UNIVERSITY OF BUCHAREST

DEPARTMENT OF PHYSICAL EDUCATION AND SPORT

UNIVERSITY ARENA

JOURNAL OF PHYSICAL EDUCATION, SPORT AND HEALTH

Vol. 7, issue 4, 2024

2024

Partial or integral reproduction, multiplication by any means and of any type, such as xeroxing, scanning, converting into an electronic or audio file, submitting for public use, including dissemination on the internet or through public networks, permanently or temporarily storing on devices or information systems which enable retrieval of information, for commercial purposes or free of charge, as well as other similar actions performed without the written consent of the copyright owner represents an infringement of the intellectual property law and is punishable through penal or civil penalties in accordance with current legislation.

Editorial Board
Chief Editor
Daniela Aducovschi, Bucharest, ROMANIA
Deputy Editors
Alina-Mihaela Stoica, Bucharest, ROMANIA
Monica Gulap, Bucharest, ROMANIA
Nikolay Paskalev, Sofia, BULGARY
Ana-Maria Gunsel, Çukurova, TURKEY
Bogdan Gozu, Bucharest, ROMANIA

Scientific Committee

Dario NOVAK – University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia – FIEPS EUROPE PRESIDENT;
Alina-Mihaela STOICA, University of Bucharest, Department of Physical Education and Sport, Romania
Enric Maria Sebastiani OBRADOR – Blanquerna Ramon Lull University, Barcelona, Spain
Pavel RUZBARSKY - University of Presov, Slovakia
Peter KRSKA – Catholic University of Ružomberok, Faculty of Education, Slovakia
Veroljub STANKOVIC - University of Pristina in Kosovska Mitrovica, Faculty of Sport and Physical Education, Serbia
Marius STOICA, National University of Physical Education and Sport of Bucharest, Department of Doctoral Studies, Romania
Vlatko NEDELKOVSKI – Ss. Cyril and Methodius University, Faculty of Physical Education, Sport and Health, Skopje, Macedonia
Tamas CSANY – Hungarian University of Sports Science, Budapest, Hungary
Martin ZVONAR – Masaryk University, Faculty of Sports Studies, Brno, Czech Republic
Zulbiye KACAY – Canakkale Onseikiz Mart University, Faculty of Sport Science, Turkey
Monica STĂNESCU – National University of Physical Education and Sport of Bucharest, Department of Doctoral Studies, Romania
Elena BENDIKOVA – Catholic University of Ružomberok, Faculty of Education, Slovakia
Jaromir SEDLACEK – University of Presov, Faculty of Sports, Slovakia
Carlos CASTELLAR – University of Saragoza, Faculty of Health and Sport Sciences, Spain
Constantin CIORBĂ – State Pedagogical University "Ion Creangă", Chişinău, Republic of Moldova
Ivana MILANOVIC – University of Belgrade, Faculty of Sport and Physical Education, Serbia
Stefania CAZZOLI – University of Torino, School of Sport and Exercise Science and Department of Philosophy and Education Science, Italy
Slobodanka DOLIC – University of University of Slobomir, Bosnia and Herzegovina
Dusan MITIC – University of Belgrade, Department of Recreation, Serbia
Gheorghe BALINT – University Vasile Alecsandri of Bacău, Department of Physical Education and Sports Performance, Romania
Stefka DJOBOVA – National Sports Academy "Vassil Levski", Sofia, Bulgary
Robert SAKIZLIAN, University of Bucharest, Department of Physical Education and Sport, Romania
Beatrice Aurelia ABĂLAŞEI, University Alexandru Ioan Cuza of Iaşi, Romania
Carmen Liliana GHERGHEL, National University of Physical Education and Sport of Bucharest, Faculty of Kinetotherapy, Romania
Nicole MAUSSIER, University of Rome ”Foro Italico”, Italy
Daniela ADUCOVSCHI, University of Bucharest, Department of Physical Education and Sport, Romania
Teodora DOMINTEANU, Bucharest University of Economic Studies, DPES, Romania
Nikolay PASKALEV, Bulgarian Academy of Science, Bulgary
Monica Tania GULAP, University of Bucharest, Department of Physical Education and Sport, Romania
Bogdan GOZU, University of Bucharest, Department of Physical Education and Sport, Romania

