar joint:

The therapist sits next to the patient seated in a chair, supports the patient's forearm on his shoulder and performs ulnar translation, keeping the patient's hand in supination.

Each technique will be performed carefully to the patient's response, avoiding movements that cause pain or discomfort.

The duration of each technique will be adjusted based on the patient's tolerance and specific recovery goals.

This manual therapy rehabilitation program was designed to be progressive and personalized, aiming to gradually improve the functionality of N.I.'s elbow as it heals from its dislocation. It is essential that the therapist carefully monitor the patient's response and adjust the intensity and duration of interventions accordingly.

4. Conclusions and recommendations

- By combining passive, active, autopassive movements, and toning exercises with manual therapy, comprehensive stimulation of the affected tissues and periarticular muscles was ensured.
- Precautions taken in approaching passive postures and mobilizations were essential to prevent further joint inflammation and avoid calcific myositis. This helped maintain a balance between extending mobility and protecting joint and soft tissue integrity.
- Understanding the complexity of the elbow musculature and the influence of reciprocal induction was important to prevent antagonist contractions, which could inhibit the progress of mobilization.
- The use of passive mobilizations and facilitation techniques, such as "hold-relax", significantly improved mobilization and control capacity, encouraging coordinated movement and fine motor skills.
- Neuromuscular facilitation techniques, such as the "hold-relax" method, had a significant impact in re-educating the muscles and improving muscle coordination. Through facilitation, the patient was able to perform movements with greater precision, regain muscle control, and improve fine motor activities, which are essential for daily functioning.
- Exercises to tone the flexors, extensors, supinators, and pronators were well balanced to ensure symmetrical recovery of strength and function. Toning strategies have proven effective in counteracting muscle atrophy caused by immobilization and in promoting robust muscle support for the elbow.
- The gradual progression of exercises, from passive to active and then to those requiring greater coordination and strength, allowed patient N.I. to adapt to his improving condition without putting unnecessary pressure on the recovering joint.
- Continuous patient feedback was essential in adjusting the intensity and types of exercises, allowing for fine-tuning of the recovery program to meet the patient's individual needs.
- The use of auto-passive exercises was particularly valuable, allowing the patient to take an active role in their healing process. Auto-passives encourage

independence, self-assessment, and self-regulation of effort, essential elements for increased involvement and increased confidence in one's own body.

- Integrating active movements into the water provided a low-resistance, low-impact environment, promoting gentle recovery and muscle toning without placing excessive pressure on the convalescent joint. The buoyancy effect of the water allowed for movements that might be too difficult or painful outside of the water, thus accelerating the recovery process.

Bibliography

1. Baciu C., (1977). Functional anatomy and biomechanics of the locomotor system, 3rd Edition, Sport-Turism Publishing House, Bucharest.
2. Fozza C., Nicolaescu V., (1980). Corrective gymnastics and massage, I.E.F.S., Bucharest.
3. Ionescu A. et al. (1964). Complex elbow injuries, 6th National Conference on Orthopedics and Traumatology, Bucharest.
4. Kiss I., (1999). Physiokinetotherapy and medical recovery, Medical Publishing House, Bucharest.
5. Krausz l., Krausz l.T., (2004). Physiokinetotherapy – on pathophysiological bases, Iuliu Hatieganu University Medical Publishing House, Cluj-Napoca.
6. Maike Friedrichsen, Ulla Haeger (2016). Leitfaden Manuelle Therapie, Herausgegeben von Dr. Dieter Heimann, Kappein; Jürgen Lawall, Berlin.
7. Panait Gh. (2002). Practical Orthopedics and Traumatology, Publistar Publishing House, Bucharest.
8. Pasztai Z., (2001). Physiotherapy in the functional recovery of the locomotor system, University of Oradea Publishing House.
9. Rădulescu Al. T., (1964). Biomechanics and physiopathology of the elbow, 6th National Conference of Orthopedics and Traumatology, Bucharest.
10. Sbenghe T., (1981). Medical recovery of post-traumatic sequelae of the limbs, Medical Publishing House, Bucharest.
11. Susan B., Denischi A., (1964). Treatment of the elbow in adults, 6th National Conference of Orthopedics and Traumatology, Bucharest.
12. Zaharia C., (1994). Elements of pathology of the locomotor system, Paideia Publishing House, Bucharest.

ANALYSIS OF THE PARTICULARITIES OF POSTURAL CONTROL MANIFESTATION IN INDIVIDUALS WITH ORTHOPEDIC FOOT DISORDERS COMPARED TO HEALTHY SUBJECTS

Marina Cucu [1]
[1] *Doctoral School of Sports Sciences, IPES (SUM), MD – 2009, Republica Moldova*

Abstract: Orthopedic conditions, including structural malformations, injuries, and degenerative processes, have a direct and often underestimated impact on postural integrity and functional balance. The foot, as the biomechanical foundation of the body, plays a critical role in maintaining alignment and postural stability. The study aimed to analyze and characterize the variables that determine the manifestation of postural control during motor tasks in individuals with orthopedic foot disorders, compared to healthy subjects. The control group (C) included subjects aged 21–36 years with confirmed orthopedic foot conditions (equin foot, varus/valgus foot, flatfoot, and cavus foot). The martor group (M) consisted of healthy subjects matched by demographic and anthropometric parameters (height and body weight). Comparative functional and stabilographic assessments were performed to evaluate postural control and balance efficiency. The analysis demonstrated that orthopedic foot disorders significantly impair postural stability, neuromotor coordination, and proprioceptive control. Increased balance errors and center-of-pressure displacements confirmed greater postural instability, particularly under visual deprivation. These findings highlight the need for physiotherapy programs focused on proprioceptive training and postural re-education to restore balance and prevent compensatory dysfunctions.

Key words: *postural control, orthopedic foot disorders, balance assessment, proprioception, physiotherapy rehabilitation*

1.Introduction

Orthopedic conditions, including structural malformations, injuries, and degenerative processes, exert a direct and often underestimated influence on the integrity and functionality of body posture (Horak, 2009, p. 2). The foot, as the biomechanical foundation upon which the entire body rests, plays a crucial role in maintaining alignment and postural balance (Savițchi, 2023, p. 86). Any deviation in the structure or function of the foot can trigger a chain of compensatory mechanisms throughout the kinetic chain, directly affecting posture and balance.

Orthopedic foot disorders such as hallux valgus, flatfoot, arthritis, and arthrosis alter the way forces are distributed across the foot and the segments of the lower limbs (Sarvari, 2024, p. 2). For example, flatfoot can reduce shock absorption capacity and disrupt normal gait dynamics, requiring postural adaptations—often incorrect—to compensate for the lack of support and stability (James, 2021, p. 32). These adaptive mechanisms may lead to misalignment of the knees, hips, and spine, increasing the risk of developing postural dysfunctions that can, in turn, trigger additional conditions (Savițchi, 2025, p. 290).

Since the foot serves as the body's supporting base, it directly influences the

alignment of body segments, the distribution of plantar pressure, and overall stability in standing and walking (Roşca, 2023, p. 2). The study is justified by the need to identify predictive factors that influence the efficiency of postural rehabilitation in patients with orthopedic foot conditions (Shanbhag, 2023, p. 2). The necessity for such research arises from the insufficient existing data regarding correlations between clinical and functional parameters in the context of planning functional rehabilitation programs (Gurfinkel, 2006, p. 2678).

2. Material and method

The aim of the research is to analyze and characterize the variables that determine the manifestation of postural control under different conditions of performing motor tasks in individuals with foot disorders, compared to healthy subjects.

The objectives of the study included the assessment of functional and stabilographic parameters, as well as the analysis of statistical relationships between them. The results obtained will provide the foundation for developing physiotherapeutic intervention strategies specifically adapted to the individual characteristics of the patients.

In this context, identifying and analyzing the factors that may influence the progression and efficiency of postural rehabilitation become essential for improving the physiotherapeutic recovery process.

In the study analyzing predictive factors in postural rehabilitation among patients with orthopedic foot disorders, inclusion and exclusion criteria were established to ensure the validity and homogeneity of the collected data.

For inclusion in the study, the control group (grupa C) consisted of subjects with a confirmed diagnosis of orthopedic foot conditions (equin foot, varus/valgus foot, flatfoot, and cavus foot) within the age range of 21–36 years. Additionally, the anthropometric parameters (such as height and body weight) were homogenized. The martor group (grupa M), composed of healthy subjects, was selected based on similar demographic and anthropometric criteria.

The exclusion criteria included, on one hand, the elimination of patients with neurological disorders, as well as those with significant vestibular or visual impairments that could affect postural control mechanisms. Participants who had undergone recent foot surgeries or suffered trauma, as well as those with major systemic conditions (including severe rheumatic diseases) that could influence the research outcomes, were also excluded.

These criteria allow the identification of specific features of orthopedic foot disorders in relation to postural control, eliminating confounding variables and contributing to a clearer interpretation of the results within the research context.

Table 1 presents the distribution of demographic data and anthropometric parameters for the group of patients with orthopedic foot disorders (grupa C) and for the group of healthy subjects (grupa M). Both groups included 22 subjects each. The mean values of the anthropometric parameters, such as height and weight,

showed no significant differences (P > 0.05), indicating homogeneity between groups. The age range, between 21 and 36 years, contributed to the uniformity of the sample and to the comparative validity of the study.

Clinical-functional testing results were also applied and compared, including: the Balance Error Scoring System (BESS) test, the Time in Balance (TIB) test, the Foot Lift test, the Side Hop test, as well as computerized stabilographic tests such as the Romberg test, the Unipodal test, and the Stability stabilographic test, for the analysis of postural control indicators in the control group (grupa C) compared to the martor group (grupa M).

Table 1. *Distribution of demographic and anthropometric data of the control group (C) and martor group (M) included in the study*

№	Variable		(C) n=22	(M) n=22
1.	Age	Range	21-36 years	
2.	Sex	Male	11	12
		Female	23	22
3.	Anthropometric indices	Height (cm)	166±9,1	164±8,2
			t =0,78; P >0,05	
		Weight (kg)	67±11,2	68±12,1
			t =0,29; P >0,05	

Note: n_C= 22 f=42 t= 2,018 2,69 3,53
n_M= 22 P=0,05 0,01 0,001

3. Results and Discussions

The data presented in Table 2 highlight the results of the functional tests, comparing the indicators of the group of patients with orthopedic foot disorders (C) with those of the healthy martor group (M).

The results of the Balance Error Scoring System (BESS) test indicate a significantly higher mean number of errors in the control group (11.7 ± 3.4) compared to the martor group (8.6 ± 2.8), a statistically validated difference (P < 0.01). The Time in Balance (TIB) test revealed lower values for the control group, which showed a reduced balance maintenance time (23.8 ± 0.7 seconds compared to 25.6 ± 3.2 seconds in the martor group), with a significant difference (P < 0.05). In the Foot Lift test, the control group performed a higher number of touches (5.6 ± 1.2) compared to the martor group (4.2 ± 1.4), with a highly significant difference (P < 0.001). The Side Hop test did not reveal significant differences between the two groups (13.2 ± 2.3 vs. 12.8 ± 2.6 seconds, P > 0.05).

These results indicate that the presence of orthopedic foot disorders influences balance performance, as demonstrated by the increased number of errors and the reduced duration of balance maintenance. The significant differences observed in the BESS, Time in Balance, and Foot Lift tests support the hypothesis that such

disorders directly affect motor function. In contrast, the absence of differences in the Side Hop test suggests that the manifestation of dynamic balance parameters remains similar even in the presence of orthopedic dysfunctions, likely due to compensatory mechanisms.

Table 2. *Results of the clinical-functional tests for the control group (C) and the martor group (M)*

№	Functional tests	Statistical indicators			
		C (n=22)	M (n=22)	t	P
1.	Balance Error Scoring System (BESS) test (errors)	11,7±3,4	8,6±2,8	3,3	< 0,01
2.	Time in Balance (TIB) test (seconds)	23,8±,7	25,6±3,2	2,42	< 0,05
3.	Foot Lift test (touches)	5,6±1,2	4,2±1,4	3,56	< 0,001
4.	Side Hop test (seconds)	13,2±2,3	12,8±2,6	0,54	> 0,05

Note: n_C= 22 f=42 t= 2,018 2,69 3,53
n_M= 22 P=0,05 0,01 0,001

The significant differences observed in the BESS, Time in Balance, and Foot Lift tests highlight the need to implement physiotherapy programs focused on re-educating postural control and movement stability during the execution of motor tasks—essential aspects for restoring optimal function. At the same time, the values obtained in the Side Hop test suggest that the manifestation of dynamic balance should be carefully analyzed during physiotherapy sessions to prevent the development of incorrect compensatory mechanisms of postural control.

The values of the stabilographic parameters obtained from the tests performed on the computerized stabilographic platform reveal clear differences between patients with orthopedic foot disorders and healthy subjects. The results of the Romberg test with eyes closed indicate significantly greater displacements of the center of pressure (Xcp and Ycp) in the studied patients, reflecting increased postural instability ($P < 0.05$ and $P < 0.001$).

The dispersion of the center of pressure in the frontal and sagittal planes (Qx and Qy), as well as the area of the statokinesiogram (S), demonstrates specific variations in postural control, although not all differences were statistically significant. The Unipodal test showed significantly different values for the mean radius of deviation (R) and mean displacement velocity (V), highlighting functional compensations in postural stability ($P < 0.001$).

Additional parameters, such as the velocity of statokinesiogram area change (SV) and the quality of balance function (QBF), recorded lower postural control values during motor tasks in patients with orthopedic disorders ($P < 0.01$ and $P < 0.05$).

These findings emphasize the significant influence of orthopedic foot disorders on the internal mechanisms responsible for maintaining balance. The statistical differences observed between the groups studied highlight the need to adapt physiotherapeutic interventions according to the specific manifestations of postural control (Table 3).

Table 3. *Results of the computerized Romberg test with eyes open for the control group C (n=22) with orthopedic foot disorders and the healthy martor group M (n=22)*

№	Stabilographic parameters	Statistical indicators			
		C (n=22)	M (n=22)	t	P
1.	Xcp (mm)	3,2±0,81	2,8±0,17	2,27	< 0,05
2.	Ycp (mm)	26,25±0,17	25,42±0,81	4,7	< 0,001
3.	Qx (mm)	2,13±0,14	2,16±0,12	0,76	> 0,05
4.	Qy (mm)	3,42±0,38	3,29±0,36	1,16	> 0,05
5.	S (mm^2/s)	204,6±6,32	202,9±5,6	0,94	> 0,05
6.	CFE (%)	92,4±3,6	93,6±3,1	1,18	> 0,05

Note: n_C= 22 f=42 t= 2,018 2,69 3,53
n_M= 22 P=0,05 0,01 0,001

The significant differences observed in the displacements of the center of pressure and in the mean velocity of movement indicate the need to implement physiotherapy programs focused on improving proprioceptive control and static balance.

The interpretation of the data from the Romberg test with eyes closed (Table 4) shows that patients with orthopedic foot disorders exhibit significant postural instability compared to healthy subjects. The higher values of the center of pressure displacements along the frontal (Xcp) and sagittal (Ycp) axes, as well as the increased area of the statokinesiogram (S), confirm difficulties in maintaining balance under visual deprivation conditions, demonstrating an increased dependence on visual control.

The statistically significant differences ($P < 0.05$; $P < 0.01$; $P < 0.001$) highlight the manifestation of compensatory mechanisms in postural control, emphasizing the need for specific physiotherapeutic interventions oriented toward proprioceptive training. However, the dispersion of the center of pressure in the frontal and sagittal planes (Qx and Qy) did not show significant differences, suggesting that not all stabilographic variables exhibit functional deficits.

The decrease in the quality of balance function (QBF) indicates a deficit in functional regulatory mechanisms. These findings underscore the necessity of a physiotherapeutic approach aimed at developing the internal mechanisms of balance control through stabilization and proprioceptive training exercises.

Table 4. *Results of the computerized Romberg test with eyes closed for the control group C (n=22) with orthopedic foot disorders and the healthy martor group M* (n=22)

№	Stabilographic parameters	Statistical indicators			
		C (n=22)	M (n=22)	t	P
1.	Xcp (mm)	6,4±0,81	5,89±0,63	2,33	< 0,05
2.	Ycp (mm)	33,82±2,36	30,34±1,27	6,09	< 0,001
3.	Qx (mm)	3,23±0,23	2,96±0,86	1,42	> 0,05
4.	Qy (mm)	4,16±0,14	3,93±0,73	1,45	> 0,05
5.	S (mm^2/s)	326,43±11,23	314±12,14	3,53	< 0,01
6.	CFE (%)	84,6±2,3	86,4±2,1	2.71	< 0,01

Note: n_C= 22 f=42 t= 2,018 2,69 3,53
n_M= 22 P=0,05 0,01 0,001

4. Conclusions

The comparative analysis between the control group (C) with orthopedic foot disorders and the martor group (M) of healthy subjects demonstrates that alterations in foot structure significantly affect postural stability and motor control. Functional testing (BESS, TIB, Foot Lift) revealed higher error rates and reduced balance duration in the control group ($P < 0.05–0.001$), indicating impaired neuromotor coordination and proprioceptive efficiency.

Stabilographic data confirmed these findings, showing greater center-of-pressure displacements and increased statokinesiogram area, especially under visual deprivation. These results highlight a higher dependence on visual input and decreased efficiency of internal balance regulation mechanisms.

Overall, orthopedic foot disorders have a marked impact on postural control mechanisms. The results emphasize the importance of physiotherapy programs focused on proprioceptive training, postural control re-education, and neuromuscular stabilization to restore functional balance and prevent compensatory dysfunctions.

Bibliography

1. Gurfinkel, V., Cacciatore, T. W., Cordo, P., Horak, F., Nutt, J., & Skoss, R. (2006). Postural muscle tone in the body axis of healthy humans. Journal of Neurophysiology, 96(5), 2678–2687. https://doi.org/10.1152/jn.00406.2006
2. Horak, F. B. (2009). *Postural control*. In M. D. Binder, N. Hirokawa, & U. Windhorst (Eds.), *Encyclopedia of neuroscience* (pp. 1–6). Springer. https://doi.org/10.1007/978-3-540-29678-2_4708
3. Pichon, R., Enez, J., Sibley, K. M., Landre, B., & Jamal, K. (2025). Postural Control Measures in Randomized Controlled Trials for Older Adults Balance: A Systematic Scoping Review. *Annals of geriatric medicine and research*, *29*(3), 305–313. https://doi.org/10.4235/agmr.25.0019
4. Roşca, V., Agapii, E., & Savițchi, S. (2023). Recovery from physical deconditioning syndrome in the elderly. *Sport şi Societate*, 1-5.

https://doi.org/10.36836/2023/1/10

5. Sarvari, M., Shanbehzadeh, S., Shavehei, Y., & ShahAli, S. (2024). Postural control among older adults with fear of falling and chronic low back pain. *BMC geriatrics*, *24*(1), 862. https://doi.org/10.1186/s12877-024-05455-7
6. Savitchi, S., Agapii, E., Darii, O., & Timciuc, A. (2025). Hippotherapy as an Alternative Rehabilitation Method in Children with Postural Balance Disorders. *Bulletin of the Transilvania University of Braşov. Series IX: Sciences of Human Kinetics*, 289-296. DOI: https://doi.org/10.31926/but.shk.2025.18.67.1.32
7. Saviţchi, S. (2023). Kinetoterapia ca parte integrantă a procesului instructiv educativ în recuperarea copiilor supraponderali. In *Conferinţa Ştiinţifică Naţională, consacrată jubileului de 95 ani din ziua naşterii academicianului Boris Melnic* (pp. 85-89).
8. Shanbhag, J., Wolf, A., Wechsler, I., Fleischmann, S., Winkler, J., Leyendecker, S., Eskofier, B. M., Koelewijn, A. D., Wartzack, S., & Miehling, J. (2023). Methods for integrating postural control into biomechanical human simulations: A systematic review. *Journal of NeuroEngineering and Rehabilitation, 20*(1), 111. https://doi.org/10.1186/s12984-023-01235-3

RECOVERY OF HANDBALL PLAYERS AFTER OPERATIONAL TREATMENT OF SHOULDER DISLOCATION

Simona-Elena Dorobăț [1], Natalia Gîrlea [2]

[1] *Clinical Hospital of Infectious Diseases "Sfînta Parascheva", Iasi, Romania*

[2] *Moldova State University, Institute of Physical Education and Sport, Chisinau*

Abstract

Of particular importance is post-operative recovery for handball athletes, for whom it is extremely important to achieve a stable active stabilization of the shoulder joint during this period, by strengthening the stabilizing muscles of the shoulder joint, a normal range of motion in the joints of the upper limb and restoring muscle strength. Currently, it is generally recognized that the only effective treatment for DOU is surgical. However, one operation alone does not solve all problems. The purpose of our study was to shorten the periods of sports disability by using the most effective means of rehabilitation proposed by various authors and introducing new techniques and methods, especially biomechanical stimulation according to V.T. Nazarov, 1986 (BS) and manual relaxation post-isometric (PIR) - Sitel A.B., 1993.

Key words: *medical recovery, shoulder injuries, handball, joints, kinetic means*

1. Introduction

Shoulder dislocations constitute 31 to 75 percent of the total number of luxations in large joints (Vasickin, 2006; Vlasov, 2013). Habitual Shoulder Dislocation (HSD) is a severe disease of the shoulder joint, being a complication of the primary luxation. According to various authors, 20 to 60 percent of primary traumatic luxations transform into chronic ones.

If sports are grouped by the nature of their motor activity, HSD is most often found among representatives of:

- Martial arts: 33.03%
- Sports games (handball): 22.11%
- Cyclic sports: 16.96%
- Technical events: 11.22%
- High-speed power sports: 3.53%

The treatment of HSD in athletes is one of the pressing issues. The quality of postoperative recovery measures is essential. Postoperative recovery for handball athletes is particularly important for achieving active stabilization of the shoulder joint, strengthening the stabilizing muscles, normalizing upper limb joint movement, and restoring muscle strength.

A feature of postoperative recovery in athletes is the desire from the early stages to restore their general performance. The final stage of recovery includes means to restore the athlete's specific motor capacities corresponding to the characteristics of the given event.

Most authors subdivide the postoperative recovery of athletes into three periods. While these authors obtained good results, the periods of sports disability remain quite long-up to 6-10 months after the operation.

The goal of our study was to shorten the periods of sports disability by using the most effective rehabilitation means and introducing new techniques, especially biomechanical stimulation (BS) according to Nazarov, 1986, and manual post-isometric relaxation (PIR) according to Sitel, 1993.

2. Material and methods

The research was conducted in the rehabilitation department on a group of 20 athletes divided into an experimental group and a control group. The new methodology was used in the experimental group, but not in the control group. Handball players dominated the subjects, with an average age of approximately 16-21 years.

Research ***methods***:

1. Dynamometry of different muscle groups of the operated arm (shoulder flexors and extensors, forearm flexors, external and internal rotators).
2. Goniometry - measuring the range of motion in the operated shoulder joint (flexion, abduction in the frontal plane, extension, external and internal rotation).
3. Differences according to shoulder circumference in cm.
4. Motor tests for muscle strength endurance of the scapulohumeral girdle:

- Testing of clean hand pull-ups (number of times).
- Testing of hand push-ups, focusing on parallel bars (number of times).
- Testing for passive flexibility of the shoulder joint of the operated limb—fingers gripping hands behind the head.

5. Statistical processing of measurement results. Studies were conducted every 1.0-1.5 months during the rehabilitation process.

Recovery Periods and Techniques

In both groups, recovery was carried out in three periods:

1. Immobilization (1 month)
2. Post-immobilization (1 to 3-4 months after surgery)
3. Training and Recovery (more than 3-4 months after surgery)

The following complete recovery technique was used in both groups:

• Immobilization period: Physiotherapy (UHF and low-frequency magnetotherapy), general development exercises for the healthy arm, legs, body, special exercises for the hand of the operated arm, isometric muscle tension of the same arm, exercises on a bicycle ergometer to maintain general performance (30 min. at 150-160 bpm pulse). The total duration of recovery activities was 2-2.5 hours per day.

- Post-immobilization period: Different types of massage, physiotherapy, continued isometric muscle tension, which was then replaced by dynamic exercises. Physical exercises for the scapulohumeral girdle muscles were performed first under easy conditions, and then in different starting positions. Various simulators were used to load specific muscle groups. Strength exercises for the scapulohumeral girdle began with small weights of 0.5-1 kg. When moving to power simulators, the principle of repeated maximum (RM) was used according to V.M. Zatsiorsky, 1986, starting with a weight for developing strength endurance that the athlete could lift 25-35 times (25-35 RM). Physical exercises and swimming in the pool were performed from the first days. Total duration of sessions was 4-5 hours per day.
- Training and recovery period: The main means of recovery were physical exercises performed in the gym, pool, training halls, and park. These exercises were divided into three groups: local and strength exercises for the scapulohumeral girdle muscles of submaximal intensity up to 5-7 RM, imitations and specially prepared exercises in accordance with the sport, and general development and increase of athletes' overall performance. Total duration of physical exercises was 5-5.5 hours.

Experimental group specifics

In the experimental group, biomechanical stimulation (BS) according to V.T. Nazarov and post-isometric relaxation (PIR) were additionally used.

- Immobilization Period: A carpal stimulator was used to affect the muscles of the hand and forearm. 4 exercises were performed, each approach lasting 30-40 seconds, with a rest of 1-1.5 minutes. The working vibration frequency was 45-50 Hz, and the vibration amplitude was 3 mm.
- Post-immobilization Period: A drum vibrator was used to affect all muscles of the operated upper limb. 2-3 exercises were performed, with the same characteristics as on the carpal stimulator.
- Post-isometric relaxation (PIR) was performed on the muscles involved in shoulder rotation.

3. Results and Discussions

During the recovery process, the rate of recovery and the final results of active movements of the shoulder joint and muscle group strength were significantly higher among representatives of the experimental group (see Table 1).

Motor tests for strength endurance (lifting and pushing on the bar 10 times without rest) were performed by representatives of the experimental group on average 4.2 months after the operation, and the control group after 5.4 months. The motor test for passive flexibility of the shoulder joint of the operated limb - "finger grasp behind the back" - was performed by athletes in the main group on average 4.8 months after the operation, and the control group after 5.9 months.

Table 1. Evaluation of joint mobility

Group	Handball players	Flexion			Extension			Abduction			Internal rotation			External rotation		
		initial	final	difference	initial	final	difference	initial	final	difference	initial	final	difference	initial	final	difference
Control	A.R.	90	100	10	30	30	0	85	110	25	25	35	10	10	15	5
	G.L.	140	170	30	20	35	15	100	150	50	80	80	0	50	80	30
	T.T.M.	170	180	10	40	45	5	110	130	20	30	60	30	50	80	30
Average		**133,3**	**150**	**16,7**	**30**	**36,6**	**6,6**	**98,3**	**130**	**31,7**	**45**	**58,3**	**13,3**	**36,6**	**58,3**	**21,7**
Experimental	O.L.	140	170	30	30	45	15	90	135	45	30	60	30	45	70	35
	I.M.	95	160	65	35	50	15	85	130	45	40	60	20	50	80	30
	G.L.	140	175	35	35	45	10	120	160	40	60	75	15	70	80	10
Average		**125**	**168,3**	**43,3**	**33,3**	**46,6**	**13,3**	**98,3**	**141,6**	**43,3**	**43,3**	**65**	**21,7**	**55**	**76,6**	**21,6**

Analyzing the averages of the two groups for joint mobility, we found the following:

- Flexion had a deficit of 8.3º in the experimental group at the initial evaluation, but at the final evaluation, the difference was in favor of the experimental group (18.3º), resulting in a progress of 26.6º;
- The extension movement ultimately had a plus of 6.7º in favor of the experimental group;
- Abduction, even though it had the same average value at the initial evaluation (98.3º), the gain of the experimental group at the end was 11.6º;
- Internal rotation meant a greater progress of 8.4º in favor of the experimental group, and external rotation a smaller progress of 0.1º for the experimental group compared to the control group.
- This can be explained by the fact that for one of the patients in the experimental group, the initial value of internal rotation was close to normal, the gain of this patient being only 10º (reaching from 70º to 80º - a value considered normal).

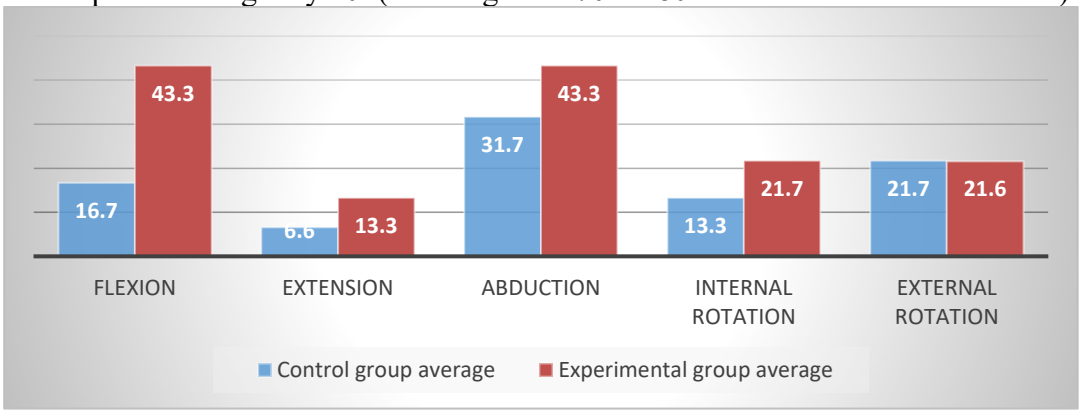


Fig. 1. Comparative analysis of mobility differences in the 2 groups

Table 2. Evaluation of joint mobility based on the calculation of the global mobility coefficient and classification in limitation degrees

Group	Patients	Global mobility coefficient (GMC)			Degree of limitation 100-GMC	
		Initial	Final	Difference	Initial	Final
Control	A.R.	64,5	71	6,5	Moderate limitation	Minimal limitation
	G.L.	83,5	97	13,5	Minimal limitation	Minimal limitation
	T.T.M.	84,5	94	9,5	Minimal limitation	Minimal limitation
Average		**77,5**	**87,3**	**9,8**	-	-
Experimental	O.L.	78	92,5	14,5	Minimal limitation	Minimal limitation
	I.M.	71	94,5	23,5	Minimal limitation	Minimal limitation
	G.L.	87	97,5	10,5	Minimal limitation	Minimal limitation
Average		**78,6**	**94,8**	**16,4**	-	-

Note: Global Mobility Coefficient of the Shoulder Joint = Coef. Flexion + Coef. Abd. + Coef. R.I. + Coef. R.E. + Coef. Extension

Following the initial evaluation, we found that the patients in the control group had muscle strength between F3 and F4, the lowest values being for flexion, abduction, and rotation movements. At the final evaluation, all movements gained strength, so that the strength levels no longer fell below F4- for any movement, but at the same time, it was not possible to exceed the strength level of F4+.

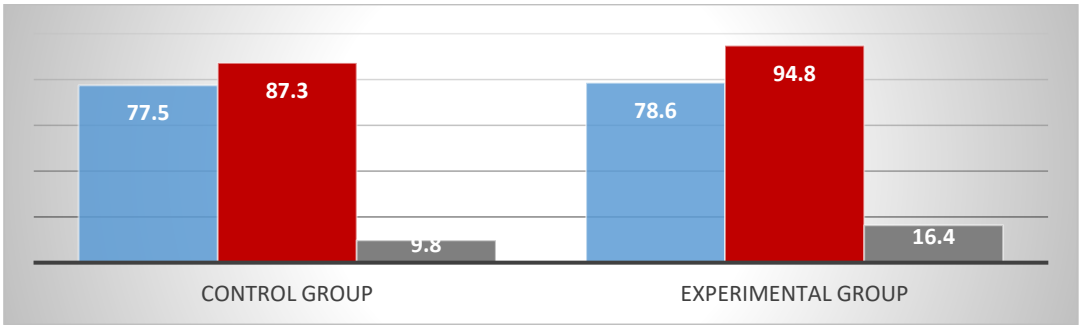


Fig. 2. Analysis of the global mobility coefficient in the 2 groups

In the experimental group, the results were better than in the control group, although the initial strength levels were similar, with increases up to F5 being obtained.