Honorary Members

Ph.D Professor Branislav ANTALA, F.I.E.P.S. International Vice-President. I.C.S.S.P.E. Executive Board Member, Comenius University, Faculty of Physical Education and Sports, Bratislava, SLOVAKIA
Ph.D Professor Gheorghe BALINT, F.I.E.P.S. Europe Vice-President. University “Vasile Alecsandri” of Bacau Faculty of Health, Sports and Human Movement Sciences, Physical Education and Sport Performance Department, ROMANIA

The cover design & layout: EUB-BUP

University of Bucharest, Bucharest University Press

Editor's address: Bl. Mihail Kogălniceanu 36-46, Hostel A, Entrance A, Floor 1-2, (Courtyard of the Faculty of Law), Sector 5, Bucharest, Romania
E-mail, phone: editura@g.unibuc.ro/ +(4) 0760 013 746/ +(4) 0726 390 815

Centru de vânzare: Bd. Regina Elisabeta, nr. 4-12, Bucureşti, Tel. (0040) 021.305.37.03

Coperta: Designer graphic EUB-BUP, Tehnoredactare: Mariana IONICĂ

https://university-arena.unibuc.ro/

ISSN 2602-0440
ISSN-L 2602-0440

CONTENTS

PHYSICAL EDUCATION

Daniela ADUCOVSCHI, Costinel MIHAIU, The study of the spatio-temporal orientation ability of students practicing sports dance at the University of Bucharest 7

Daniela BURCIU, Alina-Mihaela STOICA, Boosting student engagement in university physical activities: An exploratory study 12

Monica GULAP, The impact of using smart watches on students' effort capacity: a comparative study 17

Marius LEȘTARU, Fighting exercises against many opponents in physical education lesson 25

Costinel MIHAIU, Daniela ADUCOVSCHI, The motivation of practicing sports dance during physical education lessons in order to improve the self-image 31

Robert SAKIZLIAN, Monica SAKIZLIAN, Study concerning the improvement of speed through basketball 42

SPORT PERFORMANCE

Robert DELIU, Evaluating the laterality of martial arts practitioners through the kinematic analysis of striking techniques 48

Alexandra GHEZEA, Cosette MINCULESCU, Mircea BRATU, Oana STOIAN, Marius STOICA, The evolution of performances on a national level in aerobic gymnastics 56

Bogdan GOZU, Maria ȘCHIOPU, Lorena SPULBER, Women's football from the players' perspective 65

Andrei Vladimir MARICA, Adina Andreea DREVE, Vladi IONESCU, Marius STOICA, Optimising effort capacity in triathlon 75

Miruna Elena TRIFAN, Alina Mihaela STOICA, Adina DREVE, Comparative study on anthropometric and motor differences in u15 basketball players 81

VARIA

Bogdan GOZU, Gabriela NISTOR, Considerations regarding the importance of practicing women's football as a free-time motor activity 98

Cătălin ȘERBAN, Bogdan GOZU, The unstoppable pantelimon 2024 triathlon from the perspective of the participants 102

George Dan MOISE, Anamaria POP, Game, set, style: unveiling the fashion secrets of tennis dress code 109

George Dan MOISE, Anamaria POP, TENNIS GEAR 114

Sebastian-Iulian VICOL, Silvia TEODORESCU, Evolution of the game of football in terms of rules and formations of play 120

Atanasie-Teofil DUMITRACHE, Bogdan GOZU, From colosseum to wembley: echoes of ancient thoughts on the importance of sports in modern football 128

Miruna Elena TRIFAN, Vladi IONESCU, Alina-Mihaela STOICA, Optimizing the physical development of adults by using ems fitness technology in leisure time motor activities 132

PHYSICAL EDUCATION

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 7-11
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-1

THE STUDY OF THE SPATIO-TEMPORAL ORIENTATION ABILITY OF STUDENTS PRACTICING SPORTS DANCE AT THE UNIVERSITY OF BUCHAREST

Daniela ADUCOVSCHI[1*], Costinel MIHAIU[2]
[1,2]*University of Bucharest, D.P.E.S., Romania*
* Corresponding author:daniela.aducovschi@g.unibuc.ro

Abstract*. Background*. Sports dance is characterized by a complex coordination, its most important components being, in our opinion: the segmental, general and multisegmental coordination; the capacity of kinesthetic differentiation; the static and dynamic coordination, the ability of spatio-temporal orientation; the ability to perceive and reproduce musical rhythm and tempo. Sports dance lessons are held in the University of Bucharest with students who opt for this discipline without having a prior selection. In sports dance, all the motor capacities are involved in different weights, but we proposed for this study to analyze from the perspective of the coordinative capacities, the spatio-temporal orientation.
Objectives. The subjects in this study are students in the 1st and 2nd years, belonging to different faculties of the university and they were divided into the control and the experimental groups. Both groups worked to test a salsa choreography during the lessons. In the experimental group, the choreography was practiced facing points 1,3,5,7, and in the control group, the choreography was practiced facing point 1. The test was realized with reference to point 5.
Methods. The working methods used are observation, testing method, statistical-mathematical and graphical interpretation method.
Results. The results were significantly better in the experimental group compared to the control group. The subjects in the experimental group were able to orient themselves better in space and time in a percentage of 85% and in the control group the percentage was about 30%
Conclusion. We believe that the orientation in space and time can be improved by simple means, prepared by the teacher in the sports discipline, the methodological work being implemented according to the groups.

Keywords: spatio-temporal orientation, choreography, sports dance lesson, testing.

Introduction

Sports dance, in the context of the instructive-educational process in physical education lessons, aims to preserve good motor skills. In addition to this, young people must acquire: special body posture; motor expression; learning, perfecting and consolidating the motor content specific to each studied dance, forming the general bases of the technique, acquiring a varied repertoire; musical knowledge, related to music in general and the musical genres that accompany sports dance, in particular; civilized behavior, learning good manners, the relationship between the sexes, civic behavior; mentally as balanced as possible with the development of the qualities of will, courage, perseverance, self-control; educating the ability to appreciate the motor actions of other subjects; educating the ability to appreciate one's own motor actions; development of coordination capacities; placement of the body and body segments in different directions and planes as correctly as possible; integration into the collective and the development of communication skills through motor actions and activities.

Like any sports discipline composed of technical content with an aesthetic-artistic character in accordance with music, a complex coordination capacity is needed to practice dance.

Coordination capacity can be defined as a complex psychomotor quality, which is based on the correlation between the central nervous system and the skeletal muscles during a movement.

The coordination capacity determined in particular, through the processes of control and readjustment of movement, allows the dancer to master his motor actions with precision and economy.

Two important authors of this area, Epuran, M. and Horghidan, V. (1994), place among the components of psychomotricity, alongside the body scheme, laterality, rapidity of ideomotric movements and dynamic coordination (of the whole body and its segments), static coordination – balancing, perceptual-motor coordination (perception of space, rhythm and own movements).

The author, C. Pehoiu, 2010, emphasizes that ”spatio-temporal orientation, together with movement combination and coupling, and with kinesthetic, balance, motor reaction, movement transformation and rhythm differentiation form the coordinative abilities. From our viewpoint, these are characteristic features with high levels of manifestation in a complex psychomotor act – valorizing the quality of one’s talent – as well as indices pertaining to one’s psychomotor intelligence and creativity. Spatiality is a reality sensed objectively as form, volume or depth, while temporality represents a direct knowledge of the duration of different phenomena and of the change of moments in the actions undertaken by man”.