Table 3. Analysis of muscle strength

Lot	Pacients	Flexion		Extension		Abduction		Internal rotation		External rotation		RE	
		Initial	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*	*Initial*	*Final*
Control	A.R.	F3+	F4-	F4	F4+	F3	F4	F4	F4+	F3	F4-	F3	F4-
	G.L.	F4-	F4+	F4	F4+	F4-	F4+	F4	F4+	F4-	F4+	F3+	F4
	T.T.M.	F4-	F4+	F4-	F4+	F4-	F4+	F4	F4+	F4-	F4+	F4-	F4+
Experimental	O.L.	F3+	F4+	F4	F5-	F3	F4+	F4	F5	F3+	F4+	F3	F4+
	I.M.	F4-	F5-	F4	F5	F4	F5-	F4	F5	F4	F5	F4-	F5-
	G.L.	F4	F5	F4	F5	F3+	F4+	F4	F4+	F4-	F5-	F4-	F5

The evaluation of the flexibility of the scapular belt using the Apple Test shows us that patients in both groups face a reduction in flexibility at the level of the scapular belt, probably also associated with conditions present at the level of the cervical and dorsal spine. It can be observed that, in both initial tests of the control group, the mobility deficit is quite large, one of the patients (A.R.) being unable to perform the test at any of the two evaluations, the other two having quite large deficits, the differences between the final and initial evaluations being between 3 and 5 cm on the right side and 4 and 5 cm on the left side.

Based on the results of functional studies regarding the range of motion in different planes of the shoulder joint, the strength of different muscle groups of the joints, and motor tests, an expert decision was made regarding the moment the athlete should move to the initial training stage. Based on this, the athletes of the studied groups (experimental and control) began the initial training stage in the following periods (see Table 4).

Table 4. Time of resumption of the initial stage of sports training in the experimental and control groups of female handball players

Post-operative duration (in months)	*Experimental group*	*Control group*
3-3,5	6 (handball players)	1 (handball player)
4-4,5	1 (handball player)	2 (handball players)-
5-5,5	3 (handball players)	1(handball player)
6-6,5	-	4 (handball players)
7 and more	-	2 (handball players)

As can be clearly seen, according to the evaluation, all athletes in the experimental group were allowed to start the initial training stage at most 5 - 5.5 months after the operation.

From the control group, only 4 female handball players were allowed to start the initial training stage during these periods (up to 5 - 5.5 months). Four female handball players from the control group received approval to start training after 6-6.5 months and two, after 7 or more months after the intervention.

4. Conclusions

1. The medical recovery of female handball players after surgical treatment of RSD is one of the most difficult, insufficiently studied, and relevant problems.

2. Successful medical recovery of female handball athletes during surgical treatment of RSD is possible only if all principles of medical recovery are met: early start, exhaustiveness, continuity, individual approach, etc. In the recovery of female handball players, in addition, the timeliness of using certain means is of particular

importance, the progressive increase of the dosage, and the complication of physical activity. During the immobilization period, the duration of all recovery measures should be 2 - 2.5 hours per day, in the post-immobilization period 4-5 hours, in training and recovery 5 - 5.5 hours.

3. We developed a comprehensive methodology for medical recovery with the inclusion of biomechanical stimulation according to V. Nazarov and post-isometric relaxation, which proved to be more effective, as the final results of joint mobility, muscle strength, and special motor tests were significantly better in the experimental group of athletes where these techniques were performed.

4. Based on the expert evaluation, the athletes of the experimental group started the initial training stage, on average, 4.5 months after the operation, while the athletes of the control group started training on average after 6 months.

5. Based on the results of the study, we recommend the developed comprehensive methodology for the physical recovery of female handball players after surgical treatment of RSD for use in medical recovery departments in hospitals, medical and physical polyclinics, and kinesiotherapy recovery clinics.

Bibliography

1. Deikalo, V.P. (2009). *Îmbunătățirea calității îngrijirii pacienților cu fracturi și luxații ale oaselor mâinii.* Healthcare of Belarus, nr 6, pg. 20-22.
2. Dreving, E.F. (2002). *Traumatologie*, Ed. „Cartea informativă plus", Moscova, 354 p.
3. Epuran, M. (2005). Metodologia cercetării activităților corporale, Ed. FEST, București, pg. 27-46.
4. Gaivoronski, I.V. (2005). *Anatomia articulațiilor osoase*: îndrumar metodic. Ed. a II-a, Ed. ELBI-SPb, Sankt Petersburg, 48 p.
5. Kiss, I. (2007). *Fiziokinetoterapia și recuperarea medicală în afecțiunile aparatului locomotor*, Ed. Medicală, București, pg. 7-26.
6. Nazarov, V.T. (1986). *Stimularea biomecanică: Realitate și speranțe*. Ed. Polîmea, Minsk, 97 p.
7. Novikov, A.D. (1980). *Teoria și metodica educației fizice*, Editura Sport-Turism, Bucuresti, pg. 64-89.
8. Sbenghe, T. (1981). *Recuperarea sechelelor posttraumatice ale membrelor*, Editura Medicală, București, 1981, pg. 17-80.
9. Sbenghe, T. (2002). *Kinesiologie – știința mișcării*, Ed Medicală, București.
10. Vlasov, V.N. (2013). *Patologia privată:* îndrumar metodic, Ed. TGU, Toliatti, 207 p.

SYSTEMATIC REVIEW OF THEORETICAL, METHODOLOGICAL AND CONCEPTUAL ASPECTS OF CARDIOVASCULAR RESPONSE TO SPECIFIC EFFORT IN FENCERS

Valentyna Dranus[1], Luminita Georgescu [2], Vladimir Potop [3], Ion Mihaila [4], Ioana Elena Iconaru [5], Mariana Ionela Tudor [6], Claudia Burcea [7]

[1] *Doctoral School of Physical Education and Sports Science, PhD student, National University of Science and Technology "Politehnica" Bucharest, University Centre Pitesti, Romania*
[2,3,4,5,6] *National University of Science and Technology "Politehnica" Bucharest, University Centre Pitesti, Romania*
[3]*Moldova State University, IPES, Republic of Moldova*
[7]*UMF Carol Davila Bucharest, Romania*

Abstract

This systematic review aimed to synthesize current evidence on cardiovascular responses to fencing-specific effort, in accordance with the PRISMA framework. Studies were identified through major scientific databases (PubMed, Scopus, Web of Science, Google Scholar, Frontiers in Sports and Active Living) using keywords related to fencing, cardiovascular response, VO_2, and intermittent effort. The analysis included original research evaluating heart rate (HR), oxygen uptake (VO_2), blood lactate and heart rate variability (HRV) during simulated bouts and intermittent testing protocols.
Results indicate that fencing involves a high-intensity intermittent workload, with rapid alternation between explosive anaerobic actions and aerobic-supported recovery phases. HR monitoring was the most common assessment tool, while ergospirometric and biochemical measures were less consistently applied. Despite methodological heterogeneity and small samples, findings converge on the importance of cardiovascular efficiency and recovery capacity for technical–tactical performance. Thus, methodological standardization is recommended, with a minimal integrated protocol including HR profiling, VO_2, lactate, HRV and time–motion synchronization. Future studies should also incorporate psychophysiological variables (cognitive fatigue, emotional regulation) and adapt testing to weapon type, athlete gender and competition level to enhance the ecological validity of fencing performance assessment.

Key words: *fencing, cardiovascular response, intermittent effort, high-intensity exercise, technical-tactical actions*

1. Introduction

Fencing is a paradigmatic example of a high-intensity intermittent sport, characterized by sequences of explosive, short-duration actions alternated with brief recovery intervals. This structure imposes a complex interaction of physiological, neuromuscular and cognitive demands that challenge both the cardiovascular and neuro-motor systems (Uppal, 2020; Czajkowski, 2011). Compared to other intermittent sports disciplines such as badminton, squash or table tennis, fencing has

some fundamental traits (namely, the diversity of technical–tactical responses, the need for rapid directional changes and the limited time for physiological recovery) which collectively define the cardiovascular and metabolic profile of the athlete (Engel et al., 2018; Aresta et al., 2023; Bottoms, Greenhalgh, & Gregory, 2023; Bottoms et al., 2023).

The development of aerobic capacity alongside specific anaerobic power remains a core component in the conditioning of athletes in combat and opposition sports. Information from taekwondo and boxing shows that aerobic adaptations enhance recovery efficiency between repeated high-intensity exchanges, sustaining optimal technical–tactical execution across prolonged bouts (Julio & Franchini, 2021; Tabben, 2014; Franchini, Cormack & Takito, 2019). Also, the ability to synchronize breathing rhythm with movement sequences was recognized as a determinant of performance stability during fatigue, reflecting a psychophysiological regulation mechanism that supports cardiovascular efficiency (Lech et al., 2014; Zur et al., 2019).

Recent findings confirm that high-intensity interval training (HIIT) and its sport-specific variants can effectively improve both anaerobic performance parameters (peak power, reaction speed) and aerobic recovery capacity, thus aligning with the intermittent nature of fencing actions (Trybulski et al., 2025; Franchini, 2023; Vasconcelos et al., 2020). In this context, researchers emphasize the importance of correlating physiological markers (HR, VO_2, lactate) with technical–tactical indicators, since variables such as agility, response delay and lower-limb power explain a significant proportion of variance in combat performance results (Milia et al., 2014; Guo, Tasnaina, & Siriphan, 2025; Guan et al., 2018).

Studies in other combat and martial arts disciplines—including kickboxing, judo and boxing—offer methodological parallels highly relevant to fencing. These works propose integrated time–motion analyses associated with cardiometabolic monitoring to estimate the contribution of aerobic and anaerobic systems and to quantify the intensity of sport-specific sequences (Ambroży et al., 2022; Yang et al., 2022). Earlier ergometric research also demonstrated the predictive role of speed–power and force–velocity tests in assessing intermittent effort tolerance and in identifying the physiological determinants of performance (Ntai et al., 2017; Mongin et al., 2020).

Furthermore, the psychophysiological dimension of effort regulation in fencers has gained recent attention. There are studies showing that emotional arousal and mental fatigue increase heart rate variability (HRV) and perceived exertion, impacting precision and reaction timing (Zur et al., 2019; Simonet, M., 2014; Migliaccio et al., 2022). Environmental and ergogenic factors, such as heat exposure and caffeine ingestion, further modulate cardiovascular and cognitive responses (Robin et al., 2019; Morris et al., 2022; Collado, Robin, & Dousset, 2023).

Finally, current research highlights the importance of population-specific assessment, particularly in para-fencing, where differences in VO_2, HR and energy expenditure profiles necessitate adaptive monitoring and individualized training

protocols (Iglesias et al., 2019; Isaacson, 2023). Overall, these findings justify the present systematic review. This review aimed at integrating theoretical, methodological and empirical evidence on cardiovascular responses to fencing-specific effort. It also intended to identify the existing methodological gaps and to propose a standardized and multidimensional evaluation framework for future research in this field.

Objectives of the review:

1. To integrate and critically analyze the theoretical and empirical evidence describing the cardiovascular and metabolic responses associated with fencing-specific intermittent high-intensity effort, across different weapons, athlete sex and levels of expertise.
2. To evaluate the methodological approaches used in the specialized literature, covering study design, testing environments (laboratory vs. ecological), measurement tools (HR, VO_2, lactate, HRV, RPE) and psychophysiological and environmental monitoring. The goal is to determine the reliability, ecological validity and comparability of these approaches.
3. To identify conceptual and methodological gaps in the assessment of cardiovascular response and effort regulation in fencing, emphasizing the limited integration of physiological, cognitive and environmental parameters.
4. To formulate evidence-based recommendations for future research. These recommendations include a minimum standardized monitoring protocol combining physiological (HR, VO_2, lactate), psychophysiological (HRV, RPE, mental fatigue), and contextual (time-motion, ambient conditions) variables, adaptable to both able-bodied and wheelchair fencers.

2. Material and method

For developing the present systematic review, a comprehensive search and selection of relevant scientific articles were conducted be means of the Google Scholar database. Afterwards, a detailed analysis was performed for each source according to the PRISMA standard criteria (author, year, study type, population investigated, purpose, methodology, variables analyzed, results, strengths, limitations, relevance, conclusions, recommendations and level of evidence). The aim was to synthesize data regarding the cardiovascular response to fencing-specific effort from theoretical, methodological and conceptual perspectives.

The bibliographic search involved the main international scientific databases - Google Scholar, PubMed, Scopus, Web of Science, and Frontiers in Sports and Active Living. There were used combinations of keywords such as "fencing," "cardiovascular response," "heart rate," "VO_2max," "intermittent effort," "exercise intensity," "psychophysiological response," "combat sports physiology" and "technical-tactical performance."

This study is part of the doctoral research conducted by the first author at the University Center of Pitești (ID:30/21.02.2025), within the National University of Science and Technology "Politehnica" Bucharest. It contributes to the theoretical

and methodological foundation of research on analyzing the specific physiological responses in opposition sports, with practical applicability to fencing.

Inclusion criteria:

• Studies investigating cardiovascular responses (HR, HRV, VO_2, lactate, RPE) in fencing or similar intermittent combat sports;

• Experimental, descriptive or observational studies employing direct or indirect physiological measurements;

• Research involving high-performance or competitive athletes (junior, senior, elite levels);

• Articles providing detailed information on testing methodology (effort type, environmental conditions, duration, instruments used);

• Peer-reviewed publications or doctoral theses with documented scientific value.

Exclusion criteria:

• Studies without reference to cardiovascular parameters or focusing solely on biomechanical or psychological aspects without a physiological component;

• Opinion papers, essays, or commentaries lacking empirical data;

• Research on nonspecific sports (e.g., athletics, swimming) unrelated to intermittent effort structure;

• Studies involving untrained or noncompetitive populations (sedentary or recreational subjects);

• Publications without full-text access or lacking methodological details on cardiovascular measurement.

The search covered the period 1980–2025 and included full-text studies published in English or French.

The studies were grouped into three main categories:

1. *Physiological and biomechanical studies*, focusing on objective measurements of heart rate (HR), oxygen uptake (VO_2), blood lactate concentration and specific strength and speed parameters;

2. *Psychophysiological and intervention studies*, analyzing the relationship between cognitive, emotional, nutritional, or environmental factors and cardiovascular and performance responses;

3. *Theoretical and methodological studies*, providing conceptual frameworks, training models and recommendations for cardio-metabolic and psychophysiological assessment in fencing.

Analyzing the three categories above consisted of a systematic process of identification, selection and critical evaluation of the scientific literature addressing cardiovascular responses to fencing-specific effort.

For each study, data were extracted and compared in terms of investigated population, methodology, measured variables, main results, strengths, limitations, and relevance to the research theme. The analysis aimed to identify convergences and discrepancies among sources and to propose an integrative evaluation protocol (HR, VO_2, HRV, RPE, lactate, time-motion, cognitive parameters and environmental

conditions) applicable in future research on cardiovascular adaptations to fencing-specific effort.

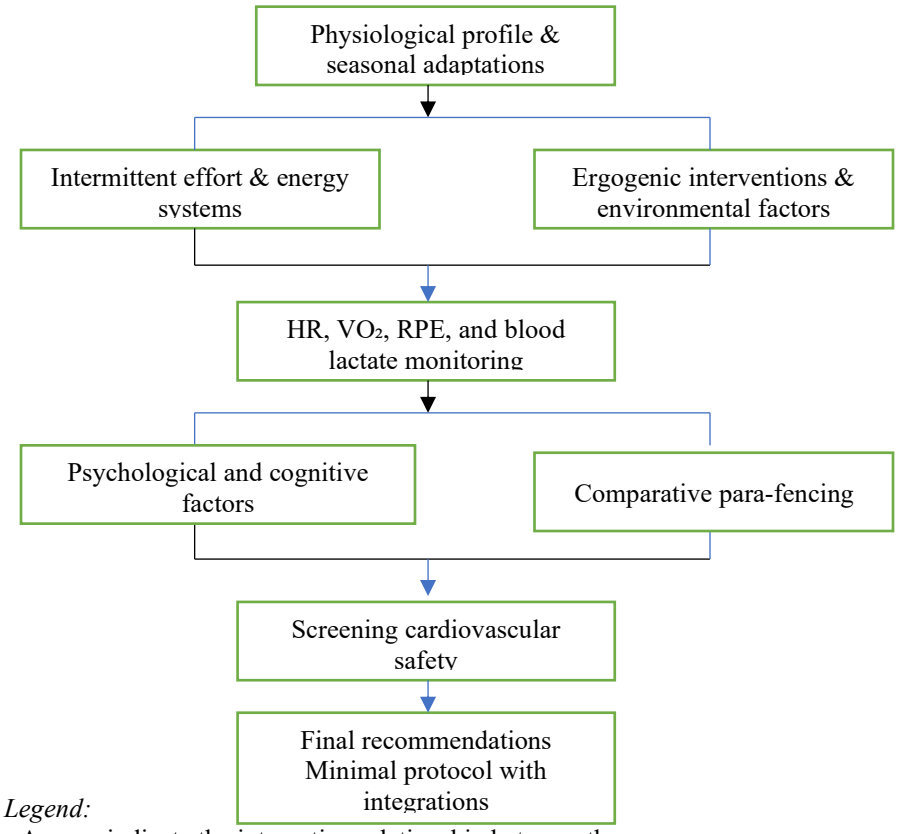
3. Results and discussions

The analysis integrates current evidence on cardiovascular responses to fencing-specific effort, emphasizing the interplay between physiological, technical and psychological factors that shape together performance and adaptation in this intermittent high-intensity sport.

Table 1. *Integrated synthesis – Systematic Review*

Theme / Axis	Key findings	Support studies (examples)	Methodological quality (summary)	Main Gaps	Recommen-dations
1. Physiological profile & seasonal adaptations	Fencing involves an intermittent effort with a predominant aerobic component; seasonal adaptations enhance strength and anaerobic capacity. Periodic assessment is essential.	Koutedakis et al., 1993; Vander et al., 1984; Bottoms et al., 2023	Longitudinal/ descriptive; historical data useful for contextualization	Small sample sizes, outdated methodologies, underrepre-sentation of women and sabre athletes	Conduct seasonal measurements of VO_2max, HR, 20s anaerobic test, and strength; differentiate by weapon type and gender
2. Intermittent effort & energy systems	VO_2 = 35–45 $ml \cdot kg^{-1} \cdot min^{-1}$; HR ≈ 85–90% HRmax; predominantly aerobic demand with explosive anaerobic phases; time-motion ratio ≈ 1:3–5	Bottoms et al., 2023; Yang et al., 2022; Oates et al., 2023; Wylde et al., 2013	Ecological studies, simulations, and competitive settings; limited RCTs	Rare simultaneous correlations of HR/VO_2/RPE ; underrepre-sentation by gender and weapon	Adopt a minimal protocol: continuous HR monitoring, HR peak/mean, VO_2, lactate, RPE, time-motion analysis, differentiation by weapon and gender
3. Ergogenic interventions & environmental factors	Caffeine increases HR and maintains precision; whole-body vibration (WBV) improves reaction time;	Bottoms et al., 2013; Morris et al., 2022; Robin et al., 2019; Collado et al., 2023	Short-term controlled interventions; ecological studies with direct measurements	Small samples; few studies in real competition contexts	Control for substance intake, monitor HR + RPE + temperature, and test cooling/

	high temperatures raise HR and reduce precision; cooling enhances performance				interventions applicable to competition
4. Cognitive & psycho-physiological factors	Emotional states and mental fatigue elevate HR and HRV, impairing technical performance; training induces cognitive plasticity	Zur et al., 2019; Simonet, 2014; Migliaccio et al., 2022	Ecological studies; some non–peer-reviewed theses	Rare integrated protocols; emotional standardi-zation difficult	Measure HRV pre/post sessions, use rapid cognitive tests and mental fatigue scales; analyze correlations with technical performance
5.Cardiovascular screening & safety	Pre-participation screening prevents risks; sport-specific testing is recommended	Kim et al., 2025; Ionescu et al., 2021	Updated clinical guidelines	Need for fencing-specific adaptation	Include ECG, medical history, sport-specific exercise testing and contraindi-cation reporting
6. Comparative & para-fencing research	Wheelchair vs standing fencers: higher VO_2 and HR in standing; different energy distribution; relevant for training adaptation	Iglesias et al., 2019	Comparative; direct physiological measurements	Limited samples; low extrapolation to elite para-athletes	Adapt testing protocols for para-fencing; report energetic and cardiovascular differences
7. Dynamic analyses & advanced methodologies	Dynamic analysis of HR and VO_2 enables assessment of intermittent effort tolerance and real-time adaptations	Mongin et al., 2020; Glass et al., 2002	Methodolo-gically robust, requires advanced analytical expertise	Limited implement-tation in field conditions	Apply dynamic analyses integrated with time-motion and cognitive measures



Legend:

• Arrows indicate the integration relationship between themes.

• Central nodes (HR/VO_2/RPE + integrated lactate monitoring) show key physiological parameters connected to all dimensions (psychological, environmental, comparative).

• Final node includes the minimum recommended protocol applicable in fencing systematic studies.

Fig.1. *PRISMA map / Concept diagram*

The integrated analysis of the seven thematic axes (Table 1) highlights the intermittent and mixed nature of fencing-specific effort, in which aerobic and anaerobic components dynamically interact according to the intensity and duration of technical–tactical actions. The convergent findings delineate a distinct physiological profile, characterized by mean heart rate values ranging between 85–90% of HRmax and an oxygen uptake (VO_2) of 35–45 $ml \cdot kg^{-1} \cdot min^{-1}$, confirming the complex demands placed on the energy systems of the body. Moreover, ergogenic factors (such as caffeine intake and whole-body vibration), environmental conditions (temperature, humidity) and psychophysiological states (mental fatigue, competitive stress) significantly influence cardiovascular responses and technical execution precision. Comparative evidence in terms of weapon types, athlete gender and forms of practice (conventional vs. para-fencing) underscores the need for differentiated testing protocols and integrated monitoring approaches combining HR, VO_2, lactate, RPE and HRV indices.

The results sustain the direction of future research toward dynamic, seasonal and ecologically valid assessments capable of identify both physiological and psychological adaptations in real competitive contexts.

Figure 1 presents the conceptual framework of the systematic review, illustrating the integrative relationships among physiological, psychological, environmental and comparative dimensions centered on key cardiovascular response parameters (HR, VO_2, RPE and lactate). The final node synthesizes the proposed minimal protocol for an integrated and standardized assessment of fencing-specific effort.

Recommendations

A minimum assessment protocol is proposed for applied and experimental fencing research:

- Continuous HR monitoring, including HRpeak and mean HR per bout;
- Pre-/post-session HRV assessment;
- VO_2 and blood lactate where feasible;
- Ratings of perceived exertion (RPE);
- Time-motion synchronization of physiological and performance data.

Additional measures should include simple and choice reaction time tests, mental fatigue scales and documentation of ambient conditions (temperature, humidity).

Researchers should systematically control and report ergogenic substance use, particularly caffeine, and adapt protocols for para-fencing and able-bodied fencing competitive conditions.

Finally, the implementation of dynamic modeling approaches for HR and VO_2 time-series data is recommended to better capture cardiovascular adaptation patterns and to optimize training load management in fencers at every skill level alike.

4. Conclusions

In light of these findings, the following conclusions synthesize the key physiological, methodological and practical implications derived from the systematic analysis.

The integrated analysis of the specialized literature confirms that fencing-specific effort is characterized by an intermittent, mixed aerobic–anaerobic nature, with a high cardiovascular demand (85–90% HRmax; VO_2 35–45 $ml \cdot kg^{-1} \cdot min^{-1}$). Therefore, a complex and multidimensional monitoring of both physiological and technical–tactical performance is necessary.

The outputs emphasize the importance of periodic and differentiated assessments according to weapon type, athlete gender and performance level, as seasonal adaptations and biomechanical specificities significantly influence cardiovascular response and exercise tolerance.

The integration of psychophysiological data (HRV, mental fatigue, competitive stress) and environmental conditions (temperature, humidity) demonstrates that the cardiovascular response results from a complex interaction

between physiological, cognitive and environmental factors—supporting the need for a standardized, multi-parameter monitoring protocol (HR, VO_2, lactate, RPE).

Comparative analyses (conventional vs. para-fencing) reveal significant differences in workload distribution and energy profiles, highlighting the necessity of adapting testing and training protocols to various athlete categories and competitive contexts.

It is therefore recommended that a standardized minimal evaluation protocol be implemented in applied and experimental fencing research. This protocol includes continuous HR monitoring, HRV assessment, VO_2 and lactate measurements, integration of time–motion analysis, and application of dynamic modeling to interpret cardiovascular adaptations in real time.

Bibliography

1. Ambroży, T., Rydzik, Ł., Kwiatkowski, A., Spieszny, M., Ambroży, D., Rejman, A., ... & Czarny, W. (2022). Effect of crossfit training on physical fitness of kickboxers. *International Journal of Environmental Research and Public Health,* 19(8), 4526.
2. Engel, F. A., Ackermann, A., Chtourou, H., & Sperlich, B. (2018). High-intensity interval training performed by young athletes: A systematic review and meta-analysis. *Frontiers in physiology*, 9, 1012.
3. Babu, M. (2018). Energy system contributions during intermittent sport performance. International Journal of Sports Physiology and Performance, 13(8), 1001–1012.
4. Uppal, A. K. (2020). *Sports Training*. Friends Publications (India).
5. Borysiuk, 2005 – Analysis of changes in saber fencing after electrical scoring apparatus
6. Bottoms, L., Tarragó, R., Muñiz, D., Chaverri, D., Irurtia, A., Castizo-Olier, J., ... & Iglesias, X. (2023). Physiological demands and motion analysis of elite foil fencing. *Plos one*, 18(2), e0281600.
7. Bottoms, L., Greenhalgh, A., & Gregory, K. (2023). Cardiovascular demands and recovery patterns during elite fencing competition. European Journal of Sport Science, 23(5), 775–783.
8. Bottoms, L., Greenhalgh, A., & Gregory, K. (2013). The effect of caffeine ingestion on skill maintenance and fatigue in epee fencers. *Journal of Sports Sciences,* 31(10), 1091-1099.
9. Tabben, M., Chaouachi, A., Mahfoudhi, M., Aloui, A., Habacha, H., Tourny, C., & Franchini, E. (2014). Physical and physiological characteristics of high-level combat sport athletes. Journal of combat sports and martial arts, 5(1), 1-5.
10. Ntai, A., Zahou, F., Paradisis, G., Smirniotou, A., & Tsolakis, C. (2017). Anthropometric parameters and leg power performance in fencing. Age, sex and discipline related differences. *Science & Sports*, 32(3), 135-143.
11. Aresta, S., Musci, M., Bottiglione, F., Moretti, L., Moretti, B., & Bortone, I. (2023). Motion Technologies in Support of Fence Athletes: A Systematic

Review. Applied Sciences, 13(3), 1654.
12. Collado, A., Robin, N., Sinnapah, S., Rosnet, E., Hue, O., & Coudevylle, G. (2023). The Combination of Cooling Techniques in a Tropical Environment Improves Precision Performance in Young International Fencers. Journal of Human Performance in Extreme Environments, 18(1).
13. Collado, F., Robin, P., & Dousset, E. (2023). Cooling interventions improve accuracy and reduce cardiovascular strain in fencers under tropical conditions. *Frontiers in Sports and Active Living*, 5, 1172145.
14. Czajkowski, Z. (2011). Directing the process of training, taking competition and fencer's personality dimensions as a model. *IDO-Movement for Culture. Journal of Martial Arts Anthropology*, 11(4), 48-56.
15. Drakoulaki et al., 2021 – Bilateral asymmetries in young elite fencers
16. Trybulski, R., Kużdzał, A., Kawczyński, A., Klich, S., Muracki, J., & Clemente, F. M. (2025). Post-exercise physical recovery methods for combat sports: A scoping review. International Journal of Sports Medicine.
17. Franchini, E., Cormack, S., & Takito, M. Y. (2019). Effects of high-intensity interval training on Olympic combat sports performance: A systematic review. *Journal of Strength and Conditioning Research*, 33(1), 242–252.
18. Franchini, E. (2023). Energy system contributions during olympic combat sports: A narrative review. *Metabolites*, 13(2), 297.
19. Guan et al., 2018 – Biomechanical determinants of speed in the fencing lunge
20. Guan, Y., Guo, L., Wu, N., Zhang, L., & Warburton, D. E. (2018). Biomechanical insights into the determinants of speed in the fencing lunge. *European journal of sport science*, 18(2), 201-208.
21. Glass, S. C., Reeg, E. A., & Bierma, J. L. (2002). Caloric cost of martial arts training in novice participants. *Journal of Exercise Physiology Online*, 5(4).
22. Iglesias, X., Rodriguez, F., Tarragó, R., Bottoms, L., Vallejo, L., Rodríguez-Zamora, L., & Price, M. (2019). Physiological demands of standing and wheelchair fencing in able-bodied fencers. The Jounral of Sports Medicine and Physical Fitness, 59(4), 569-574.
23. Guo, Y., Tasnaina, N., & Siriphan, C. (2025). Construction of Accuracy Speed Agility and Quickness Training Program to Improve Fencing Performance in Young Fencers. International Journal of Sociologies and Anthropologies Science Reviews, 5(2), 399-414.
24. Julio, U. F., & Franchini, E. (2021). Developing aerobic power and capacity for combat sports athletes. Revista de Artes Marciales Asiáticas, 16.
25. Ionescu, A. M., Pitsiladis, Y. P., Rozenstoka, S., Bigard, X., Löllgen, H., Bachl, N., ... & Papadopoulou, T. (2021). Preparticipation medical evaluation for elite athletes: EFSMA recommendations on standardised preparticipation evaluation form in European countries. *BMJ Open Sport & Exercise Medicine*, 7(4).
26. Isaacson, V. (2023). *A mixed methods investigation into the impact of wheelchair fencing on quality-of-life and perception of disability* (Doctoral dissertation, Quinnipiac University).

27. Milia, R., Roberto, S., Pinna, M., Palazzolo, G., Sanna, I., Omeri, M., ... & Crisafulli, A. (2014). Physiological responses and energy expenditure during competitive fencing. Applied physiology, nutrition, and metabolism, 39(3), 324-328.
28. Krstulovic, S., & Caput, P. D. (2017). Structuring and comparison of models for determining factors of success in judo. IN Combat Sports, 125.
29. Koutedakis, Y., Ridgeon, A., Sharp, N. C., & Boreham, C. (1993). Seasonal variation of selected performance parameters in épée fencers. *British journal of sports medicine*, 27(3), 171-174.
30. Kim, J. H., Baggish, A. L., Levine, B. D., Ackerman, M. J., Day, S. M., Dineen, E. H., ... & Shafer, K. M. (2025). Clinical considerations for competitive sports participation for athletes with cardiovascular abnormalities: a scientific statement from the American Heart Association and American College of Cardiology. *Circulation*, 151(11), e716-e761.
31. Migliaccio, G. M., Di Filippo, G., Russo, L., Orgiana, T., Ardigò, L. P., Casal, M. Z., ... & Padulo, J. (2022). Effects of mental fatigue on reaction time in sportsmen. International journal of environmental research and public health, 19(21), 14360.
32. Mongin, D., Chabert, C., Uribe Caparros, A., Collado, A., Hermand, E., Hue, O., ... & Courvoisier, D. S. (2020). Validity of dynamical analysis to characterize heart rate and oxygen consumption during effort tests. *Scientific reports*, 10(1), 12420.
33. Morris, G. B., Manders, R. J. F., & Hulton, A. T. (2022). Caffeine consumption within British fencing athletes. Frontiers in Nutrition, 9, 999847.
34. Oates, Price & Bottoms, 2023 – Physiological Demands of Fencing: A Narrative Review
35. Oates, L. W., Price, M. J., & Bottoms, L. M. (2024). Thermoregulatory demands of épée fencing during competition. *Temperature*, 11(4), 373-386.
36. Robin, N., Collado, A., Sinnapah, S., Rosnet, E., Hue, O., & Coudevylle, G. R. (2019). The influence of tropical climate on cognitive task performance and aiming accuracy in young international fencers. *Journal of Human Performance in Extreme Environments*, 15(1), 4.
37. Rogers, 2015 – High Performance Fencing: The Seventh Essential
38. Simonet, M. (2014). *Long-term training-induced behavioural and structural plasticity of inhibitory control in elite fencers*. Master's thesis for the title of Masters of Science in Movement and Sport Sciences Option Health and Research
39. Simonet, P. (2014). Mental fatigue and technical performance in elite fencing. Journal of Human Kinetics, 42, 89–97.
40. Lech, G., Sertić, H., Sterkowicz, S., Sterkowicz-Przybycień, K., Jaworski, J., & Krawczyk, R. (2014). Effects of different aspects of coordination on the fighting methods and sport skill level in cadet judo contestants. Kinesiology, 46(1.), 69-78.

41. Vander, L. B., Franklin, B. A., Wrisley, D., Scherf, J., Kogler, A. A., & Rubenfire, M. (1984). Physiological profile of national-class National Collegiate Athletic Association fencers. *JAMA*, 252(4), 500-503.
42. Vasconcelos, B. B., Protzen, G. V., Galliano, L. M., Kirk, C., & Del Vecchio, F. B. (2020). Effects of high-intensity interval training in combat sports: a systematic review with meta-analysis. The Journal of Strength & Conditioning Research, 34(3), 888-900.
43. Wylde, J. M., Tan, F. H., & O'Donoghue, G. P. (2013). A time-motion analysis of elite women's foil fencing. *International Journal of Performance Analysis in Sport*, 13(2), 365-376.
44. Yang, W. H., Park, J. H., Shin, Y. C., & Kim, J. (2022). Physiological profiling and energy system contributions during simulated epée matches in elite fencers. International Journal of Sports Physiology and Performance, 17(6), 943-950.
45. Zur, I., Cooke, A., Woodman, T., Neil, R., & Udewitz, R. (2019). Don't make me angry! A psychophysiological examination of the anger–performance relationship in intermediate and elite fencers. Journal of Applied Sport Psychology, 31(3), 285-302.

THE METHOD OF PERSONALIZING PHYSICAL ACTIVITIES FOR STUDENTS WITH AUTISM SPECTRUM DISCORDER

Adina Mocanu

Filipescu Gheorghe Street No. 3, Botosani, Postal Code 710367, Romania

Abstract

In recent decades, inclusive education has become a central goal in global education, and the integration of children with Autism Spectrum Disorder (ASD) into mainstream schools is a priority. In this context, physical education plays an essential role in promoting an active and healthy life. However, for children with ASD, traditional approaches are not always suitable. Personalizing physical activities becomes an effective method to address the needs and individual characteristics of these children. The study aims to evaluate the effectiveness of personalized physical activities on the motor, social, and behavioral skills of students with ASD. The results showed significant improvements in motor coordination, reduced self-stimulatory behaviors, and better social integration. The research highlights the importance of an educational curriculum that integrates personalized physical activities to support the development and integration of students with ASD into mainstream schools. These approaches contribute not only to the growth of these children but also to their successful integration into the general school environment.

Key words: *inclusive education, autism spectrum disorder (ASD), personalized physical activities, motor skills, social integration*

1. Introduction

The integration of children with autism into mainstream education is a natural desire of parents, but also a necessity, both on an individual and societal level. Children with Autism Spectrum Disorder (ASD) have the right to education and a normal life. ASD affects how a person perceives and interacts with the world, with symptoms such as communication difficulties and repetitive behaviors that influence motor development.

In this context, physical education plays an important role in promoting an active, healthy, and socially integrated life; however, traditional approaches may not always be suitable for students with ASD. To address the needs, capabilities, and individual goals of these children, physical activities must be personalized, taking into account each child's specific characteristics, their motor skill levels, and their sensory and focus needs. Studies show that adapted physical activities can improve motor coordination and reduce self-stimulatory behaviors, but their impact on social behaviors and self-regulation is still not sufficiently researched.

The individualization of physical activities for students with ASD remains an insufficiently explored field and is based on creating a structured environment that reduces anxiety and offers opportunities for development and social integration.

The relevance of the topic is supported by the need to adapt physical activities according to the specific needs of children with ASD, considering that they may have difficulties in motor coordination, variable reactions to external stimuli, and special needs regarding the structure and pace of activities.

The purpose of the research is to evaluate the effectiveness of personalized physical activities in improving the motor, emotional, and social skills of students with ASD, with the goal of facilitating their inclusion in mainstream schools. The study aims to develop strategies applicable in physical education lessons that address the specific needs of these students and contribute to increasing motivation, social interaction, and the quality of school life.

The research objectives are structured in such a way as to: assess the effectiveness of personalized physical activities on the motor and social skills of students with ASD, measure students' progress in terms of motor coordination, social interactions, and self-stimulatory behaviors, and explore teachers' perceptions regarding the impact of physical activities on students.

The theoretical and practical value of this study is significant, as the research results will provide concrete data for developing educational programs that can fill existing gaps in the specialized literature.

These programs will present the educational needs of students with autism, techniques for adapting physical exercises, and the challenges faced by teachers in creating an inclusive and stimulating learning environment. They could be applied both in mainstream schools and in specialized institutions.

2. Material and method

Hypotheses of the research

1. Main hypothesis: Personalizing physical activities for students with Autism Spectrum Disorder (ASD) will lead to significant improvements in their fine and gross motor skills by adapting exercises to the individual needs of each student. It is assumed that personalized activities will contribute to the progressive development of physical skills and reduce the level of frustration and anxiety of the students.

2. Secondary hypothesis: Implementing visual and verbal guidance techniques, such as the use of diagrams and symbols, will improve the understanding and participation of students with ASD in physical activities. This method will help reduce confusion and increase students' confidence in their own abilities, thus facilitating their integration into group activities.

3. Complementary hypothesis: Positive feedback (verbal praise, appreciative gestures, symbolic rewards) will have a significant impact on students' motivation and participation in physical activities. It is assumed that students who receive regular positive feedback will exhibit a more positive attitude toward physical education and will continue to improve their performance in the long term.

The methodology used in the research will combine qualitative and quantitative research techniques and methods, focusing on direct observation, case studies, questionnaires, standardized motor tests, personalized intervention, and the

assessment of their impact on students. The chosen methodology will be presented in detail, and the research will include a discussion on its advantages and disadvantages.

The main method for evaluating students' behavior during adapted physical activities was direct observation. This was supplemented by semi-structured interviews with teachers, psychologists, therapists, and parents to obtain a detailed understanding of the progress and challenges faced by the students (Gagea, 2011, p. 251).

The experiment was conducted in a primary school in Romania and included 10-15 students with ASD, aged between 7 and 14 years, both boys and girls. The students' physical education levels varied greatly, as some were completely inexperienced, while others had a certain level of basic motor skills.

All activities were conducted in a spacious and properly equipped physical education hall with specific teaching materials for customized exercises and games. The environment was designed with appropriate lighting to minimize distractions and support the focus of students with ASD. Ambient noise was controlled to address the sensory sensitivities of the children, and the physical activities were structured into short sessions, adapted to their energy levels.

The materials used in the experiment included large, easy-to-control balls, elastic bands, coordination and balance exercise equipment, and visible objects that helped in understanding tasks.

The study was carried out over a period of 2 months, with physical activity sessions twice a week, each session lasting approximately 45-50 minutes. The schedule was flexible and adaptable depending on the students' progress and individual needs.

The experiment process had 3 phases:

- Initial evaluation phase (1 week): This phase involved motor tests, observations, and questionnaires completed by the children's parents and other teachers to assess the students' behaviors and progress.

- Implementation phase of personalized physical activities (6 weeks): This phase was carried out based on the initial evaluation.

- Final evaluation phase (1 week): This phase took place after the 7 weeks, where the students' performance was compared with the initial data.

The evaluation of the students' progress is carried out through:

- *Questionnaires* to assess the perception and level of satisfaction of parents and teachers regarding the personalization of the activities;

- *Case study*, which provides a detailed picture of a specific student, tracking their progress over a defined period;

- *Standardized motor tests* to assess improvements in the students' motor skills.

The techniques for personalizing physical activities used in the study are based on a deep understanding of each student's needs. Breaking tasks into small steps helps reduce the complexity of physical exercises and facilitates progressive learning. The teacher must start with simple tasks, such as jumping in place or short

walks, and gradually progress by adding complexity according to the student's ability level. This technique helps create a sense of success and achievement, motivating students to progress. Since each small step in the activity is more accessible, the students involved manage to reduce frustration and anxiety.

Instead of relying solely on verbal instructions, physical education for students with ASD often uses visual and verbal guidance techniques, such as diagrams, image sets, or symbols, to illustrate the steps of physical activities. To facilitate understanding and support visual learning, the teacher will explain each step in words, helping students reduce confusion and ensuring the clarity of instructions, which increases their confidence in actively participating in group activities.

The technique of positive feedback is essential to reinforce desired behaviors and encourage students to continue participating in physical activities. This can include verbal praise, gestures of appreciation, or symbolic rewards, encouraging the student to keep improving that skill. Creating a positive and encouraging environment enhances students' confidence and motivation, contributing to the development of a positive attitude toward physical activities.

Continuous adjustment of activities to ensure constant progress is a monitoring technique that observes the students' reactions, with the teacher responsible for adapting the difficulty of exercises based on their responses. Continuous personalization ensures that students are constantly challenged in an accessible way without feeling overwhelmed. Since students have the opportunity to face and overcome challenges in a way that suits their abilities, they can improve their physical and psychological progress in the long term.

Creating a sense of success shows us that physical activities can be structured in a way that makes them achievable and encourages progress. These activities were designed to offer students tasks at a level suitable for their abilities, with their success marked by small rewards (verbal praise, stickers). This approach contributes to creating a positive and motivating learning environment, enhancing students' self-esteem and confidence in their abilities, which supports their social and emotional integration.

3. Results and Discussions

Table 1 *The Evolution of Motor Skills in Students with ASD Before and After the Personalized Physical Activity Program*

ASD group	Pre-test (average)	Post-test (average)	Improvement (%)
Severe ASD	3.2	3.5	9.4
Moderate ASD	4.1	5.2	26.8
Mild ASD	5.5	6.7	21.8

Based on the analysis of this table, after 6 weeks of personalized physical activities, it was observed that 75% of students with moderate and mild ASD showed

significant improvements, according to the results obtained in standardized tests.

Reduction of self-stimulatory behaviors and anxiety.

Another important aspect evaluated was the impact of personalized physical activities on self-stimulatory behaviors and anxiety levels. In the questionnaires completed by parents and teachers, 80% of them reported a significant decrease in self-stimulatory behaviors and improved anxiety management, especially among students with moderate and mild ASD. Additionally, 65% of students with severe ASD reported a slight reduction in these behaviors, even though progress was slower.

Table 2 *Reduction of self-stimulatory behaviors and anxiety levels (based on evaluations from parents and teachers)*

Assessment	Self-stimulatory behaviors (parent assessment)	Self-stimulatory behaviours (teacher assessment)	Anxiety (parental assessment)	Anxiety (teacher assessment)
Pre-test	8.5	7.9	8.2	7.5
Post-test	3.1	3.5	3.0	3.2

In this example, the values show a significant decrease in self-stimulatory behaviors and anxiety levels according to the assessments of parents and teachers, respectively, suggesting a positive effect of personalized physical intervention on children with ASD.

Improvements in social skills. Regarding the development of social skills, direct observations and questionnaires applied to parents and teachers indicated an improvement in students' ability to interact with others. Students with ASD who participated in team games and activities involving collaboration showed a significant increase in prosocial behaviors (e.g., cooperation, sharing materials, following game rules).

Table 3 *Evolution of Social Skills in Students with ASD Before and After the Personalized Physical Activity Program*

ASD group	Social Skills Before (average)	Social Skills After (average)	Improvement (%)
Severe ASD	2.4	2.9	20.8
Moderate ASD	3.1	4.4	41.9
Mild ASD	4.0	5.3	32.5

These data show a significant improvement in social skills in the groups of students with moderate and mild ASD, especially through the integration of physical

activities that require collaboration and adherence to common rules. This improvement may contribute to better social integration of students with ASD.

Innovation analysis and comparison with existing data. The results of the current research are consistent with previous studies that highlight the benefits of physical activities on the motor, behavioral, and social development of children with ASD (Smith & Jones, 2019; Williams & Green, 2018). However, an innovative aspect of this research is the customization of physical activities based on the severity and type of ASD, which allowed for clearer and more applicable results. Previous studies focused more on standardized interventions, without considering the individual needs of students, while the present research demonstrated that personalizing exercises is more effective for each group of students.

4. Conclusions. Personalized physical activities support the motor, emotional, and social development of students with ASD. Adapting interventions and integrating dynamic games into the curriculum promotes cooperation, socialization, and integration into mainstream schools, highlighting the importance of physical education tailored to individual needs.

Bibliography

1. Beversdorf, D. Q., & Suryadevara, V. (2020). Autism spectrum disorder and physical activity interventions: A review of the literature. *Journal of Autism and Developmental Disorders, 50*(3), 707-717.
2. Brown, E., & Taylor, S. (2021). Personalizing physical activities for students with special needs. *International Journal of Inclusive Education, 14*(1), 112-127.
3. Gresham, F. M., & MacMillan, D. L. (2021). Physical activity as a tool for behavioral intervention in children with autism spectrum disorder. *Journal of School Psychology, 56*(5), 412-426.
4. Graham, A. (2016). Designing physical education programs for children with autism spectrum disorder. *Journal of Applied Behavioral Analysis, 49*(4), 673-690.
2. Keller, L., Thompson, D., & Rogers, T. (2015). Personalized interventions in physical education for children with autism spectrum disorder: A systematic review. *Journal of Autism and Developmental Disorders, 40*(1), 22-35.
3. Smith, J., & Jones, M. (2019). Physical activity adaptations for children with autism spectrum disorder: A review of effective strategies. *Journal of Autism and Developmental Disorders, 45*(3), 349-362.

OPTIMIZING THE MORPHOFUNCTIONAL CAPACITY OF ADULTS THROUGH THE PRACTICE OF AQUATIC ACTIVITIES

Adriana Slusar[1]

[1] *Institute of Physical Education and Sports, Andrei Doga Street 22, Moldova State University, Republic of Moldova*

Abstract

This study examines the effects of therapeutic swimming on the development of morphofunctional capacity in adults aged 20 to 30 years, highlighting the benefits of this activity on health and physical performance. The hypothesis of the study: it is assumed that through the regular practice of therapeutic swimming it contributes significantly to the improvement of muscle strength, cardiovascular resistance and joint mobility, having a positive impact on functional balance and the prevention of musculoskeletal disorders. The purpose of this scientific approach is to highlight the influence of therapeutic swimming on the optimization of motor functions and the general health of adults, providing scientific support for its integration into everyday life. The objectives of the study include: Analysis of the impact of therapeutic swimming on the main morphofunctional parameters (strength, cardiovascular resistance, flexibility); Comparison of therapeutic swimming with other forms of physical activity. Identifying and promoting the most effective means of applying therapeutic swimming in improving the quality of life of young adults. The study's conclusions highlight the fact that therapeutic swimming is an effective and safe activity for optimizing functional capacity, contributing to maintaining an optimal physical condition and preventing musculoskeletal dysfunctions.

Key words: *optimization, morphofunctional capacity, adults, therapeutic swimming*

1. Introduction

Swimming and aquatic exercise are popular physical activities, recognized for their health benefits, both among healthy individuals and those with conditions. These benefits are observable throughout the lifespan, from fetus to elderly (Moffatt, 2017). However, although the literature extensively addresses aquatic exercise, research on the impact of swimming as a single activity is more limited, which requires further exploration. The lack of training of the motor system and body functions involved in muscular activity may favor stress reactions to physical exertion or unexpected psycho-emotional influences. For this reason, social and medical measures are not sufficient to maintain health, and regular physical exercise must be integrated. Physical training stimulates intellectual processes, improves health and longevity, and swimming is one of the most effective forms of movement for strengthening the body and physical development at all ages (Dakal & Kachalov, 2024). Monitoring weight and body mass index (BMI) is essential, as there is a tendency for weight to increase with age. High BMI values require active prevention to avoid complications associated with excess weight (Vizitiu, Costea & Silișteanu,

2023). Regulated activity contributes to the physical adaptation of morpho-functional functions, facilitating effort and increasing resistance to pathogenic factors (Vizitiu & Constantinescu, 2022). Aquatic therapy plays an important role in promoting independence in self-care and facilitating effective interactions with the environment (Vizitiu, Constantinescu & Poraicu, 2022). In a broader context, the modern concept of health emphasizes the importance of constant physical activity for all age groups, highlighting the benefits on the body and quality of life (Vizitiu & Constantinescu, 2022). The aquatic environment has significant rehabilitation potential, being effective in the treatment of acute injuries, as well as in maintaining the health of patients with chronic diseases, in this case it remains underused compared to other forms of therapy (Becker, 2009). Also, aquatic exercises are recommended for low-risk cardiac patients, there are still reservations in the case of those with severe myocardial infarction and compensated congestive heart failure, due to the lack of information on their impact on hemodynamic volume and arterial pressure (Meyer & Bücking, 2004). Regarding the effectiveness of aquatic therapy, the study conducted by Badau & Badau (2024) highlights that aquagym is the most effective means for developing motor skills, aquatic play therapy contributes to the development of functions, and therapeutic swimming offers the greatest benefits in the recovery and rehabilitation process. Swimming, one of the most used methods for correcting spinal deformities, is the horizontal position of the body in water, which reduces pressure on the spine and allows the training of the trunk muscles (Stoychevski & Belomazheva-Dimitrova, 2021). In addition, aquatic therapy offers multiple physical and psychological benefits. It not only improves the functioning of the body, but also contributes to maintaining health and increasing the quality of everyday life (Broach & Dattilo, 1996).

2. Material and method

This study examines the effects of therapeutic swimming on the development of morphofunctional capacity in adults aged 20 to 30, highlighting the benefits of this activity on health and physical performance. The aim of this scientific approach is to highlight the influence of therapeutic swimming on the optimization of motor functions and general health of adults, providing scientific support for its integration into everyday life. Study hypothesis: it is assumed that regular practice of therapeutic swimming contributes significantly to improving muscle strength, cardiovascular endurance and joint mobility, having a positive impact on functional balance and the prevention of musculoskeletal disorders. The objectives of the study include: Analysis of the impact of therapeutic swimming on the main morphofunctional parameters (strength, cardiovascular endurance, flexibility); Comparison of therapeutic swimming means with other forms of physical activity. Identification and promotion of the most effective means of applying therapeutic swimming in improving the quality of life of young adults. Inclusion criteria: age between 20 and 30 years, not practicing competitive sports, not having muscular or cardiovascular diseases, active participation in all therapeutic swimming training, non-smoker or

having quit smoking for at least 6 months. Exclusion criteria: participants with serious musculoskeletal conditions (e.g. recent fractures, untreated herniated discs, etc.), with heart problems, suffering from severe respiratory conditions (e.g. untreated bronchial asthma or other chronic lung diseases), who are unable to swim and who cannot comply with the training program for various personal reasons. The experiment took place at the Swimming and Physiotherapy Complex, a controlled environment equipped with modern facilities for swimming and physical recovery. The study period was three months, between November 2024 and January 2025, this duration being chosen to allow participants to adapt and record significant effects in physical performance. A structured therapeutic swimming program was implemented in the study, which included weekly sessions focused on increasing muscle strength, cardiovascular endurance, flexibility and balance. The duration of each session was between 35-60 minutes, with a frequency of 2 sessions per week (Tuesday and Thursday). Types of exercises: recovery swimming (crawl, breaststroke and backstroke), flexibility exercises, muscle strengthening exercises and balance exercises. Progress monitoring: Participants were evaluated at the beginning and end of the experiment through a series of tests (muscle strength test, flexibility test, balance test, cardiovascular endurance test) to evaluate the achievements recorded.

Table 1 *Therapeutic swimming program for the experimental group*

Week	The duration of the session	Objective	Exercises
1	45-50 minutes	Improving mobility and adaptability to water	Crawl swimming (5 min); Breaststroke swimming (10 min); Stretching exercises in water (10 min); Flexibility exercises (10 min); Relaxation swimming (10 min)
	45-50 minutes	Improving muscle strength and cardiovascular endurance	Backstroke swimming (10 min); Exercises for the abdominal and lower back muscles. (10 min); Arm strengthening exercises (10 min); Long swim in the preferred procedure (15 min)
2	45-50 minutes	Developing cardiovascular endurance and muscular strength	Crawl swimming (5 min); Exercises for the muscles of the abdomen, lower back and pelvis. (10 min); Intensive short-distance swimming (15 min); Relaxing swimming (10 min)
	35-45 minutes	Developing joint flexibility and balance	Stretching exercises in water (10 min); One-leg balance exercises (15 min); Arm-leg coordination exercises (10 min); Relaxation in water (10 min)
3	35-45 minutes	Improving muscle strength and joint mobility	Backstroke swimming (10 min); Chest and arm strength exercises (15 min);

			Water stretching exercises (10 min); Relaxation (10 min)
	45-50 minutes	Developing endurance and developing balance	Long distance swimming exercises (15 min); Balance exercises, lateral swimming (10 min); Core exercises (10 min); Relaxing swimming (10 min)
4	45-50 minutes	Cardiovascular endurance and leg muscle strengthening	Breaststroke swimming (10 min); Leg strength exercises with cork and other materials (10 min), Intensive swimming over different distances (10 min); Stretching exercises (10 min); Relaxation (10 min)
	45-50 minutes	Flexibility and increased muscle strength	Stretching exercises in water (15 min); Arm and leg exercises with the raft (15 min), Free swimming (10 min); Relaxation in water (10 min)
5-12	50-60 minutes	Improving muscle strength and cardiovascular endurance	Intensive swimming over various distances (15 min), Strengthening exercises for legs and arms (10 min); Exercises for arms and back (10 min), Relaxation and stretching (10 min)
	50-60 minutes	Developing balance and mobility	Single-leg balance exercises (10 min); Stretching and mobility exercises (15 min), Intensive swimming (15 min); Relaxation (10 min)

3. Results and Discussions

The results obtained from the initial and final tests provide a clear picture of the results obtained after the therapeutic swimming period. Statistical indicators such as the mean of the measured values (x), the standard deviation (α) and the coefficient of variability (CV%), were analyzed, which allows a statistical interpretation of the progress of the participants. By comparing the results between IT and IT, the evolution of the FT performance indicator and the impact of therapeutic swimming training on the tested group can be observed.

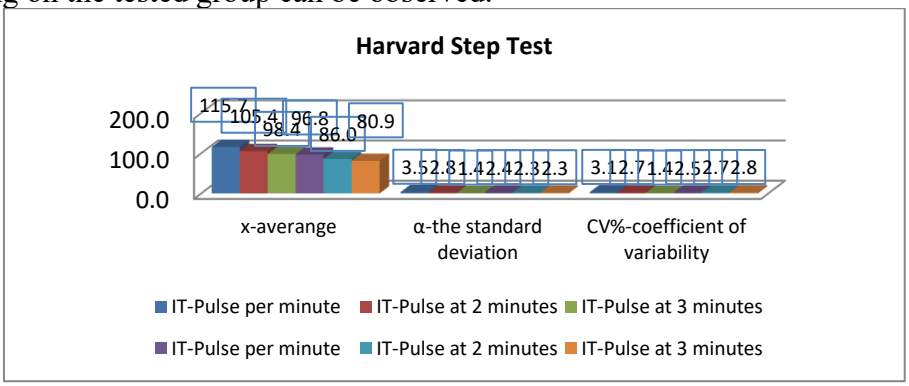


Figure 1. *Heart rate evolution during the Harvard Step Test*

The first set of data (initial testing) has higher pulse values, which indicates slower recovery after effort, immediately after the test the value is 115.7 bpm, at 2 minutes it is 105.4 bpm; and after 3 minutes it is 98.4 bpm.
The second set of data (final testing) shows lower pulse values, which suggests better aerobic capacity and faster recovery, immediately after the test at one minute the value is 96.8 bpm, at 2 minutes it is 86.0 bpm and at 3 minutes it is 80.9 bpm. The standard deviation measures the individual variation of heart rate values from the mean. In the initial testing, the standard deviation varies between 3.5 bpm (immediately after the test) and 1.4 bpm (at 3 minutes). In the final testing, the standard deviation is generally lower (between 2.4 and 2.3 bpm), which indicates a lower variability of heart rate between subjects. CV% the ratio of the standard deviation to the mean, expressed as a percentage. In the initial testing, the CV% decreases from 3.1% (immediately after the test) to 1.4% (at 3 minutes). In the final testing, the coefficient of variation is lower and relatively constant (between 2.5% and 2.8%). A lower CV% indicates a more homogeneous group in terms of cardiovascular recovery.

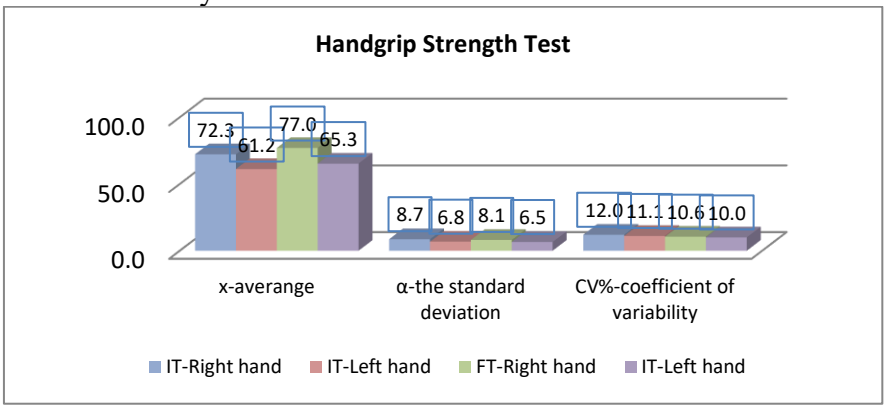


Figure 2. *Comparison of grip strength in the right and left hand in the grip test*

The grip strength of both hands increased after the final test, indicating an increase in muscle strength: Right hand: from 72.3 kgf (IT) to 77.0 kgf (FT) → +4.7 kgf (+6.5%). Left hand: from 61.2 kgf (IT) to 65.3 kgf (FT) → +4.1 kgf (+6.7%). The right hand is stronger than the left in both stages of the test, which confirms manual dominance: IT - Right hand: 72.3 kgf vs. IT - Left hand: 61.2 kgf. FT - Right hand: 77.0 kgf compared to FT - Left hand: 65.3 kgf The coefficient of variability (CV%) decreased, indicating that the differences between participants were reduced, and the results are more homogeneous after training: IT - Right hand: 12.0% → FT - Right hand: 10.6%; IT - Left hand: 11.1% → FT - Left hand: 10.0%.

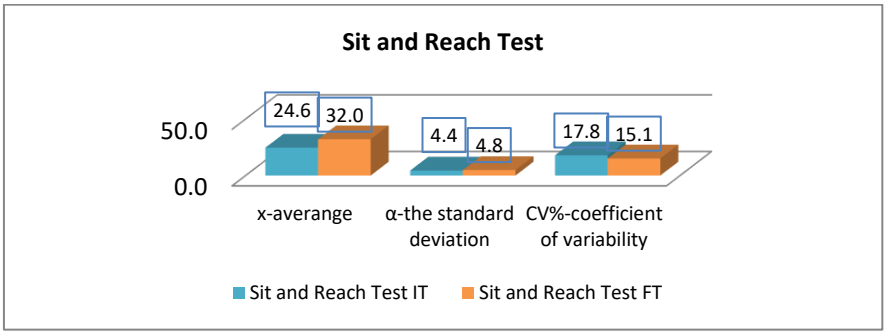


Figure 3. Comparison of flexibility in the Sit and Reach test, before and after training

After the final test (FT), flexibility increased significantly. The increase of 7.4 cm indicates considerable progress, due to mobility training or stretching. The standard deviation increased slightly after the final test, which means that although the mean increased, there is still participant variation. The coefficient of variability decreased from 17.8% to 15.1%, which shows that the results became more homogeneous after the training period. A decrease in CV% indicates that most participants progressed in a similar way, reducing individual differences.

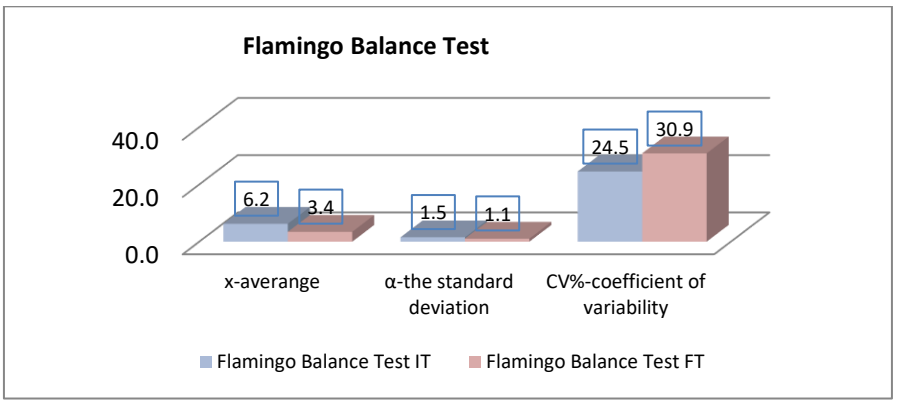


Figure 4. *Flamingo Test Balance comparison, before and after training*

After the final FT test, the number of balance losses decreased, indicating a significant increase in balance and postural stability. A 45.2% reduction suggests that participants have developed balance skills through therapeutic swimming training. The standard deviation decreased, indicating less variation between participants after the final test. Participants have closer scores to each other, suggesting more uniformity. Unlike the other tests, the coefficient of variability increased after the final test (from 24.5% to 30.9%). Although the mean will increase, there is now more variation between participants—some have progressed more than others.

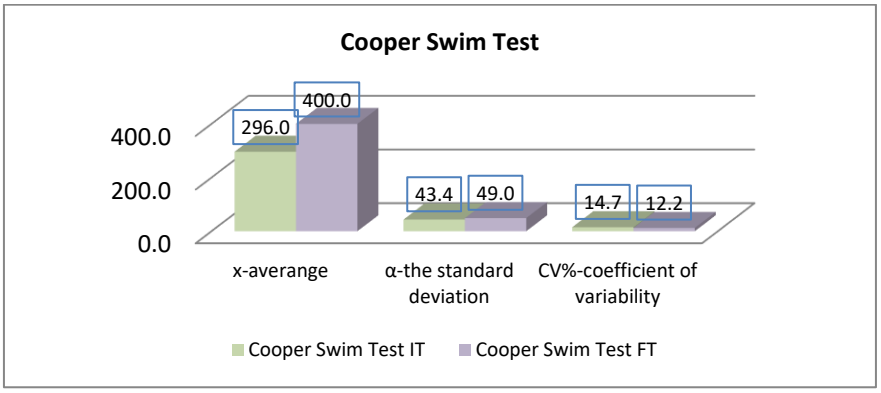


Figure 5. Cooper Swim Test performance comparison, before and after training

The Cooper Swim Test measures the distance covered by swimming in 12 minutes and is used to assess cardiovascular endurance and aerobic performance in water. After the final test (FT), participants swam an average of 104 meters more in the 12 minutes, indicating a significant value of aerobic capacity and swimming technique. The increase of 35.1% suggests a good physical adaptation, due to the specific therapeutic swimming training. The standard deviation increased slightly (from 43.4 to 49.0 meters), indicating a greater variation in performance between participants after the final test. Some participants progressed more than others, which may indicate differences in swimming technique. The coefficient of variability decreased from 14.7% to 12.2%, meaning that the differences between participants as reduced.

The present study analyzes the effects of therapeutic swimming on the morphofunctional capacity of adults aged 20 to 30, evaluating its impact on muscle strength, cardiovascular endurance, flexibility and balance. By comparing the initial (IT) and final (FT), the aim was to verify the hypothesis that regulated practice has a significant therapeutic contribution to improving motor functions and preventing musculoskeletal disorders. The applied tests allowed the objective measurement of the main physiological and motor parameters, providing relevant data on the progress recorded. Therapeutic swimming is performed in water, and this environment provides a natural resistance during movements, which helps to tone and strengthen muscles without putting much pressure on the joints, works several muscle groups simultaneously and improves cardiovascular endurance, flexibility and strength. It also helps reduce the risk of injuries and improves mobility and flexibility. Other forms of activity, such as running, weight lifting or strength exercises, are carried out on land and can put considerable pressure on the joints, which can be risky for people with muscle or joint conditions.

4. Conclusions

Participants in the therapeutic swimming program experienced significant increases in muscle strength, cardiovascular endurance, flexibility, and balance, indicating the

positive effects of swimming on overall physical fitness. The structured therapeutic swimming program demonstrated effectiveness in the progressive development of physical skills, being adaptable enough to meet the individual needs of the participants, contributing to a continuous increase in performance. The therapeutic swimming program led to increased muscle strength and increased cardiovascular endurance of the participants. The exercises performed contributed to strengthening the muscles, especially the upper and lower limbs, and to increasing the capacity to sustain physical effort for longer periods of time, which suggests a positive adaptation of the body to physical demands. After 3 months of therapeutic swimming, performance differences between participants decreased considerably, which suggests a uniformity of results. This indicates that the program had a beneficial effect on all participants, leading to an increase in the homogeneity of performances within the group.