After studying several authors (Frey, Hirtz, Fetz, Mitra & Mogoș, Epuran & Horghidan, Ozolin, Letzelter, Gundlach, Weineck, Schnadel, Blume cited by Manno, 1996), we have noticed that from a terminological point of view the description of the notion of coordination has more versions, being a rather difficult term to quantify and classify.

Basically, general and special coordination capacities are distinguished.

General coordinative capacities are the result of polyvalent gestural training in different motor actions or sports. They manifest themselves in different areas of daily life and in sports, in that certain gestural problems can be solved creatively. (according to Harre, D., Deltow, Ritter, 1984).

Special coordinative capacities develop more within the sports disciplines considered and, according to Ozolin, N. (1984), "with varied skills in sports technique depending on the discipline or of various combinations".

According to Blume, (1981) cited by Manno, R. (1996), cited by Tudor, V. (1999, 2002), cited by Șerbănoiu, S.(2002), Saulea, D. (2005) there is the following scheme:

1. the capacity to combine and couple the movements
2. the capacity to orient spatially and temporally
3. the capacity of kinesthetic differentiation
4. the capacity to maintain balance
5. the capacity of motor react
6. the capacity to transform movements
7. the rhythmic capacity

We proposed for this study to develop, through the means of sports dance, the capacity of spatial-temporal orientation of the students.

This ability allows changing the position and movement of the body in space and time in relation to a certain field of action. There are two fundamental forms of orientation that can be distinguished:

- in relation to moving objects, in relatively static conditions;
- body orientation in relation to fixed or mobile reference points.

In technical-compositional sports such as artistic gymnastics, rhythmic gymnastics, figure skating, sports dance, spatial-temporal orientation is highly required, but automation considerably reduces the role of the visual analyzer to strengthen that of the other analyzers. In the context of

sport dance, temporal orientation is related to the sense of rhythm and auditory analyzer, as this orientation is performed on specific dance steps in a certain musical tempo.

For a correct execution, a number of complex factors is needed, such as the fundamental cortical processes of excitation and inhibition through which the subcortical formations and the cerebral cortex can be able to send motor impulses to the muscle formations interested in fine, controlled, coordinated movement.

The auditory, visual, kinesthetic, vestibular, tactile analyzers have overall very important roles in achieving spatial-temporal orientation, each of them having a significant weight in realizing the most accurate execution.

"In terms of performance, from the multitude of psychic aspects and manifestations in the sphere of motor activities of mastery of the body, athletes depend on the accuracy of sensory information, differential thresholds of sensitivity that encompass the level of perceptual abilities on which the reception, processing and elaboration of information in relation to what surrounds them depend." (Adam, A.M.,2022).

The purpose and objectives of the study

During the end of the semester when we worked on structures of dance steps linked in choreographies, we have aimed to develop the spatial-temporal orientation ability of the experimental group, through simple means, ready at hand of the teacher, using specific music and different exercises for orientation.

Hypothesis

If in physical education lessons having sports dance as a study discipline we use changes in working alignment, then we predicted an improvement of the:

- coordination capacity;
- adaptation to the change of spatial orientation;
- ability to maintain the tempo.

Methods. The working methods used are observation, testing method, evaluation, statistical-mathematical and graphical interpretation method.

The analyzed subjects

The subjects in this study are students in the 1st and 2nd years, belonging to different faculties of the university and they were divided into the control and the experimental groups. Each group had 20 students. Both groups worked to test a salsa choreography during the lessons. All the lessons were conducted in the gym of the Faculty of Law, where there are audio equipments and mirrors and where the subjects normally have their dance class during the academic year.

From a greater variety of methods for developing the ability of spatial-temporal orientation, such as:

- observing the other athletes/students, in motion and standing still:
- changing the spatial orientation of working during the lessons;
- moving in space on predetermined distances;
- using different spaces/marks than the standard ones;
- using unusual positions, situations and movements;
- the possibility of observing and self-observing through video devices and/or mirrors.