Bibliography

1. Badau, D., Badau, A. (2024). *Identifying the benefits of recovery programs of aquatic gymnastics, aquatic ludotherapy and therapeutic swimming on human motor, kinetotherapeutic and mental capacity*. Heliyon, 10(19). https://doi.org/10.1016/j.heliyon.2024.e38690.
2. Becker, B. E. (2009). *Aquatic therapy: scientific foundations and clinical rehabilitation applications*. Pm&r, 1(9), 859-872., https://doi.org/10.1016/j.pmrj. 2009.05.017.
3. Broach, E., Dattilo, J. (1996). Aquatic therapy: A viable therapeutic recreation intervention. Therapeutic Recreation Journal, 30, 213-229. https://www.bctra.org/wp-content/uploads/tr_journals/1204-4720-1-PB.pdf.
4. Meyer, K., Bücking, J. (2004). *Exercise in heart failure: should aqua therapy and swimming be allowed?*. Medicine & Science in Sports & Exercise, 36(12), 2017-2023., DOI: 10.1249/01.MSS.0000147591.19416.39.
5. Moffatt, F. (2017). *The individual physical health benefits of swimming: a literature review*. The health & wellbeing benefits of swimming, 8-25, pg.18-19, ISBN 978-1-9997622-0-9.
6. Stoychevski, M., Belomazheva-Dimitrova, S. (2021). Survey of the experts'opinion on the therapeutic effect of swimming. Trakia Journal of Sciences, 19(1), 515-519., doi:10.15547/tjs.2021.s.01.078.
7. Vizitiu, E., Constantinescu Mihai. (2022). *Study on the impact of the therapeutic swimming on elderly women diagnosed with osteoporosis*, Balneo and PRM Research Journal 2022, 13(1): 495.
8. Vizitiu, E., Constantinescu M. (2022). *Comparative study on the importance of physical activity on body composition in adults*. Balneo and PRM Research Journal, 2022, 13(4): 530, Text integral DOI 10.12680/balneo.2022.530.
9. Vizitiu, E., Constantinescu, M., Poraicu C. (2022). *Aquatic therapy in neuromotor recovery – case study*, Balneo and PRM Research Journal, 13(3): 516, Text integral DOI 10.12680/balneo.2022.516.

10. Vizitiu, E., Costea, A.I., Silişteanu, S. C. (2023). *Prevalence of osteoporosis and risk factors in different age cat-egories in adult women*, Jurnalul de Cercetare Balneo și PRM.;14(4):627 Text integral DOI 10.12680/balneo.2023.627.
11. Dakal, N., Kachalov, O. (2024). Pozytyvnyi vplyv plavannia na oporno-rukhovoho aparat. Ozdorovche ta likuvalne plavannia yak sposib profilaktyky pry porushenniakh postavy ta skoliozu. Naukovyi chasopys Ukrainskoho derzhavnoho universytetu imeni Mykhaila Drahomanova. Seriia 15, (9(182), 241-244. https://doi.org/10.31392/UDU-nc.series15.2024.9(182).44.

Session Varia

AGE DYNAMICS OF THE BODY'S FUNCTIONAL RESERVES

Anatolii Bosenko [1], Mariia Topchii [1], Yevhen Mykhaliuk [2],
Mykhailo Khoroshukha [3], Yehor Horokhovskyi [4]

[1] *The State Institution South Ukrainian National Pedagogical University named after K. D. Ushinsky, Odessa, Ukraine*
[2] *Zaporizhzhia State Medical and Pharmaceutical University, Zaporizhzhia, Ukraine*
[3] *Boris Grinchenko University of Kyiv, Kyiv, Ukraine*
[4] *Zaporizhzhia National University, Zaporizhzhia, Ukraine*

Abstract

The study compared the results of the study of the body's functional reserve obtained by different methodological approaches (limit and dosed physical activity) and studied the possibility of using an original test for their assessment. For this purpose, a bicycle ergometric load with a change in power in a closed cycle (with reverse) was used, according to which about 30 criteria were obtained. The subjects were of different age, gender, physical fitness level and sports specialization (n= 354). Under the conditions of maximum and dosed physical activity, a number of indicators of physical performance, the level of functioning of the cardiovascular, respiratory, and central nervous systems, the state of the mechanisms of regulation and energy tension (activation) of the body were determined. The age dynamics of the criteria of functional reserves in males aged 7 to 22 years and their variability were determined. The use of statistical analysis made it possible to determine the normative values of physical performance indicators, heart rate, state of regulatory mechanisms and the degree of activation (stress) of the body under conditions of closed-cycle physical activity. The results of the study demonstrate the possibility of predicting the functional reserves of children and youth under the conditions of using dosed loads with reverse, in which the degree of reactions of the executive and regulatory systems correspond to the optimal level, and their graphical record takes the form of a hysteresis loop with four informative sections. The dependence between individual elements of the loop and functional capabilities (area, cross-section, angle of inclination, etc.) is established.
Keywords: *limit and dosed loads, functional reserves, children and youth*

1. Introduction

From the theoretical and practical point of view, the relevance of the considered problem is determined by the lack of agreed views on the tasks and basic provisions of functional diagnostics, which is known to be carried out in three states: a) in operational rest, under conditions of b) dosed and c) limit loads. However, of the more than 200 known methods for assessing the functional state (reserve capacity, adaptation reserves, functional capacity) of people involved in physical education and sports or those leading a sedentary lifestyle, none can claim absolute authenticity, reliability, informativeness, stability, etc., that is full compliance with the requirements of test standardization. Some of them are outdated [V. L. Karpman's data (1974) are more than 50 years old], but still serve as a reference point for many

researchers. Others have received unsatisfactory ratings from experts and restrictions on their use (e.g., the Ruffier test); others need to be improved in terms of age, gender, and normative values [functional change index (Baevsky R., Bersenova A. et al. 2009)]; others, which use only heart rate (HR), are characterized by insufficient informational value (Bosenko A., 2017).

The fifth group includes functional tests that are accompanied by excessive tension of executive and regulatory systems, and therefore are recommended for use for persons with a high level of physical fitness under conditions of medical and biological support (Mykhaliuk Ye. L., 2007). Last, but not least, there are tests that require sophisticated equipment and appropriate training of the staff (Karpman V. L. et al., 1988).

There are also ambiguous approaches to functional reserves in terms of conceptual and terminological apparatus. Functional reserves are invariably called one of the most important components of human health or physical condition (Davidenko D. N., 2005; Apanasenko H. L., 2017). Functional reserves are the basis for optimal adaptive responses, high sports performance, and successful work, especially in conditions requiring the ultimate level of functioning of systems and the body.

In the early 80s, the problem of functional reserves (Mozzhukhin A. S., 1980) was formed in the physiology of work, sports, and later in age physiology (Bosenko A. I., Belinova, A. G., Tsoneva, T. N., 1997). As defined by A. S. Mozzhukhin (1980), "...the reserve capabilities of an organism are understood as its latent capabilities (acquired in the process of evolution and ontogeny) to increase the functioning of its organs and organ systems in order to perform extremely large work, to adapt to extraordinary changes in the external or internal environment of the organism".

It is believed that the objective criterion of functional reserves of a person, in particular, a child, is the level of his or her physical performance. The most complete picture of functional reserves is given by physical performance data obtained during testing with limit loads - work to failure, especially in conditions of increased motivation (Mozzhukhin A. S., 1980; Bosenko A. I., 1986; Davidenko D. N., 2005).

We (Bosenko A. I., 1986; Bosenko A. I., Belinova, A. G., Tsoneva, T. N., 1997) have established the factor structure of functional reserves of children, adolescents and youth of different levels of fitness, developed model characteristics and prognostic formulas of physical performance reserves both for work in normal conditions and in conditions of increased motivation. The possibility of predicting physical performance (its reserve) for conditions of increased motivation, according to testing data in normal conditions, is shown.

Testing with the use of limit loads causes extraordinary shifts in regulatory and supporting systems (Karpman V. L. et al., 1988; Davidenko D. N., 2005; Mykhaliuk Ye. L., 2007), is quite complex, requires the fulfillment of special conditions and is associated with a risk to the health of the subjects. Such studies are especially difficult in childhood, which explains the insufficient study of the functional reserves

of children and adolescents and the availability of very limited data in the scientific literature, presented in separate papers (Bosenko A. I., 1986; 2017; Kalynychenko I., 2016; Fedynyak N., Mytskan B., 2020).

The aim of the study is to investigate the level of a set of criteria for physical performance and the possibility of assessing functional reserves, according to their data, in children, adolescents and young people under conditions of limiting and dosed loads.

Material and method

The study involved people of different ages, genders, fitness levels, and sports specializations (n=354), including 270 schoolchildren with an average level of physical activity and 136 athletes of different fitness levels

In the first series of studies, cyclic bicycle ergometric physical activity with a power of 70 % of the maximum under conditions of normal (NM) and increased (IM) motivation (competitive conditions) was used. When analyzing the existing methods of physical performance research, we took into account the relevance of the tests and their adequacy to the age characteristics of the subjects.

According to well-known experts (Karpman V. L. et al., 1988; Mykhaliuk Ye. L., 2007), one of the most objective methods of assessing the physical performance of children and youth is testing using a load whose power gradually increases. At the same time, the priority of continuously increasing (ramp) physical activity on a cycle ergometer is emphasized.

So, in the second series of studies, a method of testing the functional capabilities of the human body using physical activity that varies in a closed cycle (Davidenko D. N., 2005) was used. In this case, the load power continuously increases from zero to the required level at a constant rate (33 W/min), and then decreases to the initial level at the same rate. The load can be reversed either by power or by a certain level of heart rate. We chose the latter option as more physiological, since the reverse is carried out at the same heart rate for all subjects (155 beats/min). At the same time, the subjects achieved different load power. Graphical recording of heart rate dynamics depending on changes in load power during the full testing cycle due to the inertia of the cardiovascular system (CVS), took the form of a hysteresis loop (Fig. 1). According to the authors of the methodology, the heart rate dynamics under these conditions can be regarded as a generalized characteristic, since the analysis of the dependence of other indicators under similar conditions, for example, O_2, consumption, revealed general patterns. The simplicity of registration and popularity of such a parameter as heart rate determined the choice of this indicator in testing.

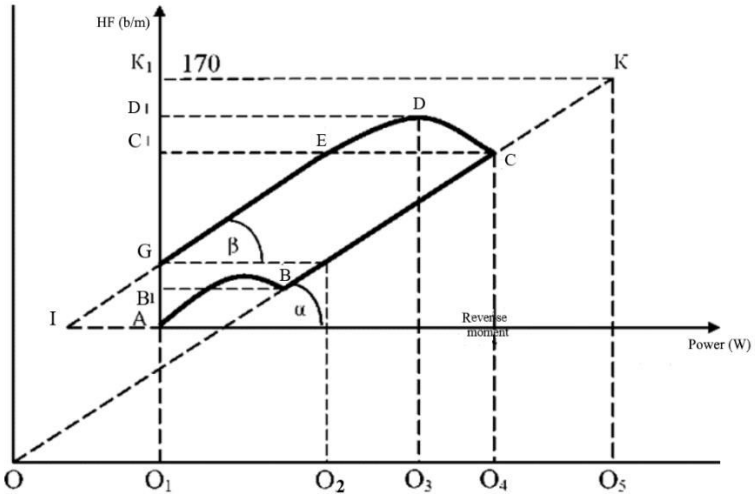


Figure 1. *Graphical representation of heart rate dynamics depending on changes in load capacity during the full testing cycle (hysteresis loop)*

Based on the results of automated analysis of the hysteresis loop parameters, 28 indicators were obtained, grouped into five groups, which were used as criteria for the formation of an individual profile and the prediction of the functional reserves of the subject.

2. In order to monitor the functional state (well-being) of the subject and to study the adaptive reactions of the executive and regulatory systems, the study was accompanied by a number of additional techniques: Assessment of brain general function using Loskutova's method; Omegametry; ECG; Variation pulsometry; Rheography and others.

3. Results and Discussions

Based on the results of the 1st series of studies, more than 80 variables were obtained, which were included in the above statistical analysis methods. As a result, regression equations were obtained that made it possible to predict reserves under conditions of NM and IM using 7 to 17 variables. Thus, limit loads confirmed their informative capacity in studying functional reserves of children, adolescents and youth. However, it is necessary to note an extremely tense level of functioning of both supporting and regulatory systems (Fig. 2). Under these conditions, the heart rate reached 200 beats/min, respiratory rate - 70 cycles/min, systolic blood pressure increased with the age of the subjects from 130 to 190 mm Hg. Diastolic pressure in trained subjects decreased, in some cases to zero (in 12 %), which reflected the phenomenon of infinite tone. Profound shifts were also noted in the state of the central nervous system, activation of sympathetic-adrenal mechanisms and suppression of parasympathetic influences.

These data, the low level of health of children and youth (Apanasenko H. L., 2017; Topchii M. S., 2018; Mykhaliuk, Y. et al., 2024), and cases of sudden deaths in physical culture and sports prompted the authors to look for other ways to diagnose the functional state and assess the adaptive reserves of the subjects. We conducted long-term longitudinal studies of schoolchildren and young people using dosed closed-cycle physical activity, which we based on an automated system (Bosenko A. I., 2003) The table below shows, as an example, the results of physical performance by a reduced number of criteria.

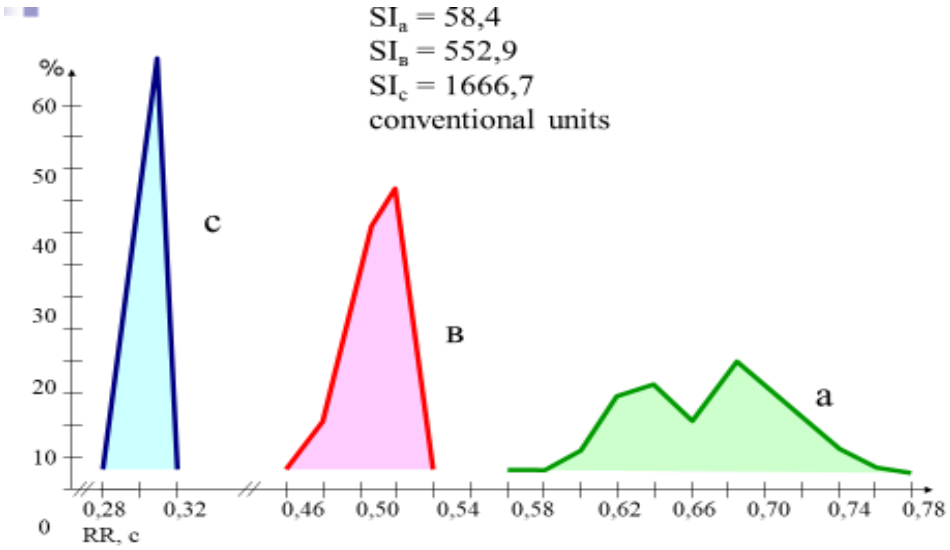


Figure 2. *The state of the heart rate regulation mechanisms of a young football player, according to SI data, in different phases of testing at maximum loads (a – initial state, c – 1st minute of recovery, b – 20th minute of recovery, according to Bosenko A. I., 1986)*

It is established that by the total time (T, s) and volume (A, kj) of the performed work, as well as by other indicators (reverse power – NR, PWC_{170}, $PWC_{170/kg}$) of working capacity, there is a progressive and reliable increase from 23.4% at 9–10 years old to 106.3% - at 15–16 years old. It is noticeable that smaller shifts are noted in relative indicators of work capacity $PWC_{170/kg}$, which is explained by the increase of body weight of the examined with age.

Table 1. *Dynamics of physical performance of boys from 7 to 16 years old, according to the data of closed-cycle load testing (with reverse)*

Groups / Indicators	7–8 years, n=50	9–10 years, n=26	12–13 years, n=21	14–15 years, n=19	15–16 years, n=18
	M±m	M±m	M±m	M±m	M±m
T, s	288.0±8.6	355.1±17.4**	374.48±11.9**	482.1±20.9**♥	594.4±14.2**♥
A, kj	9.02±0.55	16.84±1.62**	20.37±1.2**	29.9+4.49**♦	48.4±5.4**♦
NR, W	74.1±4.43	90.61±2.95**	96.24±3.06**	124.1±0.87**♥	163.35±3.3**♥
$PWC_{170,}$ W	74.55±3.45	112.5±5.1**	123.96±5.2**	157.7±7.33**♠	204.18±9.7**♠
$PWC_{170/kg,}$ W/kg	2.77±0.10	3.66±0.19**	3.12±0.11**	3.30±0.22**	3.60±0.16**

Notes. Reliability of differences in relation to the group of 7–8 years: * – p<0.05, **– p<0.001, p<0.001; in relation to the previous group: ♦– p<0.05, ♠ – p<0.002, ♥ – p<0.001

It is interesting to note the fact of a significant increase in load reverse power (NR, W) at the same physiological price, namely, heart rate of 155 beats/min. A logical explanation for this phenomenon is the positive changes in the structural and functional characteristics of the heart muscle, such as an increase in the size, weight, and volume of the ventricles, an increase in systolic and, accordingly, minute blood volumes, which generally reflects the higher circulatory efficiency of older or trained individuals.

Under these testing conditions, the level of mobilization of extra- and intracardiac functions, the state of regulatory mechanisms and stress of the body of the examined children, adolescents and young people corresponded to the optimal, and adaptive reactions were characterized by adequacy.

4. Conclusions

1. The results of the research demonstrate the possibility of building an individual profile and forecasting the functional reserves of children and youth under the conditions of using dosed loads with reverse, in which the degree of reactions of executive and regulatory systems corresponds to the optimal level, and their graphical record takes the form of a hysteresis loop with four informative sections. The correlation between individual elements of the loop and functional capabilities (area, cross-section, angle of inclination, etc.) is established.

2. The increase in physical fitness is followed by the increase in: area of segments of a loop, time of inertia, length of a loop - pulse cost, angle of inclination of a loop upon reduction of load, levels of activation of an organism. There is decrease: loop cross-section, angle of inclination with increasing load, initial, threshold, exit (recovery) heart rate, coefficient of inertia.

Bibliography

1. Apanasenko H.L. (2017). How to stop the epidemic of chronic noninfectious diseases. *Environment & Health.* 1: 19-22. https://doi.org/10.32402/dovkil2017.01.019.
2. Baevsky R. M., Berseneva A. P. et al. (2009). Assessment of the level of health in the study of practically healthy people: [methodological guide]. Moscow: Firma Slovo, 100 p.
3. Bosenko, A.I., Belinova, A.G., Tsoneva, T.N. (1997). Functional reserves of the cardiovascular system in 15–16-year-old girls. *Hygiene and sanitation,* 4, 31–33.
4. Bosenko A.I. (2003). Method for diagnosing human functional reserves. *Patent. Bull.* No. 8 State Department of Intellectual Property dated 15.08.03.
5. Bosenko, A.I. (2017). Methodological bases of adap tive capacities basic school pupils in physical education [Extended abstract of doctoral the sis]. Chernihiv. http://www.dspace.pdpu.edu.ua/ handle/123456789/7245.
6. Davidenko, D. N. (2005). The problem of reserves of adaptation of the body to extreme activity: state and development prospects. *Bulletin of the Baltic Pedagogical Academy*, 61, 117–120.
7. Kalynychenko I. (2016). Optimization of the educational process according to the constitutional, typological and functional characteristics of senior school students. *Science and education*, 8, 68-72. https://doi.org/10.24195/2414-4665-2016-8-14,
8. Mykhaliuk Ye.L. Diagnostics of chronic and pathological conditions at extreme physical loads in Olympic and professional sports [dissertation]. Dnipro (Ukraine): Dnipro State Medical University; 2007. 430 p.
9. Mykhaliuk, Y., Horokhovskyi, Y., Bosenko, A., Bazylchuk, O., & Orlyk, N. (2024). Occurrence of dystonic-type response to physical stress in soccer players. *Physical Rehabilitation and Recreational Health Technologies,* 9(1), 3-11. https://www.google.com/search?q=https://doi.org/10.15391/prrht.2024-9(1).01.
10. Topchii, M.S. (2018). Functional mechanisms of adaptation of youths of different ages to training loads [Abstract of PhD thesis]. Cherkasy. https://bit. ly/3ZzGgoG.
11. Fedynyak N., Mytskan B. (2020). Biological Age, and the Rate of Aging People of Different Age Groups. *Youth Scientific Journal Lesya Ukrainka Eastern European National University*, *12*, 45-50. https://www.sportvisnyk.vnu.edu.ua/index.php/sportvisnyk/article/view/601.

THE IMPORTANCE OF EMOTIONAL DEVELOPMENT DURING PUBERTY

Marius-Eduard Feraru [1], Petronel-Cristian Moisescu [2], Dana Lucica Ciocoiu [3]
Georgios Fakaros [4]

[1] *Doctoral Student, Institute of Physical Education and Sports, State University of Moldova, 22 Andrei Doga Street, Chișinău, MD-2024, Republic of Moldova*
[2] *Professor PhD, Faculty of Physical Education and Sports, "Dunărea de Jos" University of Galați, 47 Domnească Street, Galați, 800008, Romania*
[3] *Associate Professor PhD, Faculty of Physical Education and Sports, "Dunărea de Jos" University of Galați, 47 Domnească Street, Galați, 800008, Romania*
[4] *PhD, Teacher of Physical Education at 133 Primary School of Athens, 6 Troias Street, Athens, 11362, Greece*

Abstract

Emotional development during puberty is a pivotal process for building psychological balance, healthy relationships, and sustained school engagement. This paper synthesizes recent research to clarify how biological maturation, family and school climate, digital exposure, and participation in organized sport interact to shape emotional competences such as self-awareness, self-regulation, empathy, and social communication. A literature review design was used, with targeted searches across major academic databases over the last two decades and transparent criteria for selection and synthesis. The analysis shows consistent links between strong emotional competences and better social adaptation, resilience to stress, and academic performance. Participation in organized sport—especially team-based activities conducted under formative adult guidance—emerges as a practical context for exercising cooperation, communication, goal setting, frustration tolerance, and constructive responses to failure. The review also notes limitations related to heterogeneous measures, cultural variability, and the scarcity of longitudinal evidence. The findings support integrating physical education, team sports, and socio-emotional learning within coordinated school and community strategies to promote balanced development during puberty.

Keywords: *emotional development; puberty; organized sport; social adaptation; emotional intelligence*

1. Introduction

Puberty represents a crucial transitional stage between childhood and maturity, characterized by a combination of biological, cognitive, and emotional transformations. During this period, adolescents develop self-awareness, construct their identity, and begin to experience a wide range of emotions and increasingly complex social relationships (Fernandes et al., 2024). Emotional development is influenced by multiple factors, including neurobiological predispositions, family dynamics, school environment, peer interactions, and cultural context (Dumitrescu, 2014; Cho, 2020).

Emotional development is defined as the process through which individuals learn to recognize, understand, express, and regulate emotions in a functional way. In adolescence, these competencies are crucial, being directly correlated with social adaptation, psychological resilience, and academic success (Bar-On, 2000; Burnett

et al., 2011). The ability to manage emotions not only supports academic performance but also facilitates the integration into peer groups, reducing the risk of maladaptive behaviors.

A growing body of research highlights the formative value of sports. Participation in organized sports is associated with enhanced socio-emotional skills, including empathy, collaboration, self-control, and effective conflict resolution (Lacika, 2024; Mayer et al., 2000; Mincu, 2024). Through teamwork, adolescents repeatedly practice regulating emotions in real situations, where success depends on cooperation and mutual trust. Sports thus act as a natural laboratory for socio-emotional learning, complementing school and family influences.

The literature also places increasing emphasis on emotional intelligence (EI). EI encompasses five major components: self-awareness, self-regulation, empathy, motivation, and social skills (Donaldson & Ronan, 2006). For adolescents, these competencies are strong predictors of interpersonal relationships, capacity to cope with stress, and ability to adapt to internal and external changes specific to puberty. Adolescents with higher EI show better academic engagement, greater resilience, and fewer behavioral problems.

Despite these advances, several limitations remain. Many studies rely on Western, urban samples and pay insufficient attention to diverse educational and cultural contexts. In addition, the role of sports in emotional development is often addressed in a fragmentary way, lacking integrative perspectives (Eime et al., 2013; Leonte & Porfireanu, 2020). Moreover, contemporary challenges—such as social media dependency, academic competition, and declining face-to-face interaction—are associated with a worrying increase in emotional and behavioral disorders among adolescents (Goleman, 1995; Halian, 2024).

These challenges underline the importance of sports not only as a means of physical fitness but also as an instrument for socio-emotional education (Martinaș & Voinea, 2020; Petrides & Furnham, 2001). By integrating cognitive, affective, and behavioral dimensions, sports can support the balanced development of young people.

The central objective of this review is to provide a synthesis of the main factors influencing emotional development during puberty, with a particular focus on the role of educational interventions and extracurricular activities, especially organized sports. By highlighting both the consensus and the gaps in existing research, the paper aims to offer useful directions for educators, counselors, and policymakers.

2. Material and Method

The present research is a systematic literature review aimed at synthesizing the main factors that shape emotional development during puberty. The central interest lies in understanding how biological maturation, family and school contexts, and extracurricular activities—particularly organized sports—interact to support or hinder the acquisition of emotional competencies. Unlike experimental designs, this

review does not involve intervention on specific groups of subjects; rather, it relies on thematic analysis of scientific studies published between 2005 and 2023.

This approach enables both the identification of areas where a consensus exists and the recognition of research gaps, thus outlining directions for future investigations. In particular, emphasis was placed on recent studies highlighting the positive role of sports participation in enhancing adolescents' emotional regulation, resilience, and social integration (Lacika, 2024; Meyer & Fletcher, 2007; Predescu & Stănescu, 2023).

Objectives and Hypotheses

The study followed three main objectives:

To identify the essential factors of emotional development in puberty. These include neurobiological mechanisms, family functioning, educational approaches, and extracurricular influences such as organized sports (Bar-On, 2000; Donaldson & Ronan, 2006; Mincu, 2024).

To analyze the relationship between emotional competencies and academic/social performance. The working hypothesis is that adolescents with higher emotional intelligence show greater adaptability to school demands and peer relations. Participation in sports is hypothesized to act as a favorable context for practicing self-regulation and resilience (Brown & Patel, 2017; Marheni et al., 2023; Popovych & Blynova, 2020).

To evaluate the contribution of educational and extracurricular interventions. Programs such as Social Emotional Learning (SEL), school counseling, mindfulness, and sports activities are considered effective strategies for fostering emotional competencies (Laborde et al., 2016; Mayer et al., 2000).

Sources and Databases

The literature search was carried out using three major databases:

PubMed, for neuroscience, psychology, and clinical studies relevant to adolescent development.

Google Scholar, for interdisciplinary sources spanning psychology, sociology, and education.

ResearchGate, for recent publications, preprints, and conference papers.

Keywords included: emotional intelligence, socio-emotional development, puberty, sports and emotions, SEL programs, mindfulness in youth, parenting style. The time frame of 2005–2023 was chosen to capture both established theoretical frameworks and the most recent contributions.

Article Selection Process

The selection was conducted in three successive stages:

Initial screening of titles and abstracts. Only studies addressing emotional development in adolescence, with a clear educational, family, or sports-related dimension, were retained.

Full-text analysis. Methodologically weak studies or those with non-representative samples were excluded.

Final selection. Only peer-reviewed articles with relevance for educational practice and adolescent psychology were included.

From an initial pool of almost 9,000 articles on emotional intelligence and 4,600 on socio-emotional development in puberty, approximately 1,150 recent studies (2019–2023) were analyzed in detail, ensuring that the review reflects both long-term trends and current developments.

The inclusion criteria were:

Publications in widely circulated international languages.

Articles indexed in journals with recognized impact factors.

Studies explicitly addressing puberty and emotional development.

Research highlighting the impact of sports on adolescents emotional intelligence.

Exclusion criteria were:

- Studies focused exclusively on adults or preschool children.
- Articles without empirical foundation or clear theoretical contribution.
- Publications lacking ISSN/ISBN or scientific validation.

Data Analysis and Synthesis

Selected studies were organized thematically into five categories:

- Neurobiological aspects of puberty and emotional regulation.
- Family influences on adolescents' emotional development.
- School environment and educational programs.
- Impact of sports participation.
- Extracurricular interventions such as SEL and mindfulness.

A comparative approach was adopted to identify converging and diverging findings. Special attention was given to studies demonstrating that adolescents engaged in collective sports (football, basketball, handball) develop higher levels of empathy, communication skills, and self-confidence (Lacika, 2024; Leonte & Porfireanu, 2020; Nicholls et al., 2009).

As this is a review-based study, no ethical approval was required. Nevertheless, academic integrity was ensured by recognizing original contributions, avoiding selective citation, and including both supportive and critical findings.

3. Results and Discussions (nu reusesc sa-l ridic cu un spatiu mai sus)

The Biological Dimension

Hormonal transformations and the uneven maturation of the brain, particularly between the limbic system (responsible for emotions) and the prefrontal cortex (responsible for self-regulation), explain the emotional reactivity typical of puberty (Dumitrescu, 2014). Imaging studies confirm that brain areas involved in emotional control mature only toward late adolescence (Cho, 2020). Against this background, sports activities act as a natural regulator: physical effort balances stress responses and stimulates endorphin and dopamine secretion, thus reducing anxiety and fostering emotional stability (Meyer & Fletcher, 2007; Salovey & Mayer, 1990).

Adolescents engaged in team sports show greater emotional control, largely because they must cooperate under competitive conditions (Lacika, 2024; Predescu & Stănescu, 2023).

Emotional Intelligence and Social Adaptation

Emotional intelligence (EI) has been conceptualized as a multidimensional construct including self-awareness, self-regulation, empathy, motivation, and social skills (Bar-On, 2000; Donaldson & Ronan, 2006). Higher EI in adolescence predicts better adaptation to both academic and social demands. Studies reveal a strong correlation between EI and school performance, as emotionally competent students concentrate more effectively, persevere longer, and manage stress more constructively (Burnett et al., 2011; Halian, 2024). Organized sports play a complementary role, providing real opportunities for resilience, self-evaluation, and constructive feedback (Lacika, 2024; Martinaș & Voinea, 2020). Adolescents who are physically active display greater intrinsic motivation and higher self-efficacy (Petrides & Furnham, 2001).

Interpersonal Relationships

Emotional intelligence also enhances the quality of social relationships. Adolescents with stronger empathy and positive emotional expression are better integrated within peer groups (Brown & Patel, 2017; Cho, 2020). Sports activities, especially team-based, function as social training grounds where young people practice non-verbal communication, negotiation, and conflict resolution. These contexts reduce the risk of isolation and improve group cohesion (Lacika, 2024; Nicholls et al., 2009).

Family and School Influences

Parenting style strongly impacts adolescents' emotional strategies: democratic styles that combine clear rules with affective support are associated with balanced emotional growth (Brown & Patel, 2017). Parents who support or participate in sports alongside their children create opportunities for dialogue and positive modeling (Leonte & Porfireanu, 2020; Popovych & Blynova, 2020).

School climate also exerts a decisive influence. Collaborative and supportive environments foster socio-emotional learning (Burnett et al., 2011). Teachers who model constructive emotional management contribute to adolescents' affective stability, while school programs that combine academic activities with sports and counseling reduce absenteeism and aggression (Laborde et al., 2016; Salovey & Mayer, 1990).

Cultural and Digital Contexts

Cultural background influences how emotions are expressed and regulated. Collectivist contexts tend to restrain expression, while socio-economic disadvantages increase risks of maladaptive strategies. In such situations, access to free or subsidized sports activities proves an effective compensatory strategy (Eime et al., 2013; Kovács, 2024; Ruetti & Pirotti, 2024).

The digital dimension represents a contemporary challenge. Intensive use of social networks fosters comparison, validation pressure, and cyberbullying,

contributing to stress and anxiety (Goleman, 1995; Halian, 2024). Sports act as a counterbalance, providing real validation and reducing reliance on online recognition. Adolescents engaged in sports show fewer symptoms of depression and higher satisfaction (Lacika, 2024; Roco & Radu, 2017).

Educational and Extracurricular Interventions

SEL programs, when combined with sports, amplify adolescents' ability to practice emotional skills in real contexts (Laborde et al., 2016; Mayer et al., 2000). Mindfulness techniques, such as meditation or yoga, have greater impact when integrated with physical activity, enhancing introspection and emotional regulation (Cho, 2020; Salovey & Mayer, 1990). Community initiatives that involve schools, families, and sports clubs provide balanced frameworks for emotional development (Marheni et al., 2023; Mincu, 2024).