For this study we practiced the replacement of the spatial orientation of the subjects during the lessons in the experimental group, the choreography was worked successively facing points 1,3,5,7, and in the control group the choreography was practiced during the lessons only facing point 1. The choreographic content was made using the Latin American dance, salsa, and was interpreted on a specific melody with a duration of 2 minutes. The choreography is repeated several times during this musical interval.

All the students had to dance the choreography facing point 5. This choice was made by drawing lots of facing a dance direction. When evaluating each subject, the following was taken into account:

- respecting the choreographic program throughout the melody chosen as sound support;
- realizing the dance steps to the music.

Penalties:

- deviation from the choreographic program;
- for each deviation from the music.

The students' evaluation is a confirmative and ameliorative type.

Results

In the control group, out of 20 subjects, 9 deviated from the choreographic program, 5 failed to stay on the music, and 6 worked the choreography correctly and stayed on the music.

In the experimental group, out of the 20 subjects, 2 deviated from the choreographic program, and 1 subject went out of the musical tempo.

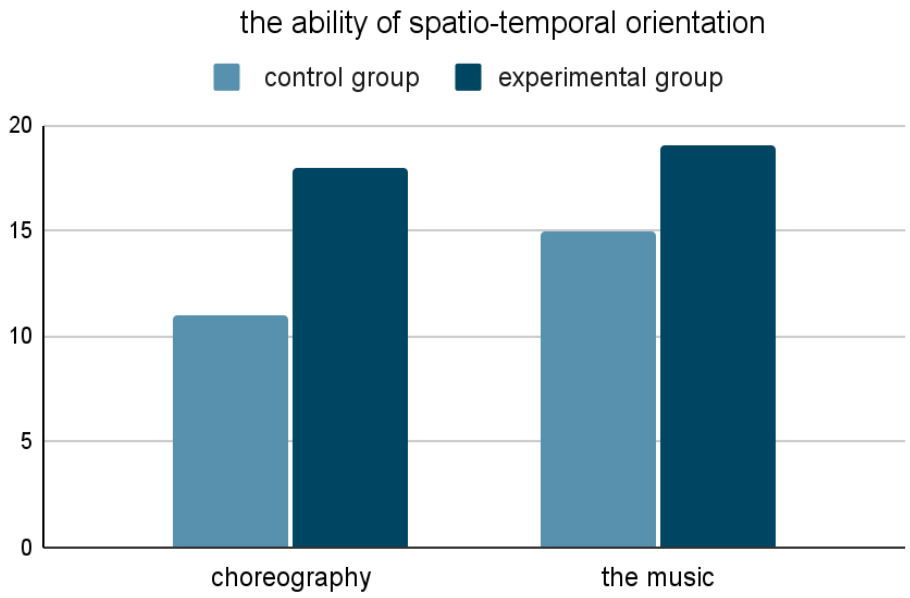


Figure 1. Results of the spatio-temporal orientation test

Conclusions

After the test results, we can conclude that the students from the experimental group made significant progress in terms of spatial-temporal orientation, the percentage of mistakes being very low (3 mistakes).

Therefore, the working methods proved effective for this level of preparation, and during the lessons a visible progress of some of the participants was observed.

The control group gathered a much larger number of mistakes (14 in total), the students being frustrated that they no longer had the marks they knew, some of them could no longer orient themselves in space and the discomfort created also led them to leaving the music.

We believe that the orientation in space and time can be improved by simple means, ready a of the teacher and the discipline, the methodological work being implemented according to the groups.

References

Adam, Andreea, M.,(2022) *Influencing the rhythm and tempo ability in sports dance for athletes in the age group 12-13 years*, Gymnasium Scientific Journal of Education, Sports, and Health ISSUE 1, VOL.XXIII/2022,DOI:https://doi.org/10.29081/gsjesh.2022.23.1.03, https://gymnasium.ub.ro/index.php/journal /article/view/656

Dragnea A., Mate-Teodorescu S. (2002) *Teoria sportului*. Bucureşti: FEST, p.100-250.