Individual Differences

Gender differences appear in the expression and regulation of emotions: girls tend to verbalize emotions and show empathy, while boys more often externalize stress through behavior (Brown & Patel, 2017; Cho, 2020). Participation in sports mitigates these differences, fostering confidence in girls and empathy in boys (Lacika, 2024; Mincu, 2024). Similarly, the coach–athlete relationship plays a mediating role: empathetic coaches foster adolescents' self-confidence and tolerance to frustration (Marheni et al., 2023; Nicholls et al., 2009).

Evidence from Reviews and Meta-Analyses

Meta-analyses confirm that consistent sports participation is correlated with superior emotional development (Cho, 2020; Laborde et al., 2016). Physical education improves competencies such as empathy and self-regulation (Mayer et al., 2000), while sports as integrative activities-physical, cognitive, and emotional—hold unique potential in promoting resilience and balanced growth (Lacika, 2024).

4. Conclusions

The synthesis of over 8,000 studies on emotional intelligence and nearly 5,000 on socio-emotional development during puberty confirms that adolescence is a critical stage for emotional identity formation. Neurological and hormonal maturation create both vulnerability and plasticity, which make this a window of opportunity for formative interventions. Emotional competencies such as self-awareness, empathy, and self-regulation are strong predictors of resilience, academic success, and social integration (Bar-On, 2000; Brown & Patel, 2017; Cho, 2020).

One of the most consistent findings is the formative value of organized sports. Participation in team activities supports the continuous practice of emotional skills, including self-regulation, collaboration, and coping with failure (Lacika, 2024; Marheni et al., 2023; Predescu & Stănescu, 2023). Sports thus emerge as an integrated educational environment that activates biological, cognitive, and emotional dimensions simultaneously.

From a practical perspective, the literature suggests clear implications. Educational curricula should integrate Social Emotional Learning (SEL) with

physical education, creating opportunities for adolescents to apply emotional competencies in real contexts (Laborde et al., 2016; Mayer et al., 2000). Cooperation between teachers, school counselors, and sports coaches is essential for building consistent and supportive environments (Marheni et al., 2023; Nicholls et al., 2009). For disadvantaged groups, access to free or subsidized sports programs is a matter not only of education but also of social equity (Leonte & Porfireanu, 2020; Salovey & Mayer, 1990).

Despite the significant advances, gaps remain. Future research should adopt longitudinal approaches to track the evolution of emotional competencies throughout adolescence, develop standardized tools adapted across cultures, and investigate how different sports contexts or coaching styles influence outcomes (Donaldson & Ronan, 2006; Salovey & Mayer, 1990).

In conclusion, puberty represents both a challenge and an opportunity for emotional growth. Sports stand out as a natural and effective mediator of this process, offering adolescents the chance to learn through experience, strengthen resilience, and build self-confidence. For education, health, and social policy, integrating sports into strategies for adolescent development is not optional but necessary for forming balanced, empathetic, and resilient future generations.

Bibliography

1. Bar-On, R. (2000). *The handbook of emotional intelligence: Theory, development, assessment, and application at home, school, and in the workplace*. Jossey-Bass.
2. Barth, M., Güllich, A., Macnamara, B. N., & Hambrick, D. Z. (2022). *Predictors of junior versus senior elite performance are opposite: A systematic review and meta-analysis of participation patterns.* Sports Medicine, 52(6), 1393–1416. https://doi.org/10.1007/s40279-021-01590-2.
3. Brown, K. A., & Patel, D. R. (2017). *Participation in sports in relation to adolescent growth and development.* Translational Pediatrics, 6(3), 150–159. https://doi.org/10.21037/tp.2017.04.03.
4. Burnett, S., Thompson, S., Bird, G., & Blakemore, S. J. (2011). *Pubertal development of the understanding of social emotions: Implications for education. Learning and Individual Differences,* 21(6), 681–689. https://doi.org/10.1016/j.lindif.2010.05.007.
5. Cho, O. (2020). *Impact of physical education on changes in students' emotional competence: A meta-analysis. International Journal of Sports Medicine,* 41(14), 1–10. https://doi.org/10.1055/a-1129-0840.
6. Donaldson, S. J., & Ronan, K. R. (2006). *The effects of sports participation on young adolescents' emotional well-being. Adolescence*, 41(162), 369–389.
7. Dumitrescu, S. (2014). *Caracteristicile dezvoltării emoționale la adolescenți.* Romanian Journal of Cognitive Behavioral Therapy and Hypnosis, 1(4), 47–56.
8. Eime, R. M., Young, J. A., Harvey, J. T., Charity, M. J., & Payne, W. R. (2013). *A systematic review of the psychological and social benefits of participation in sport for children and adolescents: Informing development of a conceptual model*

of health through sport. International Journal of Behavioral Nutrition and Physical Activity, 10, 98. https://doi.org/10.1186/1479-5868-10-98.
9. Fernandes, H. M., Costa, H., Esteves, P., Machado-Rodrigues, A. M., & Fonseca, T. (2024). *Direct and indirect effects of youth sports participation on emotional intelligence, self-esteem, and life satisfaction. Sports,* 12(6), 155. https://doi.org/10.3390/sports12060155.
10. Goleman, D. (1995). *Emotional intelligence: Why it can matter more than IQ.* Bantam Books.
11. Halian, O. (2024). *Relationship between emotional intelligence and coping strategies in junior athletes.* Journal of Physical Education and Sport, 24(11), 278–285. https://doi.org/10.7752/jpes.2024.112.
12. Kovács, K. (2024). *The impact of sports on above-the-average and high-performing students' achievements in Hungarian and Romanian higher education institutions.* Journal of Physical Education and Sport, 24(4), 390–398. https://doi.org/10.7752/jpes.2024.404.
13. Laborde, S., Dosseville, F., & Allen, M. S. (2016). *Emotional intelligence in sport and exercise: A systematic review.* Scandinavian Journal of Medicine & Science in Sports, 26(8), 862–874. https://doi.org/10.1111/sms.12510.
14. Lacika, N. (2024). *The impact of sport-related physical activity on child development. Canadian Journal of Family and Youth,* 16(3), 403–409. https://doi.org/10.29173/cjfy403.
15. Leonte, N., & Porfireanu, C. (2020). *Dezvoltarea inteligenței emoționale a tinerilor utilizând mijloacele specifice jocului de baschet*. Gymnasium, 21(1), 132–143.
16. Marheni, M., Azzi, F., & Bakdi, A. (2023). *Integrating emotional intelligence and mental education in sports to improve personal resilience of adolescents. Journal of Physical Education and Sport,* 23(3), 874–881. https://doi.org/10.7752/jpes.2023.030.
17. Martinaș, F.-P., & Voinea, N.-L. (2020). *Participarea la activități sportive organizate și evaluarea stimei de sine la copiii aflați în pubertate.* Sport and Society, 20(2), 97–103.
18. Mayer, J. D., Salovey, P., & Caruso, D. R. (2000). Models of emotional intelligence. In R. Bar-On & J. D. A. Parker (Eds.), *The handbook of emotional intelligence* (pp. 396–420). Jossey-Bass.
19. Meyer, B. B., & Fletcher, T. B. (2007). *Emotional intelligence: A theoretical overview and implications for research and professional practice in sport psychology.* Journal of Applied Sport Psychology, 19(1), 1–15. https://doi.org/10.1080/10413200601102904.
20. Mincu, L. (2024). *Calitatea vieții la tinerii sportivi români. Discobolul – Physical Education,* Sport and Kinetotherapy Journal, 63(1), 8–17.
21. Nicholls, A. R., Polman, R. C. J., Morley, D., & Taylor, N. J. (2009). *Coping and coping effectiveness in relation to a competitive sport event: Pubertal status,*

maturity, and gender differences. Journal of Sports Sciences, 27(6), 629–637. https://doi.org/10.1080/02640410902729792.

22. Petrides, K. V., & Furnham, A. (2001). *Trait emotional intelligence: Psychometric investigation with reference to established trait taxonomies. European Journal of Personality*, 15(6), 425–448. https://doi.org/10.1002/per.416.
23. Popovych, I., & Blynova, O. (2020). *Emotional intelligence in the structure of self-control among junior athletes.* Journal of Physical Education and Sport, 20(1), 184–192. https://doi.org/10.7752/jpes.2020.01024.
24. Predescu, T., & Stănescu, M. (2023). *A study regarding the opinion of Romanian athletics specialists on the multistage process of sports selection.* Journal of Human Sport and Exercise, 18(2), 196–201. https://doi.org/10.14198/jhse.2023.182.09.
25. Roco, M., & Radu, S.-M. (2017). *Cercetări empirice privind relația între inteligența emoțională și gândirea morală*. Revista de Psihologie, 63(4), 305–314.
26. Ruetti, N., & Pirotti, B. (2024). *The impact of sports on above-the-average and high-performing students' achievements in Hungarian and Romanian higher education institutions.* Innovations in Education and Teaching International, 61(1), 55–68. https://doi.org/10.1080/14703297.2023.2256789.
27. Salovey, P., & Mayer, J. D. (1990). *Emotional intelligence. Imagination, Cognition and Personality*, 9(3), 185–211. https://doi.org/10.2190/DUGG-P24E-52WK-6CDG.
28. Sinha, B. (2024). *The impact of sports participation on youth development: A longitudinal study of physical, social, and psychological outcomes.* Innovations in Sports Science, 1(2), 6–10. https://doi.org/10.1080/iss.2024.1020.
29. Voinea, N.-L., & Martinaș, F.-P. (2020). *Relația dintre activitatea sportivă și emoții în context educațional.* Journal of Physical Education and Sport, 20(4), 2326–2332. https://doi.org/10.7752/jpes.2020.04317.
30. Yang, S., Jing, L., He, Q., & Wang, H. (2024). *Fostering emotional well-being in adolescents: The role of physical activity, emotional intelligence, and interpersonal forgiveness.* Frontiers in Psychology, 15, 1408022. https://doi.org/10.3389/fpsyg.2024.1408022.

THE RIGHT TOY AND YOUR CHILD'S MOTOR DEVELOPMENT – OVERVIEW

Gabriela Pană
Middle School 30, Braşov, Romania

Abstract

For a parent, never and nothing will be too much for his child when it comes to care and love, providing the best framework in which the child can learn how to live nicely, how to enjoy all that it surrounds him.
Each parent, at his educational, spiritual, and financial scale, will do what he thinks is best for his child, at least in the early years of his life, until the little one enters the pre-school and school education system and integrates with other rules, maybe good, maybe less good.

Key words: *child, motor development, games, toys*

Introduction

The development and evolution of a child are closely linked to many aspects. From the first moment of life, the way in which the outside world is allowed to act on the little one is decisive in terms of growth, physical and mental development, health and well-being of the child. As soon as he is born, the little one enters a space that will be his place of life. All the elements contained in this space converge on his formation as a human being, elements specific to each stage, age, needs and desires.

Parents are the first to have the duty to ensure that everything that encounters their little one will lay the foundations for his formation.

A parent's first concerns are related to essential and natural aspects, ensuring the little one the right food, continuous care, unconditional love, the safe living conditions, a clean space, a well-designed room, quality clothes, medical assistance. Parents are the ones who make sure that nothing that surrounds the little one does not harm him and constantly try to create a warm environment, full of peace, understanding, love and comfort, so that the little one does not feel any hostility from the outside and can develop naturally without fears and anxieties, without frights and shortcomings. For a parent, nothing will ever be too much for his child when it comes to care and love, to ensure the best environment in which the child can learn how to live beautifully, how to enjoy everything that surrounds him (Figure 1).

Each parent, on his educational, spiritual and financial scale, will do what he thinks is best for his child, at least in the first years of life, until the little one enters the preschool and school education system and integrates with other rules, perhaps better, perhaps less good.

It is always said that it is not good to rush your little one and to let him develop – at least in terms of motor skills, at his own pace. However, there are some little tricks that you, as a parent, can help him develop his muscles more easily, and his motor

development will be the one you want.

Figure 1. *The right game*

1. Take care of your child's muscles

Even if it seems like you're torturing your little one, don't neglect to put him on his tummy, preferably as early as possible. This position will strengthen his neck muscles, making him hold his head up faster and better. If you're holding him in your arms, he should be in an upright position, with his head resting on your shoulder. In addition to his neck muscles, this position will also strengthen his arm or leg muscles, as he will have greater freedom of movement.

If you want to get him to crawl, when he's in the classic position for this movement, entice him to start walking with a toy. Don't place it at a great distance at first but gradually increase the distance.

Is your little one standing well, but still doesn't want to take his first steps? It's okay, you can help him yourself. While he's standing, hold out an object that he's attracted to, but at a short distance. At first, he will lose his balance trying to reach them, but gradually he will become more confident on his own feet and will take his first steps trying to reach the desired objects.

Even if they seem like nothing to you, for your baby all these small successes are real victories. That's why he will be very excited about his success and will want to repeat the experience if you appreciate each of his successes. Applaud him, give him a kiss, say "bravo", express your joy for his success as expressively as possible. The little one will want to receive these appreciations more often, so he will practice until he manages to do it correctly. Until then, you appreciate him, these are his first victories in the fight with life.

In addition to those mentioned above, we also have an alternative for mothers. Large toy manufacturing companies have launched models that are increasingly interesting and complex, to help parents, but also little ones, in terms of motor development. These toys are as colorful as possible, so it is no wonder that little ones are attracted to them. There are toys on the market that help little ones develop their fine motor skills—which at this age help them grasp things, practice hand-eye coordination, and later, write, draw, and dress themselves—and gross motor skills—which involve coordinating their legs, supporting their head, and torso, but there are

also toys that happily combine both.

2.The world of games and toys

Food, care, love, all are intended for the newborn. But as time goes by, from the first month of life, the child needs color and sound, beautiful and cheerful faces, lights and warmth. And how can the little one be given all this, if not with the help of cheerful and safe toys.

The world of toys has been and will remain fascinating, despite the technological evolution that encompasses every aspect of life. The charm of play and its benefits will never be replaced by any other activity.

The world of play and toys is the most beautiful world. But in this world of fairy tales and stories, only the newest toys should be found, toys designed for the age and needs of each stage of the child's growth.

The toy and children's game industry has grown impressively in the last 15-20 years, the importance given to this aspect, that of play, being very great. Games and play, being responsible for part of the quality of life of the little ones, impose rules and norms that should be reflected on the quality of products that fall into this category, thus creating the newest toys for our children.

First, the newest toys are suitable for each stage. A toy intended for a child over 3 years old will not be of any use to a 6-month-old child, on the contrary, it can even put him in danger.

At the same time, the newest toys are those that suit the age level, the child's inclinations, his preferences, the environment in which he grows and plays, the space in which he plays and the possibilities of the parents.

2. What do we need to know about the new toys?

Being such a large industry and with immense potential, there are more toy manufacturers, the raw materials are more varied, the countries of origin are more distant, and the quality can sometimes leave something to be desired. For a parent to ensure that only suitable and useful elements for their development are included in the little one's space, they should master the notion of the newest toys. These are not necessarily the most expensive toys.

The newest toys are first and foremost toys that do not endanger the little one. A toy chosen strictly for the child's age and handled according to the instructions for use is the best toy for a child.

From a technical point of view, it should be specified that toys, to meet safety conditions, should fall within certain norms. In the case of toys released on the Romanian market, they should be manufactured according to European standards, but there are also important products from larger areas that are designed and manufactured in accordance with global quality and safety standards. A parent should keep in mind that the newest toys for their child should be displayed for sale in a tightly sealed package and present accurate information about the manufacturer and its contact details.

The newest toys will have very clear assembly and use instructions, depending on the product, and will specify the age for which they are intended.

A parent should know that the newest toys are the toys that are well assembled, without loose or missing parts, toys that do not have a pungent odor, proof that the materials used to manufacture the toys are dangerous.

The best toys will not leave traces of paint on the hands of the little ones and will not have battery compartments that are superficially closed without a safety system. A good toy will be easy to handle, will be assembled quickly, and the parts will fit perfectly.

The newest toys are the ones that don't have balls coming off, hairs not falling out, eyes or headlights not coming off, and wheels that spin. A good toy will be safe because the material it is made of doesn't bend or break immediately, and it will be useful to the little one because he will be able to use it without putting himself in danger and without getting upset that it doesn't work as it should.

A toy is good when it helps to shape the little one, when by handling it, the child develops his creativity, imagination and intelligence. These toys have the role of stimulating children's imagination, giving them chances to create new approaches, to socialize, to empathize and to be open to new challenges. A good toy has the role of determining the child to look for new and new answers and variants, which helps in his natural formation and development. Toys must be precisely categorized, age-appropriate, and themed. There are toys strictly for babies, toys and games for girls or boys, indoor or outdoor toys, educational toys and games.

Toys for boys and girls are those that help them discover their inclinations and skills and develop them. Scientific games, mosaics, role-playing games, figurines, educational and creative games, puzzle games, construction and modeling games, family games, all contribute to the good development of children and help them integrate into society.

Toys have represented, represent, and will represent joy for children, they will help them spend wonderful moments, safely, in the company of friends and family, they will help them develop their skills and discover new talents and inclinations. Toys are the joy of life and have no age.

Bibliography

1. Golu, F., (2009), *Jocul și învățarea la copilul preșcolar*, Polirom Publishing House, Bucharest.
2. Golu, F. (2015), *Manual de psihologia dezvoltării*, Polirom Publishing House, Bucharest.
3. Simion, N.-M., (2010), *Rolul jocului în dezvoltarea personalității copilului*, Rovimed Publishing House, Bacau.
4. Stan, L., (2016), *Dezvoltarea copilului și educația timpurie*, Polirom Publishing House, Bucharest.
5. *** UN General Assembly Resolution, Sport as a means of promoting education, health, development and peace, 58/5/2003.

LIFELONG LEARNING: INITIATIVES AND GOOD PRACTICES IN THE UNIVERSITY SECTOR OF THE REPUBLIC OF MOLDOVA

Aliona Luca [1], Alexandra Barbăneagră [2], Ecaterina Lungu [3*]

[1] *Moldova State University, Institute of Physical Education and Sport, Chisinau*
[2,3] *"Ion Creangă" Pedagogical State University of Chisinau, Republic of Moldova*
[2,3] *"Dunarea de Jos" University of Galati, Romania*

Abstract

The present paper aims at highlighting the role of lifelong learning in the adults professional development, analyzing recent approaches to the development of continuing professional training programs within the Institute of Physical Education and Sports (IEFS) and the "Ion Creangă" State Pedagogical University of Chișinău (UPSC). The objective of the research is to highlight the applied institutional models, the convergences with European practices in the field of adult education, as well as the prospects for consolidating LLL (Lifelong Learning) programs in higher education in the Republic of Moldova. The methodology used is qualitative, interpretative and applicative in nature, and is based on the analysis of the specialized bibliography, the regulatory framework in force, the results of the implementation of the international project Erasmus+ COMPASS – Towards European University Lifelong Learning Model in Moldova and the educational models promoted by the two institutions. Reflections on the challenges and development strategic directions are formulated by the author based on her own analytical synthesis, based on the observation of current phenomena in the university space of the Republic of Moldova and on theoretical benchmarks in the field of andragogy, expressing a contextualized perspective on recent transformations in the national higher education system.

Key words: *continuing professional training, lifelong learning, adult education, higher education institutions, andragogy, educational policies*

1. Introduction

The training of highly qualified specialists is currently the strategic priority of higher education institutions, in a dynamic social and economic context, which is constantly changing. The knowledge-based economy requires the development of an increased capacity for adaptation of human resources, and teachers, as vectors of education, must respond to increasingly complex demands. Globalization, the rapid accumulation and updating of information, the digitalization of educational processes, the need for transversal skills generates additional pressures on the education system, including the higher one. Under these conditions, contemporary universities are no longer perceived only as institutions that provide initial knowledge in a certain field by offering degrees, but as active centers of continuous training, professional development and retraining, responding promptly and efficiently to the real needs of the labor market and society as a whole.

In recent years, higher education curricula have shown a clear tendency towards flexibility, in response to the accelerated pace of technological progress, the dynamics of the lab or market and rapid social transformations. These developments impose on universities the responsibility to offer graduates real opportunities for self-improvement, professional adaptation and retraining. At the same time, the validity period of the skills acquired in the university setting is becoming increasingly shorter, which determines an increased pressure on specialists, who must constantly update their knowledge and skills in order to remain professionally effective.

2. Material and methods

In this paper, we aimed at underlining the role of lifelong learning in the professional development of adults, conducting an analysis of recent efforts to develop continuing professional training programs within the Institute of Physical Education and Sports (IEFS) and the "Ion Creangă" State Pedagogical University of Chisinau (UPSC), in the context of the implementation of the international project *Erasmus+ COMPASS – Towards European University Lifelong Learning Model in Moldova*. The research aims at highlighting the applied institutional models, convergences with European practices in the field of adult education, as well as the prospects for consolidating LLL (Lifelong Learning) programs in higher education in the Republic of Moldova.

The methodology adopted is qualitative, interpretative and applicative, and is based on the analysis of the specialized bibliography, the regulatory framework in force, the results of the implementation of the COMPASS project and the educational models promoted by the two institutions. The reflections on the challenges and strategic development directions are formulated by the authors based on their own analytical synthesis, being based on the observation of current phenomena in higher education in the Republic of Moldova in terms of continuing adult education, as well as on relevant theoretical benchmarks in the field of andragogy. These formulations do not reproduce specific sources, but express a contextualized vision of recent developments in the local education system.

3. Results and Discussions

For the adult population, professional growth has become not only a current imperative, but also a pressing necessity, determined by the accelerated pace of changes in the socioeconomic and professional environment. From a personal perspective, professional development involves an evolution in several stages, starting with the executive level, focused on mastering standard tasks and procedures, and culminating in the creative level, defined by the ability to formulate original solutions, to critically reflect on one's own activity and to actively contribute to the growth of the professional field. This vision supports the need for training that goes beyond the simple accumulation of information, promoting autonomous, reflective and innovative thinking: "the objectives of training are changing, they consist not only in the acquisition of a volume of knowledge and skills, but also in

the development of the capacity for independent information search, for the accomplishment of new and non-standardized professional tasks, as well as for the assimilation of the procedures necessary for the acquisition of a new profession or specialization" (Markova, 1996, p. 261, t.n.).

In this context, the state is taking concrete actions to develop the regulatory framework for adult education, financially support professional retraining programs and promote institutional partnerships aimed at facilitating teachers' access to continuing education programs, adapted to contemporary educational requirements, which face multiple challenges: curricular reforms, digitalization, the need for inter- and transdisciplinarity, etc.

The Education Code of the Republic of Moldova regulates lifelong learning activities, stipulating that this process "includes learning activities carried out by a person throughout his life, for the purpose of training or developing skills from a personal, civic, social and professional perspective"; it includes general, vocational-technical and higher education, as well as adult continuing professional training; it can be carried out in the context of formal, non-formal and informal education (Education Code of the Republic of Moldova, Code no. 152 of 17.07.2014).

As an essential component of lifelong learning, adult continuing education "ensures continuous access to science, information, culture, in order to flexibly adapt the individual to new socio-economic realities in constant change and to develop the skills necessary for professional and social activity" (Education Code of the Republic of Moldova, Code no. 152 of 17.07.2014). Thus, continuing education is understood as a universal right and not just as a professional option. The Regulation on Adult Education (HG193/2017, revised in 2024) details the organization of training, micro-qualifications, duration of programs and certification criteria, outlining a clear framework for action for the programming and evaluation of university offers. In this way, continuing education represents an integrated element of the human resources policy in the educational system of the Republic of Moldova.

The support provided by European strategic partners facilitates to a considerable extent the implementation of the lifelong learning process for adults. For example, in the period 2018-2022, several higher education institutions from the Republic of Moldova participated in an international Erasmus+ COMPASS project – Towards European University Lifelong Learning Model in Moldova, which aimed at developing the capacity of universities to provide educational services adapted to the European concept of lifelong learning (LLL), by promoting a sustainable institutional model of lifelong learning, oriented towards flexibility, inclusion and quality. The partnership brought together, along with institutions from Belgium, Finland, Austria, Slovenia, Spain, Italy and France, six universities from the Republic of Moldova: the Academy of Economic Studies of Moldova (coordinator), the Academy of Music, Theatre and Fine Arts, the "Ion Creangă" State Pedagogical University of Chișinău, the State University of Physical Education and Sports, the Cooperative-Commercial University of Moldova and the State University of Comrat, as well as the Council of Rectors and the Ministry of Education, Culture and

Research of the Republic of Moldova [8], contributing to the development of the policy framework and the implementation of an accreditation mechanism for LLL programs.

The "Ion Creangă" State Pedagogical University of Chisinau (UPSC) and the State University of Physical Education and Sports (USEFS; from 2024 - the Institute of Physical Education and Sports of the State University of Moldova) were actively involved in the implementation of this project. As a result, the two institutions benefited from an expanded institutional development framework: they developed their own strategies for the continuous training of specialists, created or reorganized specific coordination structures (at UPSC - the Center for Continuous Training and Leadership, and at USEFS - the Department of Continuous Professional Training), organized training sessions for LLL trainers, participated in study visits to partner European universities, consolidating the exchange of good practices.

The programs subsequently offered by UPSC include professional requalifications (bachelor's/master's), medium-term advanced training modules (e.g., educational management, pedagogy, foreign languages, etc.), but also short thematic modules (e.g., didactic evaluation, digitalization of the educational process, speech therapy, etc.). The diversity of these offers allows adaptation to the needs of pre-university education teachers across the country.

IEFS has developed four LLL-type modular programs, dedicated to teachers' continuous training in physical education and sports, as well as in related areas [9]. These programs integrate applied components adapted to the professional needs of specialists in the fields of: sports sciences, education sciences, physiotherapy and occupational therapy, being oriented towards the formation of updated and relevant skills for the practice of the respective fields. One of the most appreciated modular programs piloted within the project was "Communication and sports language" (coordinator: assoc. prof., dr. Aliona Luca, IEFS), implemented in 2021 and resumed annually for four editions. The program has as its main objectives the development of professional communication skills, the appropriate use of terminology specific to physical education and sports, as well as the consolidation of an effective educational dialogue in teaching and sports activities. The efficiency of this type of training programs, along with the trainers' professionalism and involvement, were constantly mentioned by the course participants, a fact reflected in the feedback expressed in the final evaluations of the programs (Barbăneagră, Cepraga, 2024, pp. 25-27; Gheţiu, 2020, pp. 266-269).

In this way, the universities of the Republic of Moldova align themselves with the established practices in the European space, where continuing education and adult education have long been a natural component, well consolidated from an institutional and legislative point of view. In many states of the European Union, universities play an essential role not only in the specialists initial training, but also in supporting their long-term professional career. The COMPASS project offered the universities of the Republic of Moldova, in addition to the framework of action

inspired by good European practices, the opportunity to reconfigure their vision of their mission in contemporary society.

In the context of aligning with European adult education standards, it is important to understand its peculiarities. The concept of andragogy, established in Western specialized literature (see: Knowles, 1970, pp. 40-59; Merwe, 1970, pp. 11-14, etc.), refers to the theory and practice of adult education, emphasizing the motivational, experiential and applicative specifics. The differences between andragogy and pedagogy (the latter being mainly child-oriented and guided learning) are significant and concern both the way of designing the contents, as well as the trainer-student relationship, teaching methods, evaluation and the role of personal experience in the learning process. This approach implies not only a change of method, but a paradigm shift in education: "In its broadest sense, andragogy refers to any intentional and professionally guided activity that aims at a change in adults. But specifically, we define andragogy as the art and science of helping adults learn, in contrast to pedagogy, which is the art and science of teaching children" (Knowles M.S., 1980, p. 43). The above-mentioned distinction has led to the development of an educational model based on active involvement, autonomy, experimentation, applicability, reflection and emotional involvement – resulting in an effective and transformative education.

The teams of trainers from UPSC and IEFS integrated the principles of andragogy and participatory teaching into the structure and content of the implemented programs, which assumed the active involvement of adult learners, the adaptation of the contents to immediate professional needs and the encouragement of collaboration in the learning process. This approach has proven to be essential for the improvement of teaching staff in pre-university education. In this context, the two institutions propose complementary models of continuous professional training: the first – through diversity, accessibility and extended applicability in various areas of education, the second – through specialization and anchoring in the specifics of physical education and sports. The experience of the two institutions in the field of adult training validates the real potential for implementing a sustainable and efficient lifelong education system in the Republic of Moldova, based on the real needs of teaching staff and in line with current European trends.

The progress made in recent years in the field of adult continuing education has undoubtedly led to the consolidation of the institutional framework for continuing education in universities in the Republic of Moldova. However, some challenges remain to be overcome, which concern both the content of the programs and, especially, the context in which they are implemented. Among the difficulties noted there is the unequal access to training opportunities in rural areas (compared to urban areas), the time crisis, in conditions of overworked teachers, as well as the insufficiency of financial and logistical resources for the systematic updating of the educational offer.

A sensitive aspect, mentioned by the course participants, is that of the teachers' motivation to access continuing education programs, against the backdrop of an

increased workload, salaries still considered quite modest and an institutional climate sometimes reluctant to innovation. In addition, not all programs manage to integrate participants' feedback in a timely manner or to respond promptly to rapid changes in the educational system.

In this context, several measures are required to improve the continuing adult education process, including:

- optimizing adult programs by integrating new technologies, especially blended learning methods;
- diversifying microqualifications, adapting them to the specific needs of trainers and teachers in various curricular areas;
- strengthening inter-institutional partnerships, including with the pre-university environment, for the joint creation of training program content;
- ensuring an efficient system for recognizing and certifying the skills acquired;
- continuously improving the trainers' skills in the field of lifelong learning, in order to ensure optimal consistency with the specifics of the activity in this education sector.

The perspectives aim not only at developing the existing programs, but also at creating a sustainable educational system, which would fully exploit the potential of continuous training as a key factor in the modernization of the educational system and in the professionalization of human resources. In this sense, universities have the role not only of training providers, but also of promoters of change and pedagogical innovation in society.

4. Conclusions

In an educational context in constant transformation, in which professional skills must be constantly updated, teachers' continuous training becomes not only an option or a universal right, but also a necessity. The experience accumulated by IEFS and UPSC in the field of adult education demonstrates that higher education institutions in the Republic of Moldova can play an essential role in organizing an efficient lifelong learning system, capable of responding to the demands of a society based on knowledge, flexibility and inclusion.

The two institutions offer complementary models: UPSC – through curricular diversity and openness to general areas of education, IEFS – through specialization in physical education and sports and related areas. The integration of andragogy principles, the use of participatory methods and orientation towards the real needs of the beneficiaries are defining elements for the success of these programs.

The sustainable development of continuing education also involves overcoming obstacles, such as: limited resources, different access to continuing education programs, challenges related to the participants motivation, etc. Strengthening a culture of continuing education and creating a favorable institutional and legislative framework are essential conditions for an effective reform of the system. This transformation involves both curricular and structural changes, as well as a new attitude towards learning: valorizing the effort of self-improvement,

encouraging pedagogical innovation, stimulating collaboration between generations, as well as between representatives of different professional fields. In the future, continuing education must become an integral part of national educational policies, and universities must be supported in their capacity as active promoters of adult training and professional growth for a modern, democratic and competitive society. Promoting European experiences and expanding cooperation networks will contribute to the creation of an open, dynamic and sustainable educational system, capable of responding to both the individual needs of employees and the strategic objectives of the educational system in the Republic of Moldova.

Bibliography

1. Barbăneagră, A., Cepraga, L. (2024). Imersiunea cultural-lingvistică: motor al dezvoltării personale și profesionale, *Educaţia multiculturală, spaţiu formativ pentru educaţia valorilor*, Ed. 2, 5-6 decembrie 2024, Ed. CEP UPSC, Chișinău, pg. 19-28.
2. Gheţiu, A. (2020). Proiectul COMPASS (ERASMUS+): oportunități pentru dezvoltarea programelor de formare profesională continuă, *Sport. Olimpism. Sănătate*, Ed. 5, 10-12 septembrie 2020, Ed. USEFS, Chișinău, pg. 263-270.
3. Merwe, A. (1977). Participative Adult Business Teaching [online], *South African Journal of Business Management*, Vol. 8, pg. 11-14.
4. Knowles, M.S. (1970). *The Modern Practice of Adult Education: From Pedagogy to Andragogy* [online], Revised and updates: 1980, pg. 40-59.
5. Markova, A.K. (1996). *Psychology of professionalism*, Moscow, 360 p.
6. *** *Codul Educației al Republicii Moldova* (Cod nr. 152 din 17.07.2014). [online]. https://www.legis.md/cautare/ getResults?doc_id=110112&lang=ro
7. *** *Regulament cu privire la educația adulților* (HG nr.222 din 26.03.2024). [online]. https://www.legis.md/cautare/ getResults?doc_id=142707&lang=ro
8. *** *Start Proiectului ERASMUS+ COMPASS „CĂTRE MODELUL UNIVERSITAR EUROPEAN DE ÎNVĂȚARE CONTINUĂ ÎN MOLDOVA", 597889-EPP-1-2018-1-MD-EPPKA2-CBHE-SP*. [online]. https://upsc.md/ 2019/03/22/start-proiectului-erasmus-compass-catre-modelul-universitar-european-de-invatare-continua-in-moldova-597889-epp-1-2018-1-md-eppka2-cbhe-sp/?utm_source=chatgpt.com
9. *** *Results of the implementation of the COMPASS Project within the State University of Physical Education and Sport*. [online]. https://usefs.md/ PDF_NEW/2022/P3_SUPES_Results%20impl%20COMPASS%20Project_Senat_29.09.2022.pdf

OCCURRENCE OF A DYSTONIC RESPONSE TO GRADED PHYSICAL EXERTION IN YOUNG ATHLETES IN TEAM SPORTS

Yevhen Mykhaliuk[1], Yehor Horokhovskyi[2], Anatolii Bosenko[3], Nadiia Orlyk[3], Valeriia Borshchenko[3]
[1]Zaporizhzhia State Medical And Pharmaceutical University, Zaporizhzhia, Ukraine
[2]Zaporizhzhia National University, Zaporizhzhia, Ukraine
[3]State Institution "South Ukrainian National Pedagogical University named after Kostiantyn Ushynskyi", Odesa, Ukraine

Abstract
This study is present current data on the phenomenon of "infinite tone" observed after physical activity in young athletes participating in team sports. *Material and methods.* A total of 191 athletes were examined, including 174 football players with a sports qualification of 3rd to 2nd class athlete (mean age 15.82 ± 0.15 years) and 17 handball players with a sports qualification of 2nd class athlete (mean age 14.2 ± 0.29 years). Blood pressure was measured using the Korotkov method with an aneroid sphygmomanometer. Physical performance was assessed on a bicycle ergometer following the established protocol, with measurements of heart rate (HR) and blood pressure (BP) taken at rest while seated on the bicycle ergometer, after the first and second levels of physical exertion, as well as at the 5th minute of the recovery period. *Conclusions*. In young athletes participating in soccerand handball, the phenomenon of "infinite tone" following the submaximal PWC170 test is observed in 39.65% and 35.29% of cases, respectively. The comparison of the relative physical work capacity in soccer and handball players exhibiting the "infinite tone" phenomenon did not reveal statistically significant differences from similar indicators in athletes without this phenomenon (soccer players: 2.88 ± 0.06 W·kg⁻¹ vs. 2.86 ± 0.07 W·kg⁻¹, p = 0.842; handball players: 2.40 ± 0.37 W·kg⁻¹ vs. 2.58 ± 0.15 W·kg⁻¹, p = 0.564). This suggests the absence of signs of physical overstrain in the studied athletes and does not constitute a contraindication for their participation in the training process. The review of scientific literature indicates a limited understanding of the hemodynamic causes of "infinite tone" after graded physical activity, as most studies have focused on the empirical assessment of its detection frequency without considering various factors such as sport, sex, age, health status, and skill level. Consequently, it is difficult to concur with the opinion of some authors who assess the functional state of such athletes as unsatisfactory or low and recommend their training in a special medical group.

Key words: *blood pressure, phases of Korotkoff tones, "infinite tone" phenomenon, physical performance, soccer players, handball players*.

1. Introduction

During the initial medical examination of athletes, particular attention is given to the measurement of resting heart rate (HR) and blood pressure (BP). These measurements are also performed following graded physical exertion: in less skilled athletes, typically using the Martinet-Kushelevsky test (20 squats in 30 seconds), and in high-performance athletes, often after the Rufier test or the submaximal PWC170 test conducted on a bicycle ergometer or treadmill. Some researchers have observed that athletes may exhibit a dystonic type of reaction characterized by the

phenomenon of "infinite tone" following such physical activity (Viru, E.A., 1985; Mykhaliuk, Y. et al., 2022; Abramov V.V. et al., 2014; Mykhaliuk, Y., et al., 2024). Several authors emphasize the necessity of ensuring the proper technical condition of blood pressure measuring devices to prevent inaccuracies (Sharman, J.E. & La Gerche, A, 2015). Currently, blood pressure is primarily measured using manual and automated sphygmomanometers (Tocci, G. et al., 2022). While automatic blood pressure monitors employing the oscillometric method have become widespread, concerns regarding their accuracy due to the underlying measurement algorithms have been raised (Ihm, S.H. et al., 2022).

Despite the availability of numerous validated blood pressure monitors, Murthy S. et al. (2023) highlight existing gaps in their geographical representation, specifically concerning particular target populations, diseases or conditions, and arm circumference. Furthermore, strategies to expedite the adoption of the European Society of Hypertension/International Organization for Standardization's universal standard for the validation of automated blood pressure monitors should be developed.

This relatively detailed discussion of blood pressure measurement methodologies is prompted by reports questioning the very existence of the "infinite tone" phenomenon. Since 1984, the prevailing view has been that true diastolic pressure rarely falls below 50 mm Hg, and the so-called "infinite tone" is, in fact, an auscultatory artifact where the measurement of true blood pressure does not reach zero. Consequently, the dystonic type of response was considered an "atypical" response (Chogovadze, A.V., & Butchenko, L.A., 1984). Moreover, Ivanov S.M. (1970) and Karpman V.L. (1980), considering diastolic pressure to never be zero, did not investigate its origin, regarding this phenomenon as a common finding in the examination of healthy athletes.

Thus, a review of the literature concerning the reaction of athletes to physical activity with the occurrence of the "infinite tone" phenomenon reveals existing challenges in the recording and interpretation of diastolic blood pressure.

The aim of this study is to present current data on the phenomenon of "infinite tone" observed after physical activity in young athletes participating in team sports.

2. Material and Methods

A cycling ergometric study was conducted involving 191 athletes, comprising 174 soccerplayers with a sports qualification of 3rd to 2nd class athlete (mean age 15.82 ± 0.15 years) and 17 handball players with a sports qualification of 2nd class athlete (mean age 14.2 ± 0.29 years).

Considering the absence of validated automatic blood pressure monitors for professional athletes, blood pressure was measured manually according to the Korotkov method using an aneroid sphygmomanometer (Romed, the Netherlands). Measurements were taken on the right arm three times with 5-minute intervals, and the lowest recorded value was used for analysis (Abramov V.V. et al., 2014). Physical performance was assessed using the Corival Lode ergometer following the

established protocol (Mykhaliuk, Y. et al., 2022; Abramov V.V. et al., 2014; Mykhaliuk, Y. et al., 2022). During this assessment, heart rate (HR) and blood pressure (BP) were recorded at the following stages: at rest while seated on the ergometer (resting HR - HR0, resting BP - BP0), after the first level of physical exertion (HR1, BP1), after the second level of physical exertion (HR2, BP2), and at the 5^{th} minute of the recovery period (recovery HR - HR3, recovery BP - BP3).

Statistical analysis of the obtained data was performed using the Statistica 6.0 for Windows software package (StatSoft Inc.) employing parametric statistical methods. Data are presented as mean (M) ± standard error of the mean (m). A significance level of $p \leq 0.05$ was used to determine statistical significance.

3. Results and Discussion

In 75 of the 191 athletes examined (39.26%), a dystonic type of reaction characterized by the "infinite tone" phenomenon was observed on the ergometer following the second level of physical exertion. To facilitate the interpretation of the obtained data, the athletes were categorized by sport and by the presence or absence of this phenomenon.

Age comparisons were conducted between 69 soccerplayers (mean age 15.79 ± 0.21 years) exhibiting the "infinite tone" phenomenon and 105 soccerplayers (mean age 15.84 ± 0.21 years; $p = 0.895$) who did not. Similarly, comparisons were made between 6 handball players (mean age 14.5 ± 0.68 years) with the "infinite tone" phenomenon and 11 handball players (mean age 14.0 ± 0.30 years; $p = 0.566$) without it. No statistically significant age differences were found between the respective groups of athletes.

The proportion of soccerplayers displaying the "infinite tone" phenomenon was 39.65%, while among handball players, it was 35.29%. This difference was not statistically significant. Thus, the occurrence of the "infinite tone" phenomenon in the studied sample of young soccerand handball players did not appear to be dependent on the sport.

Comparison of the relative physical work capacity (PWC170/kg) yielded the following results: in soccer players, 2.88 ± 0.06 $W \cdot kg^{-1}$ versus 2.86 ± 0.07 $W \cdot kg^{-1}$ ($p = 0.842$), and in handball players, 2.40 ± 0.37 $W \cdot kg^{-1}$ versus 2.58 ± 0.15 $W \cdot kg^{-1}$ ($p = 0.564$). No statistically significant differences in relative physical work capacity were observed between the groups with and without the "infinite tone" phenomenon. It is worth noting that the average values of relative physical performance in these young athletes were relatively high in both groups.

It is established that physical performance typically declines in athletes experiencing physical overstrain or overtraining. In our study, we did not find a statistically significant reduction in physical performance in the young athletes exhibiting the "infinite tone" phenomenon, suggesting the absence of signs of physical overstrain or overtraining in this group. Therefore, there is no evidence to suggest that decreased physical performance is a causative factor for this phenomenon.

In our previous research, conducted on a larger cohort of athletes (n = 741), including adult highly skilled soccer players (Master of Sports - International Master of Sports) and second to third category soccer players, we observed a trend towards higher PWC170/kg values in athletes with the "infinite tone" phenomenon. Specifically, among first category and candidate master of sports soccerplayers, the PWC170/kg value was statistically significantly higher in the group with the "infinite tone" phenomenon compared to the group without it (3.18 ± 0.03 $W \cdot kg^{-1}$ vs. 3.05 ± 0.04 $W \cdot kg^{-1}$; $p = 0.016$) (Mykhaliuk, Y. et al., 2024).

In clinical practice, the "infinite tone" phenomenon is relatively uncommon, whereas it is detected considerably more frequently in sports medicine settings following graded physical exertion. According to Viru E.A. (1985), in adolescents aged 11-16 years, this phenomenon was observed in 16-30% of boys and 21-27% of girls after physical activity (20-35 squats, adjusted for age).

In our broader study involving 3914 athletes of both sexes and sports veterans, the "infinite tone" phenomenon was detected in 57.46% of cases (Mykhaliuk, Y. et al., 2022). Among 741 soccerplayers of varying skill levels (from 3rd class athlete to Master of Sports International Class), the prevalence was 52.36%, with the lowest frequency in second to third category athletes (37.7%), followed by Master of Sports and International Master of Sports (49.64%), and the highest in first category and Candidate for Master of Sports soccer players (58.24%) (Mykhaliuk, Y. et al., 2024).

We found no scientific publications by Ukrainian authors reporting complaints or any pre-pathological or pathological conditions in athletes exhibiting the "infinite tone" phenomenon, nor any prospective studies indicating contraindications for sports participation. Conversely, the Ukrainian textbook for higher medical education students in Ukraine, "Physical Rehabilitation, Sports Medicine," states that a dystonic response to physical activity with the "infinite tone" phenomenon is unfavorable, indicating an unsatisfactory or low functional state. It recommends that such athletes or physical education instructors train in a preparatory (in the absence of contraindications) or special medical group with a reduced training or movement regimen (Abramov V.V. et al., 2014).

It is important to note that in our study, the "infinite tone" phenomenon was observed in young athletes after graded physical activity in the form of a submaximal PWC170 test. However, the descriptions in some of the cited works make it unclear regarding the athletes' engagement in sports and the presence or absence of a preceding testing load.

Furthermore, historical disagreements exist concerning the appropriate level of diastolic pressure. These inconsistencies may suggest that the auscultatory method does not always provide a precise measurement of diastolic blood pressure (Moss A.J., 1983).

4. Conclusions

In young athletes participating in soccer and handball, the phenomenon of "infinite tone" following the submaximal PWC170 test is observed in 39.65% and

35.29% of cases, respectively. The comparison of the relative physical work capacity in soccerand handball players exhibiting the "infinite tone" phenomenon did not reveal statistically significant differences from similar indicators in athletes without this phenomenon (soccer players: 2.88 ± 0.06 $W \cdot kg^{-1}$ vs. 2.86 ± 0.07 $W \cdot kg^{-1}$, p = 0.842; handball players: 2.40 ± 0.37 $W \cdot kg^{-1}$ vs. 2.58 ± 0.15 $W \cdot kg^{-1}$, p = 0.564). This suggests the absence of signs of physical overstrain in the studied athletes and does not constitute a contraindication for their participation in the training process. The review of scientific literature indicates a limited understanding of the hemodynamic causes of "infinite tone" after graded physical activity, as most studies have focused on the empirical assessment of its detection frequency without considering various factors such as sport, sex, age, health status, and skill level. Consequently, it is difficult to concur with the opinion of some authors who assess the functional state of such athletes as unsatisfactory or low and recommend their training in a special medical group.

Bibliography

1. Abramov, V.V., Klapchuk, V.V., Nekhanevych, O.B., [et al.]. (2014). Fizichna reabilitatsiya, sportyvna medytsyna: pidruchnyk dlia stud. vyshchykh med. navch. zakladiv [Physical rehabilitation, sports medicine: textbook for students of higher medical educational institutions]. Zhurfond.
2. Chogovadze, A.V., & Butchenko, L.A. (Eds.). (1984). Sportivnaya meditsina (Rukovodstvo dlya vrachey) [Sports medicine (Guidance for physicians)] (p. 88). Meditsina.
3. Ihm, S.H., Park, J.H., Kim, J.Y., Kim, J.H., Kim, K.I., Lee, E.M., Lee, H.Y., Park, S., Shin, J., & Kim, C.H. (2022). Home blood pressure monitoring: a position statement from the Korean Society of Hypertension Home Blood Pressure Forum. Clinical Hypertension, 28(1), 38. https://doi.org/10.1186/s40885-022-00218-1.
4. Ivanov, S.M. (1970). Vrachebnyy kontrol' i lechebnaya fizkul'tura: uchebnik [Medical control and therapeutic physical culture: textbook] (470 p.). Meditsina.
5. Karpman, V.L. (Ed.). (1980). Sportivnaya meditsina: uchebnik dlya institutov fizicheskoy kul'tury [Sports medicine: textbook for institutes of physical culture] (304 p.). FiS.
6. Moss, A.J. (1983). Criteria for diastolic pressure: Revolution, counterrevolution and now a compromise. Pediatrics, 71, 854–855.
7. Murthy, S., Rajwar, E., Johnson, R., Shrivastava, K., Kamath, P., Rahman, R., Devaria, A., Ismavel, V. A., Vetter, B. N., Jacob, A. G., & John, O. (2023). Validation of Blood Pressure Devices as per 2020 World Health Organization Technical Specifications: A Scoping Review of Global Literature. Hypertension, 80(5), 1110–1116. https://doi.org/10.1161/HYPERTENSIONAHA.122.20425.

8. Mykhaliuk, Y., Horokhovskyi, Y., & Bosenko, A. (2022). Retrospective review of the definition of "infinite tone" under conditions of functional tests in sports medicine. Science and Education, (2), 61-68.
9. Mykhaliuk, Y., Horokhovskyi, Y., Bosenko, A., Bazylchuk, O., & Orlyk, N. (2024). Occurrence of dystonic-type response to physical stress in soccer players. Physical Rehabilitation and Recreational Health Technologies, 9(1), 3-11. https://www.google.com/search?q=https://doi.org/10.15391/prrht.2024-9(1).01.
10. Mykhaliuk, Y. L., Syvolap, V. V., & Horokhovskyi, Y. Y. (2022). Autonomic support of central hemodynamics and physical working capacity in female swimmers and runners in a one-year training cycle. Zaporozhskii Meditsinskii Zhurnal, 24(1(130)), 44–48.
11. Sharman, J. E., & La Gerche, A. (2015). Exercise blood pressure: clinical relevance and correct measurement. Journal of Human Hypertension, 29(6), 351–358. https://doi.org/10.1038/jhh.2014.84.
12. Tocci, G., Citoni, B., Nardoianni, G., Figliuzzi, I., & Volpe, M. (2022). Current applications and limitations of European guidelines on blood pressure measurement: implications for clinical practice. Internal and Emergency Medicine, 17(3), 645–654. https://doi.org/10.1007/s11739-022-02961-7.
13. Viru, E. A. (1985). K voprosu ob auskul'tatornom fenomene beskonechnogo tona [On the question of the auscultatory phenomenon of infinite tone]. Uchenye Zapiski Tartuskogo Gosudarstvennogo Universiteta, Vypusk 723: Sportivnaya rabotosposobnost'. Trudy po fizicheskoy kul'ture [Scientific Notes of Tartu State University, Issue 723: Sports Work Capacity. Works on Physical Culture] (pp. 63-67). Tartu.

KNOWLEDGE AND DEEP COGNITION, PRODUCTIVE WAYS OF POSITIVE TRANSFER IN CREATIVE THINKING AND CREATIVITY

Natalia Nastas [1], Teodor Grimalschi [2]
[1]*Moldova State University, Faculty of Letters, Department of Romano-Germanic Languages, Chisinau, Republic of Moldova*
[1]*"Dunarea de Jos" University of Galati, Romania*
[1,2]*Institute of Physical Education and Sport, Moldova State University, Chisinau, Republic of Moldova*

Abstract
The products of the cognition and adaptation processes are knowledge. Knowledge is the ability to know, perceive and think. Creativity means having imagination and generating some ideas, being able to analyze a situation, to work, to look for the solution. Messages with their quantity and quality of concrete information cannot be learned and understood properly by students without interactive processes of communication and knowledge. The innovative force of higher educational institutions, the instructional processes through which they run, scientific progress, interdisciplinary approaches require opportunities to develop methods, techniques to modernize and prospect the content of the instructional-educational process, to experiment new ways of activity, new ways of organizing operative and productive teaching-learning, based on knowledge, deep cognition and projective-creativity.

Keywords: *knowledge, cognition, creative thinking, creativity, communication, university education, instructional-educational process, positive transfer.*

1. Introduction

The specific creativity skills of the English language at the university education level are correlated with the theory and methodology of the education process, aiming the training and developing the students' professional skills, completion of the methods and means in education and evaluation by lessons, quarters of a training cycle, thus subordinating and orienting the entire activity of teaching staff and students during the study year.

The competence of professional communication in the foreign language is formed through learning, knowledge and the permanent use of the speech act, representing a basic condition of the strategy, of a successful integration, not only on personal level, but also on social scale, in successful structures of long-term psycho-pedagogical activity.

From a quantitative point of view, the methodology of training professional skills is considered a large normative tool that aims to register as many conceptual values and to give some necessary indications in the formative-informative aspect.

The data of the special literature research in this field allows us to mention the following desideratum:

1. training of the ability vision for applying foreign language within the training in the disciplines of the university educational institutions of physical culture and sports;

2. training of didactic selection and design skills, research, experimentation and application in learning activities of different methodological strategies in the foreign language and physical culture;

3. training scientific research skills in the field of language, using knowledge effectively in sports activities;

4. training of personal professional competence in an integrated science system, marked by dynamism, complexity, interdependence and globalization, on the selection of teaching content and inter- and transdisciplinary learning, which is to promote knowledge of the language and the approach of athletes, people, growing the Olympic spirit, education for change.

According to the analysis and synthesis of data from the specialized literature, foreign language works in a competence-based education. Possession of other languages usually allows the activity of knowledge and awareness, a factor that must be capitalized (Nastas, 2020). At the same time, according to our study of the theory and practice of teaching English in higher education institutions of physical education and sports, in the aspect of integrating interdisciplinary English with the educational professional subject for future specialists in the field are not given due attention.

In order to achieve creative thinking, the algorithmized case study method was used, which consists of observations of practical-applicative ideas, setting and the creative-productive solution models. The algorithm was based on the following components of knowledge, understanding and application, on the thematic areas *Communication, Culture, Connection, Comparison and Community* during the technology valuation,

The data obtained from the pedagogical experiment demonstrated creative motivation and creative behaviour of students with a probability of 95%-99% at the significance level $p<0.005$-0.01.

*Actuality of the researched problem***.** The research undertaken demonstrates the strategic role of constructivism in educational communication, its contribution to "thinking as much as possible" all cognitive processes, from perception to creative thinking. The act of creative thinking materializes in different forms of communication involved in intelligent behaviour, the future prospecting.

2. Material and methods

The aim of the work consists in the theoretical-practical substantiation of the technological modernization of training students' professional skills based on deep knowledge and knowledge as a productive way of positive transfer in creative thinking and creativity.

The main methods undertaken in the research.

1. Researching the theoretical-conceptual, methodological and practical aspects exposed in the scientific-methodical literature.
2. Analysis of documentary materials specific to the problem addressed.
3. Observation of pedagogical experience.
4. Testing the level of creative-linguistic preparation.
5. The method of modeling educational communication.
6. The method of pedagogical experiment.
7. The mathematical-statistical method of processing and interpreting the obtained data.
8. Tabular and graphical method.

3. Results and comments

The act of creation is the activity through which new cultural and spiritual values; new material goods are performed. Creativity is a native and/or cultivated human potential, without creation is not performed and not exploited. Creation enotes the science that underpins creative activity (Bobanu et al., 1998, p. 10]. Creation manifests itself in the form of inventions of new things not yet made, called inventions. Invention is a part of creation. According to V. Mandacanu, the creative work of the teacher is an act of creation, of art (Mandacanu, 2009, p.20). The teacher works with people with the noblest goal - to awaken feelings and thoughts, learn, educate, form the personality and professionalism of future teachers from all fields of life, grounds the acquisition of knowledge for the elaboration of knowledge by pupil/student, who becomes a creator of knowledge (Bocoș, 2017, p.416). Inspiration as strength, enthusiasm, complex creator of creative ideas and last but not least, a state of maximum creative tension (Dicționarul limbii romane pentru elevi, p.405), skills and motives, expectations, which is the moment of entering the grip of virtual creativity, as well as through the specifics of visualized creativity (Șchiopu U., p.190]. Creativity refers to the third category of features of the higher endowment (Crețu, 1997, p.38-39):

1. Above-average intellectual ability (general and special ability);
2. Task (the function of the individual motivation oriented towards a field as a specific work task). The task includes sets of targeted features:

- the ability to develop high levels of interest, enthusiasm, fascination and involvement in a particular problem in a field of study;
- high capacity for perseverance, tenacity, patience, devotion, self-confidence, in the personal possibilities to achieve something important, optimism, the training of high standards for one's own work;

3. Creativity - the forms of manifestation of creativity: fluency, flexibility and originality, openness to experience and receptivity to the new and different; curiosity, spirit of adventure; the desire to take risks in thought and action; disinhibition; sensitivity for details and for the aesthetic side of things; the desire to

act and react to external stimulation or to one's own ideas and feelings (Crețu, 1997, p.39).

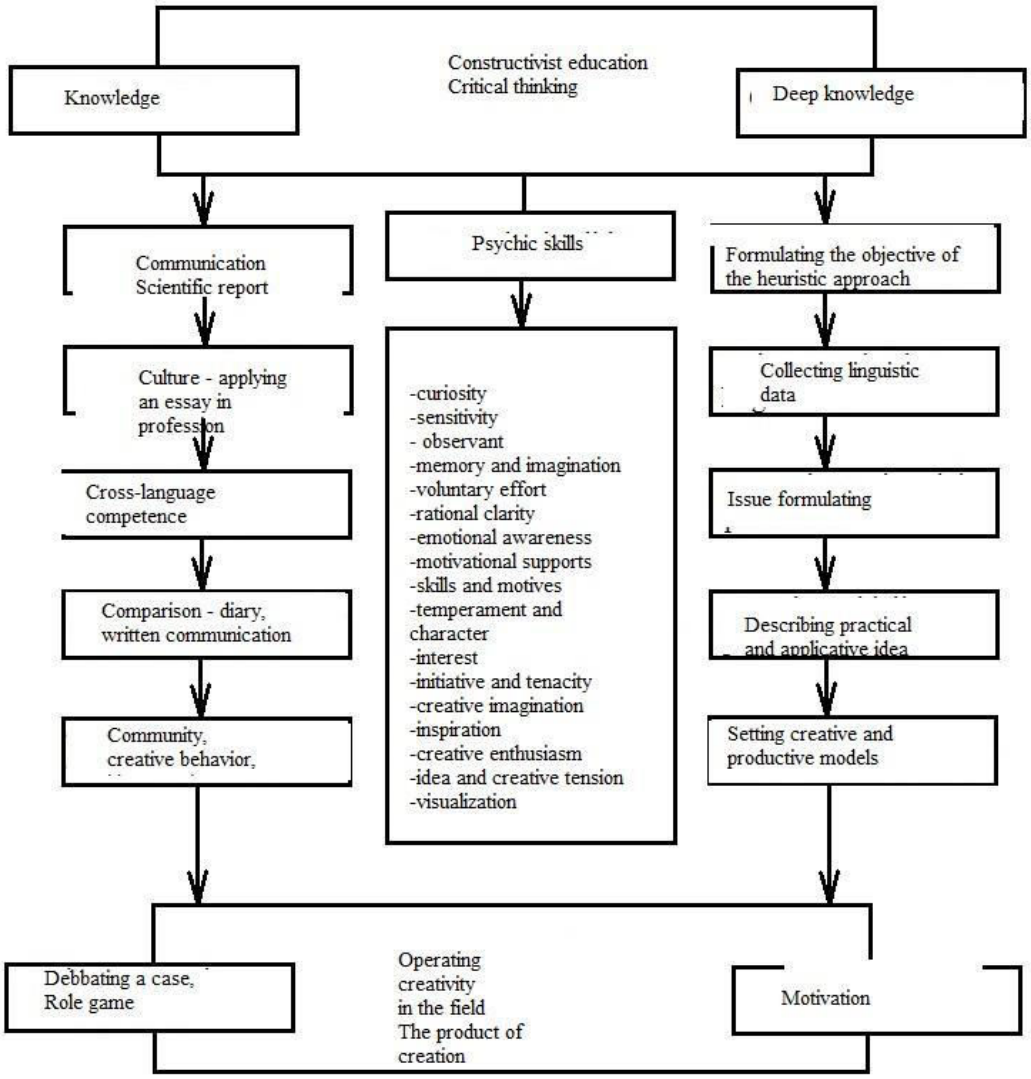


Fig. 1. *Illustrating the basis of creative thinking and creativity in the language education system (English)*

There was developed the conceptual model of the formation of creative-professional competences for students of higher institutions in the discipline of English , synthesizing the ideas presented previously, starting from the orientations of knowledge and knowledge to increase the performance of fluidizing specialized communication for the activity of *composing, theses of reports, essays in English*, thus reconstructing a possible educational approach in the field of creativity of students following the purpose of the research, , which includes a series of events of realities consisting in the functional designation of the actions of creative thinking,

with important connection consequences on the meaning of these constructivist actions: who creates, how creates, when creates, why creates, becoming a developer, a conscious actor of the product of creation (Figure 1).

During the training process, it was used in the bilateral communication relationship, on the one hand English, on the other hand the fields adopted in the chosen profession, constituting a bilateral operational-creative interaction [Figure 2].

1.	2.	CE	CE	CE	FE	3.	4.	CE	CE	CE	FE	5.
	6.	7.	8.	9.	10.		11.	12.	13.	14.	15.	
	16. The cognitive-motivational formative stage in learning English. Formation of creative linguistic competence.						17. The training pragmatic-creative stage in professional activity fields.					
18.	IX	X	XI	XII	I	II	III	VI	V	VI		
19. Months of the study year												

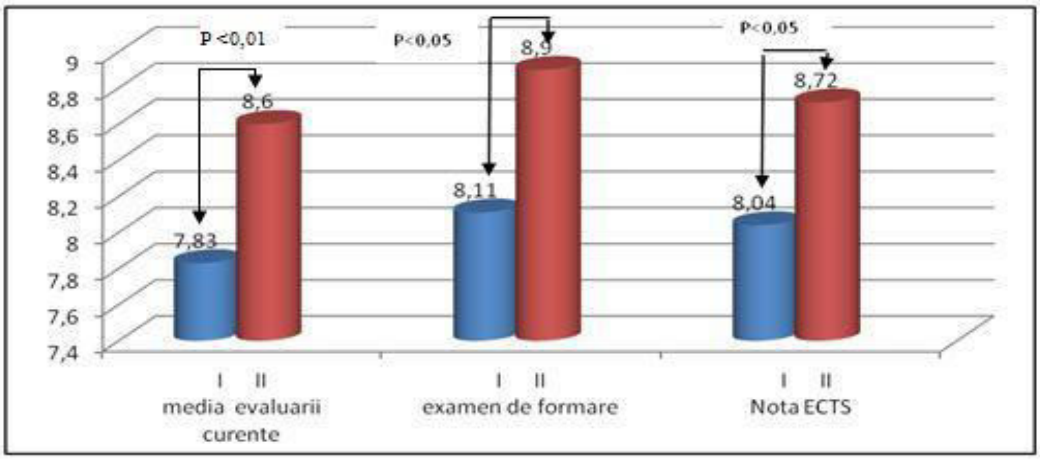


Fig. 2. *The stages of formation of linguistic-creative and constructive professional skills.*

The statistical data accumulated during the post-experiment are presented in Table 1.

Table 1. *The share of students' creative performances in the result of applying the model of creative thinking and creativity formation in the language education system*

The period of creativity testing	Type of testing					
	Current evaluation		Exam (FE)		Final grade	
	$\bar{x} \pm m$	in%	$\bar{x} \pm m$	in%	$\bar{x} \pm m$	in%
Semester I	7,83±0,18	8,04	8,11±0,23	8,63	8,04±0,23	8,63
Semester II	8,00±0,21	7,79	8,90±0,21	7,53	8,72±0,21	7,68
t	3,684		2,31		2,24	
P	<0,01		<0,05		<0,05	

The calculated value t=3.684 at the current evaluation is greater than its tabulated value at P<0.01 with a probability of 99%. The average grades obtained in the final evaluation are in favour of the formation of creative thinking in students

with a more advantageous inspiration, in establishing creative-productive models, using algorithmized case study methods. The calculated value ($t<2.24$) is higher than its tabular value. We conclude that the significance of $P<0.05$ in the observed difference between the two average grades is significant, with a probability of 95.0%

4. Conclusions

1. Taking into account the knowledge and the deep knowledge of the didactic material designed in the experiment based on bilateral training in an approach, applied in the case study and the correlation of the professional communication skills formed within the discipline of the English language with the professional ones in the field of specialty, creative skills were acquired at an innovative level in the performance of tasks, without having to exert too much effort.

2. Starting from the educational values of the Conceptual Model, from its formative-creative objectivity, the Technology of training students' creative skills in relation to learning English Language was conceived and developed, which has a primary role in creating the premises for the development and adaptation to the current demands of the educational system through the training of professional-creative communication skills in a foreign language.

3. It was deduced that learning a foreign language can be productive if the process focuses on the main thematic areas of activity: Communication, Culture, Connection, Comparison and Community, which demonstrates the creative character of consciousness, implicitly its creative-projective function. In learning foreign languages, positive bilateral transfer processes take place at the expressive, productive and constructivist level.

Bibliography

1. Bobanu Ș., Cozma R., Luxandroiu D., Foisoreanu V. Tehnici de creativitate, Brașov: Lux Libris, 1998, p.10.
2. Bocoș M. Subiectul educației –creator de cunoștințe și deținător al unui mod de gândire. În: Didactica disciplinelor pedagogice. Un cadru constructivist. Pitești:Paralela 45, 2017, p.416-418.
3. Crețu, C. Psihologia succesului. Iasi: Polirom,1997, p.38-39.
4. Dicționarul limbii romane pentru elevi. Inspirație. În redacția Luiza Seche si Mircea Seche, București: Didactica și pedagogica, 1983, p.405.
5. Marileym Fryer. Predarea și învățarea creativă. Chișinău: Uniunea scriitorilor, 1989, p.10.
6. Mandacanu V. Munca creatoare a învățătorului-un act de creație, de arta. În: Profesorul maestru . Chișinău: Pontos, 2009, p. 20-22.
7. Zlate, M. Introducere în psihologie. București: Șansa, R.L., 1994, p. 241.
8. Nastas N. Formarea competențelor profesionale la studenții instituțiilor de cultură fizică în cadrul disciplinei "limba engleză". Teza de doctor, Chișinău 2020.
9. Șchiopu U. Creativitate. Dicționar enciclopedie de psihologie. București:B abel, 1997, p. 182-241.
10. Sternberg R. J, Manual de creativitate. Iași: Polirom, 2005, 291 p.