Denisa-Mădălina Bălănean, Cristian Negrea, Eugen Bota, Simona Petracovschi,* and Bogdan Almăjan-Guţă, *Optimizing the Development of Space-Temporal Orientation in Physical Education and Sports Lessons for Students Aged 8–11 Years,* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9497162/

Published online 2022 Aug 27.https://doi.org/10.3390/children9091299

Manno R. (1996) *Bazele teoretice ale antrenamentului sportiv.* Bucureşti: C.C.P.S., p. 14-68, 135-148. 8.

Moisescu, P., C., Gürbüz, A.,(2017) *Dezvoltarea capacităţilor coordinative prin jocuri de mişcare,* USEFS, Ştiinţa culturii fizice, *CZU 796.012:796.015.31+796.333*, Nr. 28/2 – 2017.

https://ibn.idsi.md/sites/default/files/imag_file/Dezvoltarea%20capacitatilor%20coordinative%20prin%20jocuri%20de%20miscare.pdf

V. C. Luca, L.Mihăilescu, (2022) *Study on the Contribution of the Dancesport in Enhancing the Quality of Life in Visually Impaired Children,* Revista Românească pentru Educaţie Multidimensională, 2022, Volume 14, Issue 3, pages: 301-324, https://doi.org/10.18662/rrem/14.3/611.

Ozolin, N., G., (1972) *Metodica antrenamentului sportiv*, Ed. Stadion, Bucureşti

C Pehoiu, 2010, *Spatio-temporal orientation development during the physical education class, with 5th and 6th form pupils*, World Academy of Science, Engineering and Technology International Journal of Educational and Pedagogical Sciences Vol:4, No:12, 2010, academia.edu

Raţă G., Raţă B. C. (2006) *Aptitudinile în activitatea motrică*. Bacău: EduSoft, 318 p.

Saulea, D., (2005) Relaţia "*Dans sportiv – Capacităţi coordinative" – în învăţământul superior de neprofil*, ANEFS, teză de doctorat, Bucureşti.

Schneider, W., Spring, M., Trischler, T., (1995) *La mobilite' – Theorie et practique*, R. Gym. – Medicine du Sport Edition „Mosby".

Şerbănoiu, S., (2002) *Capacităţile coordinative în sportul de performanţă*, Ed. Afir, Bucureşti.

Tudor, V., (2001) *Evaluarea în educaţia fizică şcolară*, Ed. Printech, Bucureşti.

Tudor, V., (1999) *Capacităţile condiţionale, coordinative şi intermediare – componente ale capacităţii motrice*, Bucureşti, Ed. RAI.

Tudor, V., (1998) *Bazele biologice şi psihologice ale capacităţilor motrice*, Referat doctorat nr. 2, Bucureşti,

https://www.academia.edu/9278568/Capacit%C4%83%C5%A3i_condi%C5%A3ionale_intermediare_%C5%9Fi_coordinative_componente_ale_capacit%C4%83%C5%A3ii_motrice

https://www.scrigroup.com/diverse/muzica/CAPACITATILE-COORDINATIVE-IN-D85522.php#google_vignette

https://www.scrigroup.com/sanatate/sport/DEZVOLTARII-CALITATIILOR-MOTRI91486.php

https://fefsoradea.ro/fisiere/cadre/3_curs_didactica.pdf

https://ibn.idsi.md/sites/default/files/imag_file/Dezvoltarea%20capacitatilor%20coordinative%20prin%20jocuri%20de%20miscare.pdf

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 12-16
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-2

BOOSTING STUDENT ENGAGEMENT IN UNIVERSITY PHYSICAL ACTIVITIES: AN EXPLORATORY STUDY

Daniela BURCIU[1], Alina-Mihaela STOICA[2]*
[1]*Faculty of Psychology – Psychology and Cognitive Sciences II,*
[2]*Department of Physical Education and Sport University of Bucharest, Romania*
* Corresponding author: alina.stoica@g.unibuc.ro