CONTRIBUTIONS ON TECHNIQUES AND PROCEDURES FOR SURVIVAL, LIVING AND LIFE IN EMERGENCY SITUATIONS

Florina Liliana Neder[1], Vasile Dogaru[2], Antonică Constantin[3], Adela Melinte[4]

[1] *Ecological University, 1G Vasile Milea Street, Bucharest, Romania*
[2,4] *Eco Alpin Sports Club Association, Râșnov, Romania*
[3] *"Aurel Vlaicu" Military Aviation Institute, Buzau, Romania*

Abstract

Most people have never had outings in nature or wilderness without gadgets to help them cope. Therefore, there are not many people who know how to light a fire without a lighter, how to build a shelter, how to maintain body heat in colder weather, or how to improvise a water filter. In a world without technology, knowing these things can make the difference between life and death. General information that can be used in emergency situations will be presented in this paper. For survival you must have: air, shelter, fire, water, food and a positive mental attitude. The cessation of the functioning of the human body (death) can be caused by: deterioration of health (injuries, shock, hemorrhage, respiratory arrest, crushing, serious illness, etc.), lack of water, food, cold or excessive heat. Emergencies are life-threatening, so they must be taken seriously, anticipated, prevented and combated, in order to function properly, both on a personal level and on a societal level.

Key words: *emergency, survival, shelter, water, food*

1. Introduction

Given the current geopolitical situation, the profound changes in the security environment, but also the profound climate change, there is a risk of more and more frequent emergency situations.

Children are considered the segment most prone to damage, loss, suffering, injury and death in the event of a disaster, and the impact of the disaster can be disproportionately greater for children living in poverty.

As adults, we want all children to feel safe and not worry about possible emergencies. But at the same time, we also know that disasters can happen, often without warning. Children need to know what steps they should take so they can stay safe during and after an unpleasant event.

Staying alive after a natural disaster, catastrophe, cataclysm, wandering on the mountain, armed attack, nuclear, chemical, bacteriological/CBRN accident, etc. is survival (Derlogea Ș., 2002).

Any situation that requires immediate or prompt intervention to protect lives, property, or the environment (natural disasters, fires, serious accidents, loss/wandering in the wilderness, or other circumstances where resources and assistance are limited or inaccessible) is an emergency.

The emergency situation is an event that threatens the life or health of people, the environment, material or cultural values, and in order to restore the state of normality, it is necessary to adopt urgent measures and actions, the allocation of specialized resources and the unitary management of the forces and means involved (https://ro.wikipedia.org/wiki/Situa%C8%9Bie_de_urgen%C8%9B%C4%83).

A crisis situation is a difficult or dangerous situation involving people or organisations and which can have significant negative consequences (armed conflicts and wars, economic crises, pandemics and epidemics, political or social crises).

The emergency situations are:

- a fire;
- a storm;
- a flood;
- an earthquake;
- a landslide;
- low temperatures;
- heat wave;
- a technological accident.

The crisis situations are:

- earthquake;
- flood;
- storm,
- tornado;
- fires;
- landslides;
- external or internal armed confrontations;
- nuclear accident;
- hybrid warfare.

The purpose of the research is to provide information necessary to solve emergency situations.

2. Material and method

Research hypothesis. If the capacity for decision-making is developed quickly, in a timely and efficient manner, with good theoretical and practical training in emergency situations, then practical survival skills can be improved.

Research objectives:

✓ Awareness of the integrated approach to emergency situations.

✓ Improving professional skills to intervene in emergency situations.

✓ Increasing the quality of training programs in the field of emergency management.

✓ Developing organizational capacity for an adapted response to different emergency situations.

The 6 basic techniques for survival are: attitude, shelter, water, lighting a fire, food and help.

Attitude. Regardless of the situation, keep calm and reason. A clear mind can be the most valuable tool for survival. Don't panic and focus on making thoughtful decisions.

Mental survival is just as important as physical abilities. By managing fear, cultivating positive thinking, and practicing mental exercises, you can stay focused and motivated.

Positive thinking plays a crucial role in survival. Instead of focusing on possible negative scenarios, focus on solutions and what you can control.

Make a list of the resources you have at your disposal and establish clear steps to follow. This planning will help you feel more confident and reduce feelings of helplessness.

HOW LONG CAN YOU LAST WITHOUT HAVING THE ESSENTIALS OF LIFE?

In general, the human body can survive for 3 minutes without air, 3 hours without shelter (if the temperature is very low/high), 3 days without water, and 3 weeks without food.

a) 3 minutes without air - Breathing is the number 1 priority

Lack of oxygen can lead to loss of consciousness in just a few minutes. Managing your breath is crucial. Depending on the situation, one of the following measures can be taken:

- For severe obstruction of the airways, abdominal compressions will be performed - the "Heimlich maneuver" or the active cough position;
- In case of hyperventilation, breathing will be controlled – "deep inhalation, slow exhalation";
- If the air is contaminated, it is recommended to use a mask or improvise a fabric one;
- If breathing is affected by smoke or gas, immediate movement to an area of fresh air should be made.

b) 3 hours without shelter (if there are very low/high temperatures)

Without protection from cold or rain, the body can go into hypothermia. In this case, building a shelter quickly is vital.

The construction of the shelter can be done from branches, leaves and foil. You can use natural shelters (caves, grottoes) that have a stable microclimate, offering protection against extreme temperature variations and bad weather. If there are no materials for building the shelter, it is recommended to dig a hole in the ground, which must be covered with natural materials (branches and leaves). The earth provides GOOD THERMAL INSULATION, keeping the heat inside the pit.

c) Water-free days - Hydration is essential!

Without water, the body quickly becomes dehydrated. Identifying safe sources of water is a priority, even before food. Under normal conditions, an adult needs about

2-3 litres of water per day. Water sources can be: rivers and springs, dew, rain, clean snow.

d) 3 weeks without food - Nutrition is important in the long term

The body can last up to 3 weeks without food, but with water. Food is the body's fuel. Even in the absence, save your energy and resources to look for food. Energy is extracted from glycogen stores, then from fats, and finally from muscle proteins.

Malnutrition quickly affects physical strength, concentration and immunity. Signs of malnutrition: extreme fatigue, dizziness, muscle weakness, inability to maintain body temperature.

HOW TO BUILD A SHELTER

The *shelter* protects the body from hypothermia, being one of the biggest threats in the mountain environment, especially if:

- ✓ It is cold, strong wind or raining;
- ✓ At night, temperatures drop dramatically;
- ✓ Clothes are wet, which accelerates heat loss.

A shelter must:

− To ensure a smooth surface, this allows the arrangement of a small terrace at the entrance;

− To be sheltered from drafts, to provide protection against wind, cold and humidity;

− Do not install shelter on peaks or ridges, but in places away from the wind;

− Its arrangement should be made on counter slopes exposed to the sun's radiation, rich in vegetation that maintains the high temperature;

− They must have wood nearby for cooking and heating;

− Not under dry trees;

− It is recommended to avoid building the shelter at the base of a slope or near rivers.

Fire is vital, but it only reaches its full potential once you have shelter. It is useful for:

- It provides extra heat (especially at night) preventing hypothermia, which is essential for survival;
- Drying wet clothes is crucial for maintaining body temperature;
- Preparation of drinking water or food;
- Signage for help;
- Stress reduction - provides a sense of comfort and security, reducing stress and anxiety;
- Deterrence of predators - keeps wild animals at bay.
- It provides a sense of security during the night.
- The equipment (knives or other equipment) can be sterilized, preventing infections.

Not only does fire provide warmth and will keep wildlife at bay, but it can also be a great SOS signal. It is advisable to know how to quickly light a fire, using dry materials and to maintain it.

Once you have shelter, build a fire if you have dry materials and the necessary tools (matches, flints, magnesium bar, and lighter). Choose a place away from the wind, but not under trees that can catch fire. To light the fire, you can use the magnesium bar, the lighter, a magnifying glass, glass or improvised lenses (from glasses).

Materials needed:

For ignition: thin, dry twigs.

For feeding: logs, thicker branches.

For maintenance: natural charcoal, wood from dry trunks.

As materials can be used: dry wood chips, dried yeast, birch bark, dandelion down, dry grass, reed feathers, dried leaves or fibers from corn cobs, cotton swabs + grease, scraps of paper or cardboard, lint from clothes or string.

A survival knife with a magnesium bar hidden in the handle is the tool that should not be missing from the luggage when going out into nature. Survival knives also work in wet conditions, with them you can cut the logs and light the fire, clean fish and cut food. The survival knife is the ideal tool in difficult conditions (https://www.magazinoutdoor.ro/blog/tehnici-esentiale-de-supravietuire-in-natura/).

Water can be purchased from flowing waters: rivers, streams, springs, rainwater and snow.

It is advisable to always have some water purification or boiling drinking water tablets on hand. Most water sources are unsafe and may contain dangerous pathogens. Dew, rainwater, water from high mountain rivers or this resulting from melting snow can be consumed without problems. Stagnant water is dangerous (https://www.magazinoutdoor.ro/blog/tehnici-esentiale-de-supravietuire-in-natura/).

Water should be consumed even if the sensation of thirst is not felt. It is recommended to store drinking water in clean containers. Boiling water is one of the most effective methods for killing bacteria, viruses, and parasites, but it does not remove chemical impurities or sediment.

Iodine tablets are widely used to disinfect water, but they can leave an unpleasant taste and are not recommended for long-term use or for people with iodine allergies. Chlorine dioxide tablets are very effective against a broad spectrum of microorganisms and leave less taste in the water compared to iodine or chlorine.

Procurement of food

In the backpack of any hiker must find dry and high-calorie food. Plant food can be found in nature:

- Edible fruits and plants: berries, nettles, laurels, sea buckthorn, thyme, dandelion roots;
- Aquatic plants: rush, water lily (rhizomes, seeds), pond thistles;
- Seeds and nuts: acorns (prepared, because they are bitter), hazelnuts.

The animal food found in nature is:

- Fish: uses improvised tools (spears, hooks);

- Small game: rabbits, lizards, small birds;
- Insects: grasshoppers, ants, worms (rich in protein).

It is advisable to avoid unknown mushrooms because the risk is very high.

How is food prepared?

Meat - Boil or roast over direct heat to remove parasites. The organs and hair/feathers will be removed.

Fish - Peel the scales and entrails before cooking.

Herbs – Boil bitter leaves (e.g. acorn, to remove tannin).

Unknown plants will be tested by the "Edibility Test" method. First touch the plant to the skin, then to the lips and tongue. We will wait 8 hours for reactions.

Help and signalling for help can be done by:

- Smoke signals, strategically placed on heights to be visible;
- Signals with mirrors or reflective surfaces can be used to reflect the sun's rays towards aircraft or rescue crews;
- Contrasting colours, such as red or orange, are ideal for creating visible signs on the ground or equipment;
- Flashlights;
- Hitting the tree, stone or metal with a hard object – stone, stick;
- Whistle – the universal signal is used: 3 short whistles, pause, repeat;
- Simple and clear cries of "Help".

In the mountainous area, echo is used to amplify the sound.

Last but not least, knowledge of *first aid* techniques is essential. In case of cuts, fractures or other accidents, the knowledge of using a first aid kit can save one's own life or that of fellow travellers. On any trip it is necessary to take a well-equipped first aid kit and to know how to use each element of it (https://outdoorlife.ro/supravietuire-in-padure-tehnici-si-sfaturi-esentiale/).

The first aid kit should contain:

Basic materials: sterile bandages and gauze, leucoplast, patches or adhesive tape, small scissors, tweezers, disposable gloves.

Basic substances: antiseptic solution (betadine, alcohol), ointment for burns, essential medicines, analgesics, antihistamines, salt and sugar for rehydration solutions.

Most people don't even think of essential survival techniques as something they need to acquire. They have the impression that they will never be in emergency situations, but the point is that we don't plan to wake up in their midst, it just happens and we should always be prepared.

3. Conclusions

1. Emergency and/or crisis training is a process that consists of preparing people for a possible random event that could occur at any time.
2. When an event occurs that can endanger life and health, it is necessary to know the essential survival techniques.

3. Knowing the main elements of survival is essential nowadays and refers to procuring water and food, lighting fires, building a makeshift shelter, keeping a positive mental attitude.
4. Emergency situations are life-threatening, so they must be taken seriously, anticipated, prevented and combated, in order to function properly, both on a personal level and on a societal level.

Bibliography

1. Derlogea Ș., Manual de Supraviețuire, Editura Amaltea, 2002.
2. https://www.magazinoutdoor.ro/blog/tehnici-esentiale-de-supravietuire-in-natura/
3. https://outdoorlife.ro/supravietuire-in-padure-tehnici-si-sfaturi-esentiale/
4. https://ro.wikipedia.org/wiki/Situa%C8%9Bie_de_urgen%C8%9B%C4%83

MEANS OF GETTING THE ADULTS INTO FITNESS CLUBS

Serghei Stratulat

Moldova State University, Institute of Physical Education and Sport, Chisinau, Republic of Moldova

Abstract

The purpose of the research is to substantiate the trends, potential and prospects for the development of fitness services in the Republic of Moldova as a means of attracting the adult population to practice physical education. Research methods and organization. The research methods that we used were content analysis of literary sources and statistical data, synthesis, generalization, and survey. In order to achieve the objectives of the study, from January to March 2022, we conducted a questionnaire survey with people who were engaged in 5 fitness clubs from Chisinau. 200 people aged between 30 and 40 participated in the survey. We developed a questionnaire of 10 questions aimed at determining the age of the respondents, the frequency of visits to fitness clubs, the reasons, the suitable time of training, enjoyment. In addition, during the same period, a survey was conducted on 200 people aged between 30 and 40 who are not involved in physical culture. We developed a questionnaire of 15 questions. The following factors were determined: age; reasons that prevent physical education training; factors that can encourage people to exercise. The statistical processing of the obtained data was carried out using the SPSS 20 program. Results and discussions. In the Republic of Moldova, as well as abroad, the trend of intensive development of the fitness industry has decreased significantly (decrease in the number of clients, closure of small fitness clubs, decrease in income). The potential of fitness centers is due to the ability to satisfy the need for physical activity through the variety of means offered to the client and loyalty conditions.

Reasons for denying fitness services: lack of time, high-profile locations of fitness centers, high cost of services, health status. The prospects of getting into adult population to classes in fitness centers are possible due to the increase in the number of fitness clubs, the price reduction of gym membership, building corporate sports, inferring social taxes. Conclusion. The progressive development trend of the fitness industry experienced a strong negative pandemic impact both in the Republic of Moldova and abroad. Fitness centers in the Republic of Moldova are a profitable area where the working age population is the main consumer of fitness services. The main age contingent of people (working age population) was identified; the potential of fitness centers as a means of attracting the adult population to physical education and their development perspectives were evaluated. We have come to the conclusion that the fitness industry is a socially oriented industry for providing physical culture and wellness services to the population.

Keywords: *physical education, fitness club, adult population, fitness industry, physical activity.*

Introduction

Currently, the state pays special attention to strengthening the health of the population, using the potential of physical culture and sports for these purposes. The federal project "Sport is the norm of life" of the national project "Demography" foresees an increase until 2030 in the proportion of the population systematically involved in physical education and sports. In this case, it becomes important to involve different categories of the country's population in active physical exercises and physical activity (Budevici–Puiu, Braniște, & Popa, 2020). It is believed that the majority of this indicator is made up of schoolchildren and students involved in

systematic physical education classes in educational institutions. At the same time, the adult population often remains outside the process of systematic physical education.

One of the most popular and acceptable means of meeting the motor needs of the working population is exercise in fitness clubs, which, as a result, arouses scientific interest.

Many authors (Budevici–Puiu et al., 2020; Cârstea, 1993) have studied the structure and content of the fitness services sector, the regulatory framework for the activities of fitness centers and the analysis of the fitness services market in the Republic of Moldova. The social significance of fitness, economic, aspects of the development of fitness centers, management issues of sports organizations and fitness clubs are reflected in the works (Dorgan et al., 2016; Stratulat, Budevici–Puiu A., & Bulai, 2021). The issues of fitness service quality, ease of service, management, marketing of fitness centers and motivation of the population to engage in fitness are presented in the works of foreign authors. Dumitriu G. and Cirstea G. define fitness centers as organizations that provide services for sports activities, whose task is to satisfy the interests of society in physical education and communication based on the participation of the population in sports events (Dumitru, 1997; Stratulat, Budevici–Puiu, & Dorgan, 2022). According to the International Fitness Association IHRSA (International Health, Racquet & Sports club Association), the volume of the fitness industry in the United States in 2O19 in monetary terms amounted to 35 billion dollars in 2O19, fitness clubs provided their services to 64.2 million of customers (compared to Europe - 52 million). In 2020, industry revenue has dropped significantly. After 10 years of steady revenue growth, the US fitness industry lost $20.2 billion in revenue compared to 2019 and $29.2 billion from March 2020 to June 2021. In Europe, we are talking about a market of 32 .1 billion dollars. In 2O21, the total number of health clubs in the USA was 32.269.

Thus, in the Republic of Moldova and abroad, the 5-year development trend of the fitness industry during the pandemic not only stopped, but also significantly decreased in all indicators (number of involved clubs (clients), monetary income). In our country, before the pandemic, according to the National Fitness Community, the industry was growing (although the contribution of the Republic of Moldova is estimated at no more than 2-3% of the global volume): at the end of 2019, the total volume of the domestic sports market was the activity and services including the market for sports equipment and nutrition. The number of customers who frequented fitness centers in 2019 was estimated at a high number. In 2020, 500 fitness facilities operated in the Republic of Moldova, including 100 large multifunctional clubs; the industry provided jobs for 450 employees. At the same time, the fitness industry develops predominantly in large cities, which indicates its geographical diversification. On average, in cities with a population of one million, there are 14 gyms per hundred thousand people. The average cost of a visit in the Republic of Moldova is approximately 350 lei. The COVID-19 virus pandemic has significantly

affected the fitness industry in Moldova. Despite the initial positive outlook and the fact that the fitness industry was one of the few businesses to see growth in 2019, the industry has faced a number of challenges as a result of the pandemic. According to estimates from the Association of Fitness Industry Operators (AFIO), the fitness industry lost 20% of people and approximately 30% of gross revenue at the end of 2020. Fitness club revenue in the first quarter of 2021 was 10% lower compared to the same period in 2019. The pandemic crashed the market when many fitness clubs (mostly small market actors) were forced to close. The blockade lasted from five months to a year, depending on the region. During this period, the Moldovan market lost approximately 50 billion lei. During the pandemic, there was a flow of customers to online platforms (5-6% of the market), and in the summer - to open areas.

In 2020, the sales decline ranged from 30 to 40%. By the end of the year, this figure had reached 28.1%. The analysts of the online service have calculated that in the cities of the Republic of Moldova with a population of less than 500 thousand inhabitants, the number of fitness centers by 2022 has decreased by 200 facilities. By comparison, in 2023, 65 new units were opened in the Republic of Moldova only between March and December. Thus, in the Republic of Moldova, as well as abroad, in recent years the trend of intensive development of the fitness industry has decreased significantly (clients leaving, closure of small fitness clubs, decrease in income). The pandemic has had a negative impact on the health of the population directly and indirectly: through an industry potentially associated with improving its health. This updates the topic of our research and determines the search for experimental work: what is the potential and prospects for the development of fitness services in Moldova, the subjective attitude of the population towards it as a means of attracting physical education in the current reality.

2. Material and method

Content analysis of references and statistical data, synthesis, generalization, as well as empirical methods such as surveys and questionnaires were used as research methods. In order to achieve the objectives of the study, in January-March 2022, we conducted a questionnaire survey of those involved in 5 fitness clubs in Chisinau. 200 people aged between 20 and 40 participated in the survey. We developed a semi-closed questionnaire of 10 questions aimed at determining the age category of the participants, the frequency of visits to fitness clubs, the reasons for visits and the convenient time for training. Furthermore, during the same period, a survey (interview) was conducted with 200 people aged from 20 to 40, not involved in physical education. We developed a semi-closed questionnaire consisting of 15 questions. The following were determined: age; reasons that prevent physical education; factors that can motivate you to exercise.

3. Results and Discussion

Currently, there is an increasing need to pay attention to the management mechanisms of the development process of the fitness industry and, consequently,

the motivation of each category of athletes. This is especially clear during a pandemic for the older age group.

In 2020, the National Fitness Community, as part of achieving the goals set by the project, "Sport is the norm of life", implemented the project "Physical Education for the Mass!" , whose goal was to increase the availability of fitness services for middle-aged and older Moldovans. This project made it possible to attract more than 29 thousand Moldovans who had not previously been involved in sports to systematic exercises in 2022, and the number of participating clubs was 250. Before the pandemic, 1 million people in the Republic of Moldova were engaged in fitness - about 15% of the country's population. During the implementation of the project, 190 master courses were held in open areas of the cities of the Republic of Moldova: in parks, stadiums and central squares - with personal testing and consultations with the population regarding maintaining a healthy lifestyle. 90% of project participants decided to continue to systematically engage in physical education. Among them, there are also elderly and middle-aged people. Thus, fitness is a socially oriented industry, where many operators form separate groups for the elderly and create the most affordable price conditions. We analyzed the age group of visitors to fitness clubs: 30% - the working age population aged 19-64 years (25-40 years - 50%, 55-64 years - 7%), while 13% among young people aged 19-24.

A significant flow of visitors is observed mainly in the afternoon (the so-called prime-time), which lasts between 18.00 and 23.00). This can be explained by the fact that 70% of customers are at work or school until 17.00-18.00. However, there are categories of trainees who come to fitness centers in the first half of the day - people with flexible hours and retirees. A significant number of fitness centers open around 8:00 a.m. on weekdays, which allows some full-time clients to have time to be physically active in the morning.

Group programs are often designed to accommodate uneven distribution of visitor flow. Thus, group martial arts classes and intense strength training are more likely to take place after 6pm, while gentle classes (Pilates, some types of yoga) can be held an hour earlier. In our survey, respondents were asked to answer several questions: how often do they visit fitness clubs, why do they do it, what time of day is more convenient for them to exercise. The group consisted of 100 people. The graph shows the percentage of people who visit fitness clubs, indicating the reasons why they use this service (Figure 1).

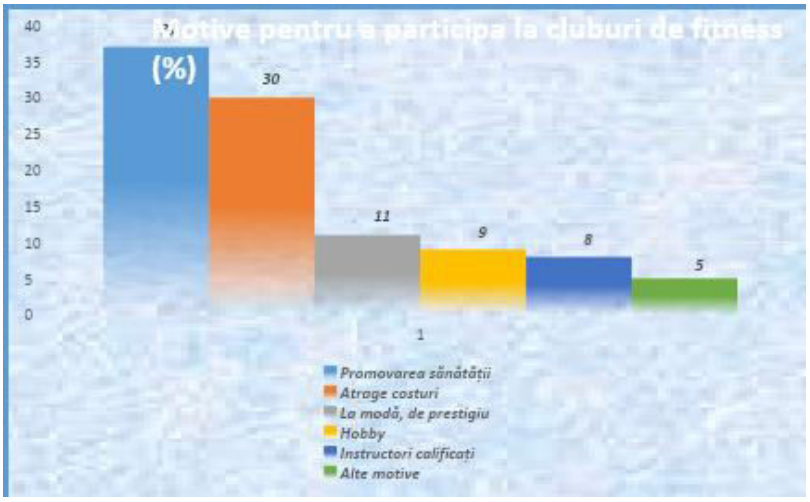


Fig.1. Reasons to participate in fitness clubs

Accordingly, the graph shows the reasons why respondents (100 people) do not visit fitness clubs (Figure 2). According to our research, most people now visit fitness centers to maintain their health. These are mainly people between 20 and 40 years old who do sports on average 2-3 times a week for 60 minutes.

Clients of fitness centers noted that the classes satisfy the need for physical activity. The advantages are: choice of time, programs (from simple - for beginners to complex), forms of courses, material and technical basis, emotional factor, professionalism of instructors. In their opinion, meeting loyalty conditions for visitors (discounts, installment payments, subscription freezes, etc.) now becomes promising. Among those who do not do sports, most adults are adults who do not have enough free time for this type of activity. Respondents also mentioned that their financial situation does not allow them to visit fitness clubs. They agree to practice sports if the membership will cost between ***300 and 500*** lei per month, excluding transport costs.

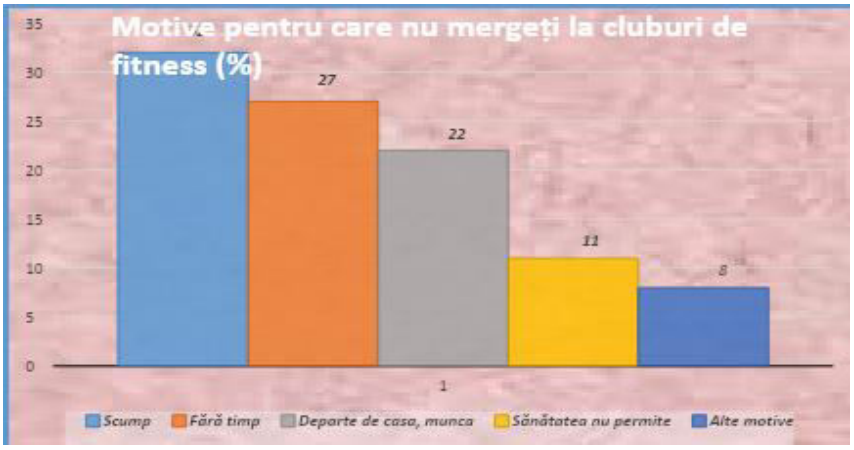


Fig. 2. Reasons why you do not visit fitness clubs

Our data match with the research from the National Fitness Society: about 7% of people aged 60-70 frequented fitness clubs twice a week before the pandemic while 64% of people over 60 have wanted to exercise regularly for years but haven't had the opportunity due to the lack of a nearby sports and recreational facility, the ability to pay for training, as well as significant health issues.

The research results suggest the presence of a systemic problem, which has worsened even more during the pandemic: on the one hand, there is a lack of free time and a decrease in purchasing membership, but for representatives of fitness, business, cost optimization, negotiations with owners on the most acceptable terms on the other hand — achieving national indicators is impossible without the conscious need of the adult population for regular physical education. Resolving this contradiction is possible with government and corporate support. In the first case, a deduction of the social tax for the population is provided, confirming the expenses for physical education and health services. The second is the development of corporate sports, which becomes one of the priority areas of activity for the involvement of the adult population in physical education and systematic sports. This form of cooperation requires the employer to pay the organization's employees the full or partial cost of classes in a fitness club. The organization receives a wide range of corporate services for various types of physical education and health activities.

4. Conclusion

The trend of ten years of consistent progressive development of the fitness industry has experienced a strong negative impact of the COVID-19 virus pandemic both abroad and in the Republic of Moldova.

The sports services market in the Republic of Moldova is completing its development stage. Fitness centers are a profitable area in the private sector, where the main source of profit is visitors, because the amount of cash receipts of the organization depends on their number. The main consumer of fitness services is currently the working age adult population.

The research conducted made it possible to determine the potential of fitness centers in attracting the adult population to physical education and sports: fitness clubs satisfy the need for physical activity of the adult population through a variety of means and the freedom of choice of customers: choice of time, programs (from easy - for beginners, to complex), forms of training, material and technical basis, emotional factor, professionalism of instructors, loyalty conditions for visitors (discounts, payment in installments, "freezing" of a membership, etc.). The reasons for refusal of fitness services by the active adult population were identified: lack of time, distance from fitness centers, high cost (according to respondents) of the service, health condition.

The study made it possible to establish the prospects for attracting the adult population to exercise in fitness centers: increasing the number of fitness clubs (will allow visitors to save time exercising), reducing the price of membership, developing corporate sports (the employer pays the full or partial cost of hours in a fitness club

to employee organizations), deduction of social tax confirming expenses for physical education and health services. After the study, we came to the conclusion that the fitness industry is a socially oriented industry that provides physical culture and health services to the population, and the development of fitness clubs can solve the problem of involving the adult population in systematic physical education and sports, strengthening their health and increasing work longevity.

Bibliography

1. Budevici–Puiu A., Branişte Gh., Popa G. (2020). Management aplicat în știința sportului și educației fizice. Chişinău : USEFS, (Tipogr. "Valinex"). – 163 p.
2. Cârstea, Gh, (1993). Teoria şi metodica educaţiei fizice şi sportului. Editura Universul, Bucureşti
3. Dorgan, V., Liuşnea, C.Ş., Gheorghiu, A. (2016). Rolul mijloacelor din fitness în realizarea obiectivelor de dezvoltare fizică la adolescenţi. În: Sport. Olimpism. Sănătate: Materialele Congresului Ştiinţific Internaţional. Chişinău: USEFS, p. 441-447.
4. Dumitru, G., (1997), Sănătate prin sport pe înţelesul tuturor, Bucureşti, Editura Federaţia Română Sportul pentru toţi.
5. Stratulat S., Budevici–Puiu A., Bulai V. (2021). Managementul organizațiilor de educație fizică și sport Chișinău: S.n., Tip. „Valinex". – 244 p.
6. Stratulat S., Budevici–Puiu A., Dorgan V. (2022). Managementul organizațiilor de cultură fizică și sport Materialele Congresului Științific Internațional,, Sport. Olimpism. Sănătate", Ediția a VII-a, 15-17 septembrie 2022. Chișinău: USEFS, 2022, pp. 296-301.

INTEGRATION OF A DIGITAL EDUCATIONAL PLATFORM FOR OPTIMIZING THE TEACHING PROCESS IN PHYSICAL EDUCATION AND SPORT LESSONS IN PRIMARY SCHOOL

Alina Petruța Țurcanu[1]

[1]*State University of Physical Education and Sport, Andrei Doga Street 22, Chisinau Republic of Moldova*

Abstract

In the context of digital transformations in education, the implementation of an educational platform dedicated to physical education and sport lessons in primary education facilitates the improvement of the pedagogical process by integrating advanced technological tools for continuous assessment of student performance, personalization of learning and promotion of a more effective education tailored to their individual needs. The hypothesis of this study assumes that the use of a digital educational platform in physical education lessons in primary school will improve the learning process, increase student motivation and optimize the methods of physical performance assessment. The objectives of the paper include analyzing the effectiveness of the educational platform in teaching and assessment, identifying the impact of technology use on student engagement, and comparing traditional and digital methods. The use of digital educational platform in physical education and sport lessons demonstrated an increase in student motivation and engagement and provided more accurate assessments. Teachers benefited from an efficient tool for managing and analyse student performance. The integration of technology in physical education contributes to the modernization of the school curriculum, adapting it to the needs of students in the digital age, and the implementation of digital educational platforms requires continuous training of teachers for the optimal use of available resources.

Key words: *physical education, digital educational platform, information technologies, primary school.*

1. Introduction

The digital transformation of education is an essential process for adapting the education system to the demands of contemporary society (Cucoș, C., Pânișoara, I. O., Istrate, O., Ceobanu, C., 2022).

In this context, the use of digital educational platforms in physical education and sport lessons is becoming a necessity, with the potential to improve both teaching and assessment. Digital technologies enable continuous and objective assessment of students' performance, facilitating personalization of learning and increasing their motivation to actively participate in physical activities (Casey, A., Jones, B., 2011, p. 51).

Physical education is essential for the harmonious development of pupils, but traditional teaching and assessment methods can have limitations in terms of objectivity and effectiveness of the educational process. Recent studies show that the use of digital technologies in physical education can improve student motivation and performance. For example, research shows that the implementation of digital educational applications increases learning motivation and performance of primary

school students (Doman, M. E., 2024, p. 15; Țurcanu, A. P., 2024, p. 103).

The integration of a specialized educational platform can contribute to the modernization of the curriculum, providing advanced tools for monitoring progress and adjusting teaching strategies according to the individual needs of students (Juniu, S., Shonfeld, M., Ganot, A., 2013, p. 1).

In addition, the increased accessibility of digital resources and real-time feedback allow for better management of teaching activities and optimization of the time allocated to administrative processes (Hilvoorde, I. V., Koekoek, J., 2018, p. 54).