Abstract. Physical activity is a critical component of a healthy lifestyle, significantly contributing to the prevention and management of chronic diseases, mental health support, and overall well-being. Despite its benefits, recent lifestyle changes in post-communist Romania have led to an alarming increase in overweight and obesity rates, especially among urban youth. This research focuses on the University of Bucharest (UniBuc) to explore the reasons behind students' low participation in university-organized physical activities. By employing a structured questionnaire distributed electronically, this study aims to collect comprehensive data on student demographics, participation levels, motivations, barriers, and suggestions for improvement. The quantitative analysis component of the study aims to identify participation trends and barriers, while qualitative insights will provide nuanced perspectives on students' experiences. The findings will inform targeted strategies to promote physical activity among students, contributing to their immediate and long-term health. Overall, this exploratory study seeks to lay the groundwork for future research on enhancing physical activity participation in academic settings, ultimately supporting the holistic development of young adults.

Key words. Sports, physical activity, exercise, health, mental health, depression, anxiety, youth, academia, overweight, obesity.

Introduction

Physical activity is widely recognized as a key-element of a healthy lifestyle, contributing significantly to the prevention and management of various chronic diseases, supporting mental health, and the promotion of overall well-being of individuals. However, post-communist changes in nutrition and lifestyle (with its shift towards more sedentary jobs and activities) have contributed significantly to an excess weight epidemic affecting Romania over the past decades. Data shows that weight-related issues debut at young ages, as well as the prevalence of overweight (including obesity) in children, particularly in the urban area of Western Romania – where it was recorded at alarming levels, higher in boys and at the pre-puberty ages (Pop TL, 2021, p. 51).

These issues tend to continue into young adulthood and adulthood; establishing "physical activity habits during the young adult years are likely to be important influences on habitual physical activity during overall adult life and, consequently, have significant implications for long-term health outcomes". (Leslie, Sparling, & Owen, 2001). This topic is insufficiently tackled at national level, specifically from an institutional perspective, despite the existence of a dedicated governmental agency**.

** Agenția Națională pentru Sport – https://sport.gov.ro/

However, the lack of participation in sports and physical activities exhibited by young people is addressed in the academic environment, specifically in the University of Bucharest (UniBuc), which makes the subject of the present study. In spite of the well-documented benefits of physical activity, many students struggle to meet the recommended levels of physical activity due to a variety of barriers, including academic pressures, time constraints, lack of motivation, and limited access to appropriate facilities and programs. This research effort aims to lay the groundwork of an extended research effort centered on identifying the main reasons why young students (roughly aged 18–35) don't participate – or only participate sporadically, or only because of the mandatory component – in physical activities organized by the university they are enrolled in, and, in subsidiary, in physical activities overall.

Understanding the importance of physical activity for the body and the mind. The benefits of exercise in young adulthood.

Depending on the scope, duration and intensity of the exercises, the human organism benefits greatly from regular physical activity. Studies have highlighted that regular physical activity, such as strength training, aerobics or walking, as well as flexibility, balance and aerobic training, or a combination of these exercises for 16 weeks to one year, is able to improve a series of relevant health-related parameters (Portugal et al., 2013, p. 4), including *neuroplasticity* some related to various mental health disorders such as depression or anxiety disorders – it reduces stress – mainly through the release of endorphins and reduction of cortisol, which is a stress hormone – and stimulates the overall mood regulation, through the release of neurotransmitters like serotonin and dopamine (Kandola et al. , 2018, p. 22).