The transition of physical education to the online environment has created both opportunities and major challenges. Online platforms have made interactive and tailored lessons possible, but the lack of adequate space and the difficulty of proper monitoring have affected the effectiveness of activities. Online physical education cannot replace traditional lessons, but can become a valuable complementary element in modernizing the educational process (Augustin, I., Ologeanu, N., Croitoru, D., 2021, p. 223; Lungu A. C., 2023, p. 215).

The integration of digital educational platforms in physical education in the primary cycle not only modernizes the curriculum, but also provides advanced tools for monitoring progress and adjusting teaching strategies according to the individual needs of students (Stoica, A. L., 2022, p. 18)

In this article, we will analyze the impact of the use of implemented digital educational platforms on students' motivation and involvement in physical education lessons, as well as the effectiveness of these tools in facilitating the teaching and assessment process. We will also compare traditional and digitally assisted methods to highlight the differences in student performance and propose strategies for integrating technology into the physical education and sport curriculum at primary level.

2. Material and method

The research was conducted at Technological High School "Iorgu Vârnav Liteanu", Liteni during the school year 2023-2024 and included a group of 48 students from 4rd grade A and B, divided into two groups, the experimental group (24 students, from 4rd grade A, 12 girls, 12 boys) and the control group (24 students, from 4rd grade B, 12 girls, 12 boys). The experimental group participated in the physical education lessons using the digital educational platform specially designed for sports activities and monitoring the physical progress of students, while the control group followed the physical education lessons using traditional methods without digital support.

The research hypothesis assumes that the integration of a digital educational platform in physical education lessons in primary school will lead to an increase in student motivation and involvement, optimize the methods of physical performance assessment and improve the learning process compared to traditional methods.

Several scientific methods were used to carry out the research: specialized bibliographical study method, direct observation method, pedagogical experiment

method, survey method, test method and method of interpretation and information processing.

The tests applied were standardized tests to assess basic motor skills: *30 m sprint running, endurance running, standing long jump* and *mini handball - simple game structure*. These tests were applied both at the beginning and at the end of the experiment in order to identify and compare the progress of the students in the two groups.

The experimental procedure included the use of a digital educational platform in physical education lessons for the experimental group, providing video resources, interactive worksheets and progress reports. Lesson content was tailored according to student performance, supporting personalized learning. The control group followed the lessons using traditional methods without digital support. Comparison of results and feedback analysis showed the positive impact of technology on motivation, engagement and physical performance of primary school pupils.

3. Results and Discussions

The analysis of the data collected following the application of motor tests and questionnaires revealed significant differences between the experimental group, which used the digital educational platform, and the control group, which completed physical education lessons using traditional methods.

Table 1. *Centralization of statistical results*

Subjects		**Sample**											
		Sprint running, 30 m			**Endurance running, 3 min.**			**Standing long jump, m**			**Mini handball - simple game structure, s**		
		X	+/- S	Cv %	X	+/- S	Cv %	X	+/- S	Cv %	X	+/- S	Cv %
24 students, experimental group	T. I.	5,68	0,46	8,19	364,79	35,79	9,81	132,16	12,34	9,33	12,93	5,05	39,37
	T. F.	5,07	0,43	8,53	411,66	34,15	8,29	147,37	12,70	8,61	10,66	4,16	39,07
	D.	*0,61*	*0,03*	*0,16*	*46,87*	*1,64*	*1,52*	*15,21*	*0,36*	*0,72*	*2,27*	*0,89*	*0,3*
24 students, control group	T. I.	5,65	0,47	8,36	363,12	37,35	10,28	131,95	12,57	9,52	12,94	5,19	40,08
	T. F.	5,62	0,42	7,63	372,08	37,78	10,15	132,75	12,22	9,20	12,78	5,10	40,06
	D.	*0,03*	*0,05*	*0,73*	*8,96*	*0,43*	*0,13*	*0,8*	*0,35*	*0,32*	*0,16*	*0,09*	*0,02*

Table 1 centralizes the results obtained after the application of the physical tests to the two experimental groups. Comparing the two groups, it can be seen that the students in the experimental group, who benefited from the application of

information technology, made significant progress compared to those in the control group, who followed the standard curriculum and conducted their lessons using traditional methods.

In the *sprint running* test, the experimental group managed to decrease their average time from 5.68 seconds to 5.07 seconds, an improvement of 0.61 seconds. The control group, on the other hand, achieved an insignificant decrease of only 0.03 seconds, from 5.65 seconds to 5.62 seconds. These results show that the program applied in the experimental group had a significant impact on speed development, while in the control group the progress was almost non-existent.

In the *endurance run*, the experimental group increased the distance covered from 364.79 meters to 411.66 meters, i.e. an improvement of 46.87 meters. In comparison, the control group had a much smaller increase of only 8.96 meters, from 363.12 meters to 372.08 meters. The major difference between the two groups shows that the intervention applied in the experimental group contributed substantially to the improvement in overall endurance, while the control group remained almost at the same level.

In the *standing long jump*, the progress of the experimental group was also much more evident, as they managed to improve their performance from 132.16 centimeters to 147.37 centimeters, an improvement of 15.21 centimeters. In the control group, progress was insignificant, only 0.8 centimeters, from 131.95 centimeters to 132.75 centimeters. This confirms that the intervention applied in the experimental group had a beneficial effect on the development of explosive force, in contrast to the control group, where the lack of additional methods led to stagnation.

Regarding the *mini handball - simple game structure*, in the experimental group a decrease in the average score from 12.93 points to 10.66 points was observed. This decrease may indicate a more efficient game structure with fewer mistakes and better organization. In the control group, the result remained almost unchanged, from 12.94 seconds to 12.78 seconds, indicating that without a specific intervention, the students' playing skills did not improve significantly. The comparative analysis between the two groups shows the superiority of the progress made by the pupils in the experimental group in all the tasks tested.

The greater differences in progress recorded by the experimental group are attributed to the use of the educational platform, which allowed constant monitoring of performance and individualized adaptation of exercises according to the level of each student.

The results of the questionnaire administered at the end of the experiment to the pupils in the two groups confirm a higher level of motivation and involvement among pupils in the experimental group. More than 85% of the pupils in this group stated that their physical education lessons were more engaging thanks to the interactive materials and personalized feedback provided by the platform. In contrast, only 43% of pupils in the control group said that physical education lessons consistently captured their interest. The distribution of responses on the attractiveness of physical education lessons for the two groups is shown in Figure 2.

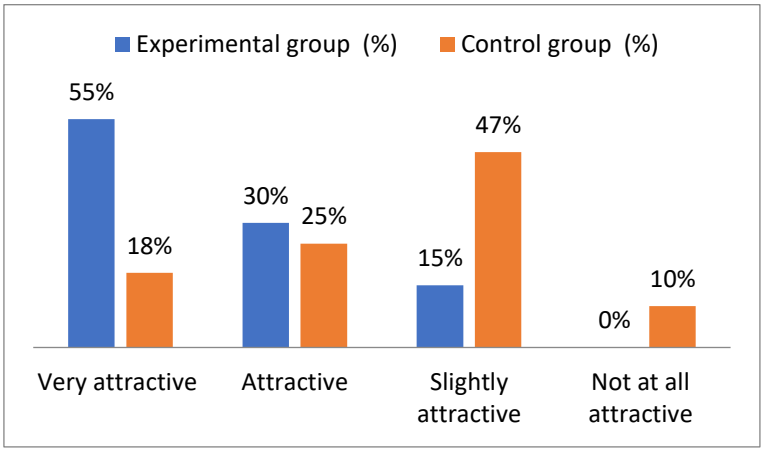


Figure 2. *Distribution of responses on the attractiveness of physical education lessons among pupils at the end of the experiment*

In the experiment we noticed a greater empowerment of students in the self-assessment process and an increased interest in personal progress, thanks to the reports and rankings automatically generated by the platform.

Direct observations revealed more active engagement and collaboration between students during digitally assisted activities.

The results are in line with previous studies (Casey, Jones, 2011; Juniu, Shonfeld, Ganot, 2013; Lungu, 2023; Stoica, 2022, Țurcanu, A. P., 2024), which emphasize the positive potential of technology in increasing the attractiveness of physical education lessons and improving physical performance in primary school students.

The significant differences between the experimental and control groups confirm that the integration of digital educational platforms not only modernizes the teaching process, but also contributes to the development of better motor skills, along with increasing students' motivation and active involvement.

We believe that the use of interactive materials, demonstration videos and progress monitoring apps provided the students in the experimental group with greater clarity about the requirements and objectives of each lesson. This was also evidenced by the students' questionnaire responses, which emphasized that being able to visualize their own performance and receive personalized feedback was an important factor in maintaining motivation throughout the experiment.

4. Conclusions

The study has shown that the integration of a digital educational platform in physical education and sport lessons in primary school contributes significantly to the optimization of the instructional-educational process, by modernizing the methods of teaching, evaluation and monitoring of student progress.

A comparison of the performances of the experimental group, which benefited

from the use of the educational platform, with those of the control group shows significant improvements in most of the motor tests evaluated. Pupils in the experimental group showed an increased interest in physical activities and increased motivation due to the interactive, engaging and personalized nature of the digitally assisted lessons.

The use of digital technologies allowed an objective and detailed evaluation of the students' progress, providing both teachers and parents with access to individualized reports, thus facilitating a continuous feedback process and the adaptation of the didactic content according to the needs of each student.

The implementation of the educational platform has also led to an increase in pupils' involvement in physical activities by introducing gamification and self-assessment elements, which have turned physical education lessons into attractive and motivating experiences.

The obtained results confirm the research hypothesis that the integration of a digital educational platform contributes to improving the learning process, increasing motivation and optimizing the methods of assessing physical performance in primary education.

Thus, it is recommended to expand the use of digital educational platforms in physical education and sport lessons, along with continuous training of teachers for the effective use of available technological resources.

Bibliography

1. Augustin, I., Ologeanu, N., Croitoru, D., Opportunities and constraints in online physical education, *Discobolul – Physical Education, Sport and Kinetotherapy Journal*, Volume 60, Issue 3, pg. 223-231. https://doi.org/10.35189/dpeskj.2021.60.3.2
2. Casey, A., Jones, B., (2011) Using digital technology to enhance student engagement in physical education*, Asia-Pacific Journal of Health, Sport and Physical Education*, 2(2), pg. 51-55. http://dx.doi.org/10.1080/18377122.2011.9730351
3. Cucoș, C., Pânișoara, I. O., Istrate, O., Ceobanu, C., (2022), *Educația digitală*, Ediția a II-a revăzută și adăugită, Iași: Editura Polirom, ISBN 9789734689385.
4. Doman, M. E., (2024). Impactul utilizării aplicațiilor educaționale digitale asupra elevilor de clasa pregătitoare. *Revista de Pedagogie Digitală*, 3(1) pg. 15-23, București: Institutul pentru Educație. https://doi.org/10.61071/RPD.2493
5. Hilvoorde, I. V., Koekoek, J., (2018). *Digital technologies: A challenge for Physical Education*, In: Changes in Childhood and Adolescence: Current Challenges for Physical Education, Publisher: Logos Verlag Berlin, pg. 54-63. https://www.researchgate.net/publication/328768497_Digital_technologies_A_challenge_for_Physical_Education
6. Juniu, S., Shonfeld, M., Ganot, A., (2013), Technology integration in physical education teacher education programs: a comparative analysis, *Actualidades Investigativas en Educación*, 13(3), pg. 1-22.

http://dx.doi.org/10.15517/aie.v13i3.12044

7. Lungu, A., C., (2023), Impactul predării educației fizice și sportului în format online la elevii ciclului primar -demers investigativ. *In: Probleme actuale ale teoriei şi practicii culturii fizice,* Ediția 1, Chişinău., 2023, pg. 215-222. ISBN 978-9975-68-530-6. https://ibn.idsi.md/vizualizare_articol/219422
8. Stoica, A. L. (2022). *Beneficiile utilizării platformelor e-learning în predare-învățare*. Arad: Editura Școala Vremii, pg. 18. ISBN 978-606-9067-80-2.
9. Țurcanu**,** A. P. Impact of information technology on physical education in primary education. In: *The Annals of the "Ştefan cel Mare" University of Suceava. Physical Education and Sport Section*. The Science and Art of Movement, vol. XVII issue 2, 2024, p. 103-111, ISSN 1844-9131, eISSN 2601 - 341X. https://doi.org/10.4316/SAM.2024.0211

THE ROLE OF MANAGEMENT IN THE WORK OF THE PHYSICAL EDUCATION TEACHER

Gheorghe Volcu
Moldova State University, Institute of Physical Education and Sport, Chisinau, Republic of Moldova

Abstract. This article reflects management in the activity of the physical education teacher. The term management, initially used by economists, has expanded into many fields, including the educational system, because it has demonstrated its usefulness in terms of planning, controlling actions and their orientation in social activity.

Effective management is conditioned by the knowledge of the teaching staff, the mastery with which the teacher imprints the teaching act and the traits of his own personality. Theoretical and methodological elements intertwine with personal experience and talent, aiming at the efficient achievement of objectives by operationalizing all resources within the physical education lesson.

Success in classroom activity depends greatly on the applied management, which must come according to the curricular standards and the inner source of the person. The teacher has a greater chance of success if he knows how to make himself liked and respected by the students. Based on the professional and scientific prestige, following the development of good relationships with the students, the teacher also obtains an informal authority.

Following the research, we can conclude that management plays an important role in the activity of the teaching staff and requires a scientific-practical approach, based on studies and useful examples, in order to achieve the set goals.

Key words: *management, physical education, teacher, pupil, activity.*

1. Introduction

Theoretical and practical developments in the field of management have modified the referential area of the term, currently being used in various fields and referring to various subjects, starting from economic activities and ending with human issues.

According to the dictionary (Saineanu, L. 1998), management is the set of activities for organizing, leading and managing enterprises.

The concept of management signifies both the leadership, administration and management of the unit, as well as a certain way of directing its resources, among which people occupy a primary place, in order to achieve goals or objectives.

Therefore, management directs the organizational system in the context of a dynamic environment, aiming for efficient and effective functioning.

From the educational perspective of the term of management, we found, according to M. Zlate (2004), that the managerial processes in education are differentiated from other social sectors by the fact that in the educational process, leadership is carried out directly on the personalities in training of children and young people. And if in industry, waste can be reconditioned and reintroduced into the economic circuit (the losses not being too significant), in education, the failures recorded in the training process can have negative individual and social consequences: incompetence, illiteracy, and inadequacy, delinquency, the author

claims. As L. Zastinceanu (2017, p. 10) claims, only in classroom management are the relations between the manager (teacher) and subordinates (students) not regulated by an employment contract of the subordinates, which would establish what they should do in the classroom and what not. The management of the student class is subordinated to activities that arise from the teacher's competences, a variant of which for the Republic of Moldova is stipulated in the Standards of Competence of Teachers in General Education (2018). On the other hand, students are to fulfill their school obligations, which, although prescribed in the school statute, are not strict in nature, with few penalty effects.

In the field of education, management has crystallized into a science that shapes human personalities according to the purposes required by social order.

Educational management is neither developed nor applied in isolation from the other components of the system. In achieving educational objectives, management integrates and adapts data provided by many other disciplines related to the field of physical education and sport: Economics, Psychology, Sociology, Marketing, Information and Communication Technology, Ethics, Deontology, etc.

Management in the physical education lesson aims at the teacher's activity by providing students with the theoretical and practical tools to carry out physical education lessons in the best conditions by becoming aware of and assuming responsibility for successes and failures.

The physical education lesson, the extracurricular activity, the students' free time require and impose a lively and active, permanent and interesting presence on the part of the physical education teacher, a quality in which the profile of a leader, of a manager of the students is manifested. Few teachers have the special opportunity of the specialized teacher, to be among the students for a long time (vacations, camps, etc.), to influence them, instructive and educational, not from the chair and in the classroom, but from direct contact with them, in the middle of nature and in activities beloved by them. For this, the physical education teacher must permanently be a professional example, with a perfect general and specialized culture and with extensive knowledge of management.

The belief of the physical education teacher must be the raising of generations of healthy, socially integrated students, accustomed to practicing physical exercises in their free time, capable of carrying out efficient activities in and outside of school.

Although in most cases experience in management theory issues is lacking, physical education teachers must at least know the major theories of organizational behavior in order to be able to maximize their knowledge, authority and leadership attributes – essential components of their personal and professional profile. Often, physical education teachers are responsible for organizing and carrying out programs that involve substantial budgets and a large staff, such as friendly games between several teams practicing a certain sports event (football, basketball, volleyball, handball, etc.), or competitions of different levels. Until recently, intuition and direct practical experience were their only tools for solving administrative problems. The formal study of the principles on which a sound managerial practice is based should

help physical education teachers to better solve their tasks (Ursanu G., Budevici A., Ursanu V. 2008; Budevici-Puiu L., Manolachi V. 2016).

The purpose of the research is to study the role of management in the activity of the physical education teacher.

2.Material and Methods

The article consisted of analyzing the role of management in the work of the physical education teacher.

For this, we used the following research methods: theoretical analysis, survey method, interview, observation, statistical-mathematical method, graphic method.

Data collection was carried out by developing a questionnaire and filling it out by students, future physical education teachers. Participants were asked to provide an answer for each item. For this, respondents were given general instructions on how to fill out the questionnaire, as well as the use of the data provided by them.

At the same time, an analysis of some bibliographic sources was carried out to create the possibility of documentation regarding the topic addressed.

3. Results and discussion

To conduct an analysis on the topic, we conducted a study on statistical data and a sociological survey, where the following results were obtained:

When asked if they were familiar with the notion of educational management, 81.24% of respondents answered affirmatively, while 7.61% said no, and for 11.15% it was difficult to answer this question.

From the responses received, we find that most respondents know what education management is, which demonstrates theoretical training in the field (Fig. 1).

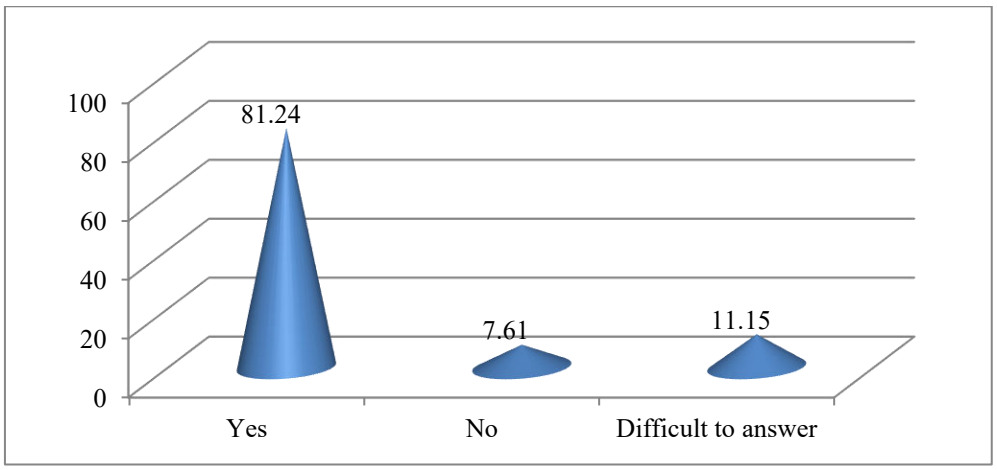


Figure 1. *Percentage distribution of responses regarding familiarity with the notion of education management*

As S. Cristea (2002) argues, educational management represents the global, optimal, strategic management activity of the education system, applicable at all its

levels, according to the general functions (organization-planning, orientation-guidance, regulation-self-regulation) and the institutional structures corresponding to them.

As a general methodology, educational management promotes a model of global, optimal, strategic approach to the pedagogical issues of personality training-development activity. Consequently, it is possible to develop conceptual maps that concentrate fundamental notions, fixed axiomatically and developed pragmatically in their interaction.

Being asked if the physical education teacher must possess managerial knowledge and skills, 95.18% answered affirmatively, 2.26% said no, and 2.56% considered it difficult to answer (Fig. 2). Analyzing these answers, we observe that the physical education teacher must possess managerial knowledge and skills.

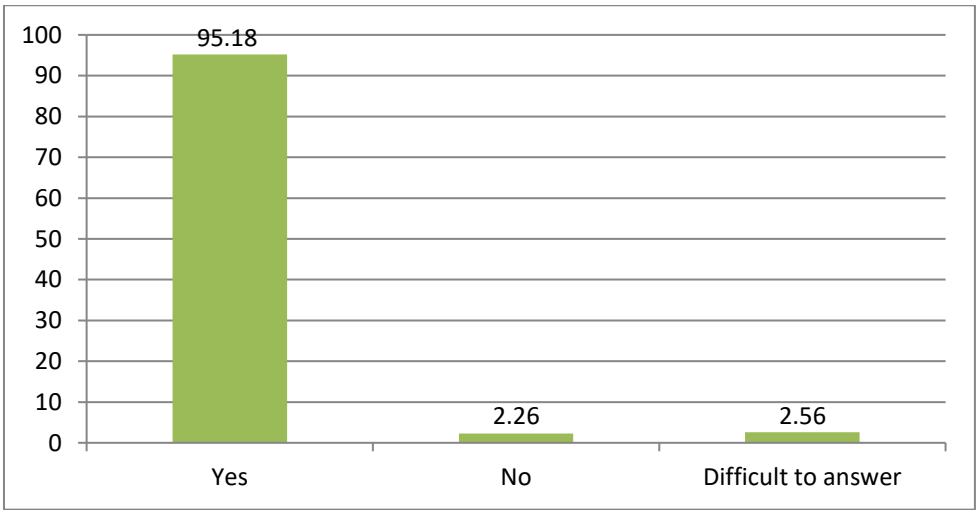


Figure 2. *Percentage distribution of responses regarding the need for managerial knowledge and skills among physical education teachers*

According to the Curriculum (2023) for the first cycle, bachelor's studies, in the field of professional training 0114 Teacher Training, for the specialty 0114.16 Physical Education, the discipline Management and Legislation in Physical Education and Sport is provided for in the fourth semester, with a total of 90 hours of which 45 are direct contact with a ratio of 1:2 in favor of practical/laboratory ones.

Thus, within this discipline, students acquire managerial knowledge and skills, which are essential in the professional activity of the physical education teacher.

Being asked what role management plays in the professional activity of the physical education teacher, 83.15% answered that it is very important, 11.35% - important, 2.26 said no, while 3.24% considered this question difficult to answer (Fig. 3). We find that management has a very important role in the professional activity of the physical education teacher, because in order to achieve the expected results, it is necessary to effectively manage the entire educational process and adapt it to any situation.

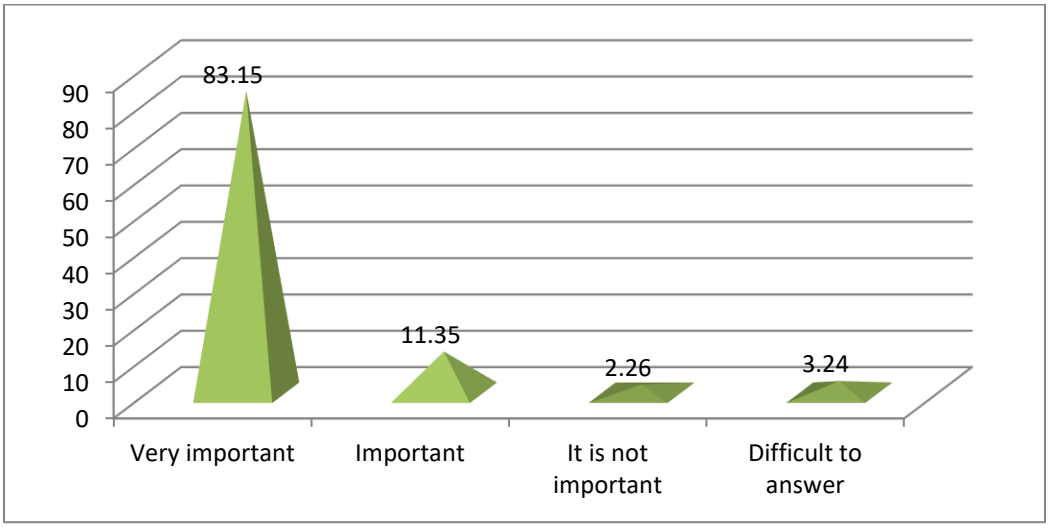


Figure 3. *Percentage distribution of responses regarding the role of management in the physical education teacher's activity*

Several researches by specialists (Stan, E. 2009; Iucu, R. 2006; Zastinceanu, L. 2017) show that during the instructional-educational activity, the teacher carries out several fundamental behaviors. The basic roles of the teacher, in terms of classroom management, are: planning, organization, communication, leadership.

- Planning or design, which involves designing the entire activity with the class in accordance with the regulatory documents: Education Code (2014), Standards for effective learning by subject, disciplinary curricula (2020), school textbook. At the same time, at the lesson design level, in the development of their own educational technologies, the teacher will also take into account the psycho-pedagogical characteristics of the class.
- Organizing a class of students, which can only be successful in a situation where, in addition to the teacher, in some situations the role of organizer is taken on by the students. The weight of this role on the part of the students will increase with their growth and awareness of their position in society and their own learning needs.
- Communication in the implementation of the educational process is essential due to the possibility of ensuring the transmission of information of all types between all its actors, in any direction: from teacher to student, from student to teacher, from student to student.
- Leadership in the situation of managing a class of students would mean directing the training and education activities of children. Adapting any pedagogical style, the teacher must still remain the leader (conductor) of the activities, being by his status as a mature, educated and specialist in the field a person who knows more about what and how to learn than all the students taken together.

Other roles that the teacher fulfills as a manager of the student class: coordination, guidance, motivation, counseling, control and evaluation complete the description of the activities carried out by the teacher in the classroom.

These roles of the teacher in his professional activity remain intact in any period of activity and the didactic technology used. At the same time, with the change in the didactic technologies used, the accents in each of these roles change: the teacher's share in the activity increases or decreases, and in some situations it changes completely.

Being asked if they consider themselves a good organizer of the physical education activities in which they are involved, 63.18% say yes, 4.12% - no, and 32.70% considered it difficult to answer (Fig. 4).

A person is considered to be a good organizer of physical education activities if he fulfills a complex role, which involves planning, coordinating and implementing programs, events and other sports activities to promote a healthy and active lifestyle. For this, he must possess essential qualities such as: solid knowledge, organizational and communication skills, creativity and adaptability, enthusiasm and passion for sport and physical activity that inspires others to active involvement.

A good organizer of physical education activities contributes significantly to improving the quality of life of people, promoting health, well-being and team spirit.

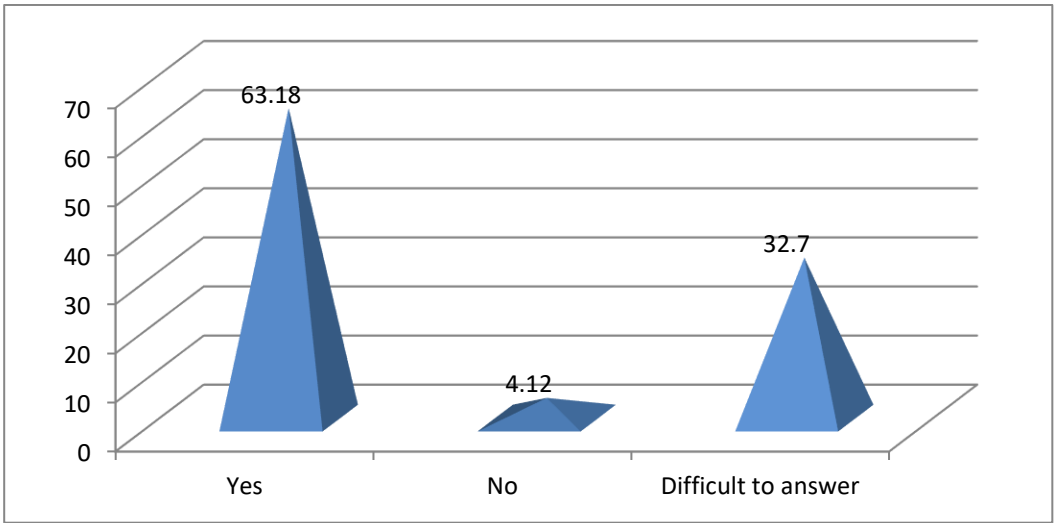


Figure 4. *Percentage distribution of responses regarding self-assessment as a good organizer of the physical education activities in which they are involved*

The physical education teacher must also be concerned with the psychological environment or climate in which his students will carry out their activity, because various misunderstandings can be created between students following the sports results during the lesson and it is necessary to modify his instructional strategies when needed and to monitor the students' activity.

There are several things that a teacher must do to create a climate in which everyone gives the highest priority to their own learning activity, in which students

feel that they have the freedom to take risks and make mistakes, a very important aspect for their long-term progress, including (Schaffer, H. 2010; Saranciuc-Gordea, L. 2023): creating in students the feeling that the teacher is understanding, humane and close, the certainty that he accepts them as they are, respects them, gives them full attention and treats them as human beings; establishing an atmosphere of order, but non-threatening; providing the feeling that they have control over the activities they are going to carry out in the classroom; creating a feeling of belonging to the instructional group.

4.Conclusions

Management plays a substantial role (94.50%) in the activity of the physical education teacher, it is an essential factor in achieving the expected results and performance, manifesting itself throughout the educational process through the exercise of managerial functions.

To achieve performance, physical education teachers must not only possess motor skills, but also have general training and acquire managerial knowledge and skills (95.18%).

Effective management contributes to the creation of an optimal learning environment, the harmonious development of students, and the achievement of educational objectives in the field of physical education and sport.

Bibliography

1. Budevici-Puiu L., Manolachi V. Management şi legislaţie în educaţie fizică şi sport. Curs universitar. Ediţia a II-a, Edit. USEFS, Chișinău, 2016. 283 p.
2. Codul Educației al Republicii Moldova" nr. 152 din 17.07.2014 Publicat: 24.10.2014 în Monitorul Oficial Nr. 319-324. Modificat LP294 din 13.12.24, MO564-568/31.12.24 art.782; în vigoare 31.01.25.
3. Cristea, S. (2002). Managementul educației. În: Revista Didactica Pro..., Nr 6 (16), Chișinău, pg. 77-79.
4. Curriculum naţional. Educaţia fizică. Clasele V-IX. Chişinău, 2020, 112 p.
5. Curriculum naţional. Educaţia fizică. Clasele X-XII. Chişinău, 2020, 108 p.
6. Iucu, R. (2006). Managementul clasei de elevi. Edit. Polirom, Iași, 272 p.
7. Plan de învățământ pentru ciclul I, studii de licență, la domeniul de formare profesională 0114 Formarea profesorilor, specialitatea 0114.16 Educație fizică, aprobat la ședința Senatului Universității de Stat de Educație Fizică și Sport, proces-verbal nr. 7 din 09 februarie 2023.
8. Saranciuc-Gordea, L. (2023). Managementul clasei de elevi (suport de curs). Edit. CEP UPSC, Chişinău, 182 p.
9. Schaffer, H. (2010). Introducere în psihologia copilului. Edit. Asociația de Științe Cognitive din Romania, Cluj-Napoca, 391p.

10. Stan, E. (2009). Managementul clasei. Edit. Institutul European, Bucureşti, 266p.
11. Standarde de competență a cadrelor didactice din învățământul general. Aprobat: la ședința Consiliul Național pentru Curriculum, proces-verbal nr. 18 din 03 iulie 2018; prin Ordinul ministrului educației, culturii și cercetării nr. 1124 din 20 iulie 2018.
12. Șăineanu, L. (1998). Dicționar universal al limbii române. Edit. LITERA. Chișinău, 1368p.
13. Ursanu G., Budevici A., Ursanu V. (2008). Modelarea şi algoritmizarea managerială a antrenamentului sportiv la grupele de începători şi avansaţi în atletism: îndrumar metodic pentru profesori. Edit. Casa Editorială Demiurg, Iaşi, 164p.
14. Zastînceanu, L. (2017). Teoriile educaționale moderne și managementul clasei de elevi, În: Materialele Conferinţei ştiinţifico-practice internaţionale „Managementul educaţional: realizări şi perspective de dezvoltare = Educational management: achievements and the development perspectives", Bălţi, Tipografia din Bălţi, pp. 10-13.
15. Zlate, M. (2004). Tratat de psihologie organizațional-managerială. Edit. Polirom, Iași, 568 p.
16. https://dexonline.ro/definitie/integra/definitii (accesat 18.03.2025).