At brain activity level *„exercise is associated with the increased synthesis and release of both neurotransmitters and neurotrophic factors, and these increases may be associated with* [adult] *neurogenesis, angiogenesis and neuroplasticity*". Physical activity stimulates the production of new neurons in the hippocampus, a region of the brain that is critical for learning and memory (Portugal et al., 2013, p. 1). It also plays a role in the prevention of neurodegenerative disorders – a 2021 neurological study calculated that about 3% of all dementia cases could be prevented by increasing levels of physical activity (Dominguez et al., 2021, p. 2).

The health benefits of physical activity depend on being active throughout the entire life span, but, for most people, research shows that physical activity declines strikingly with age, with most rapid declines in physical activity occurring during the adolescence and young adulthood years (Stephens, 2002). Moreover, physical activity has also been found to elevate mood and reduce symptoms of depression, anxiety, and stress. Exercise-induced release of endorphins, along with the modulation of neurotransmitters and inflammation, contributes to improved mental well-being.

The study. Methodology

In order to identify the possible explanations behind students' lack of participation in physical activities organized by the University of Bucharest, a structured questionnaire was developed and will be administered via e-mail to all UniBuc students (from freshmen to seniors, regardless of their current participation in sports class, as they will be questioned about previous experience as well), aiming to ensure a representative sample, as well as the broad reach and convenience for respondents. The questionnaire was designed to gather comprehensive data – incorporating both quantitative and qualitative questions for a holistic image of the phenomenon – on various aspects influencing students' engagement in physical activities, including demographic information, current participation levels, motivations, barriers, and suggestions for improvement.

Quantitative data will provide measurable insights into participation rates and perceived barriers, while qualitative responses are expected to offer more nuanced perspectives on the personal experiences and recommendations, with the overarching objective to find reasons for the

lack of participation of students in sports activities and draw potential solutions to address these issues to the benefit of students' and their health. Data collected from the survey will be analyzed using various statistical methods to identify prevalent trends and correlations, while thematic analysis will be applied to the qualitative responses of the UniBuc students in order to extract common themes and insights.

Conclusion & future research directions

For young people, particularly for young students who are navigating an essential stage of their psychosocial and professional development, engaging in regular physical activity provides immediate health benefits, but also for establish lifelong habits that contribute to long-term health outcomes. The complex demands associated with student life, along with the social, professional, developmental and emotional challenges of young adulthood, highlight the imperative need to encourage and facilitate an active lifestyle, to the largest possible extent, in line with individual needs and opportunities.

The proposed questionnaire is addressed to all UniBuc students, from the bachelor's and master's study programs and is being applied. After receiving the answers from the respondents, they will be analyzed and based on the obtained results, proposals and strategies will be formulated to improve the state of health by promoting physical activity among children, young people and adults.

Understanding the factors that influence students' engagement in physical activity will contribute significantly to the process of building the necessary conditions for their future participation, which represents the main point of this exploratory study, and, in line with its results, other potential research efforts focused on this pressing issue.

Annex 1 – the Questionnaire (will be applied via Google Form)

A. Demographics

1. What is your age range?
   a. 18-21 years old
   b. 22-25 years old
   c. 26-29 years old
   d. 30+ years old
2. What is your gender?
   a. Female
   b. Male
   c. Non-binary
   d. Prefer not to say
3. What year of study are you in?
   a. First year
   b. Second year
   c. Third year
   d. Fourth-Sixth year
4. What is your area of study (*faculty, specialty)*?
   _____

B. Participation in sports activities

5. The sport you are/were enrolled in at the University (if applicable; check multiple options if you were enrolled in more than one):
   a. Athletics
   b. Self-defense
   c. Basketball
   d. Badminton

e. Dancing (folklore/competitive)
f. Physical and methodical education (chess)
g. Fitness
h. Football
i. Aerobics
j. Medical gymnastics
k. Handball
l. Swimming
m. Martial arts
n. Table tennis
o. Tennis
p. Volleyball

6. How often do you attend Sports class at the University?
   a. Never
   b. Rarely (< 4-5 times per semester)
   c. Occasionally (> 4-5 times per semester)
   d. Regularly (> once every 1-2 weeks)
   e. Oftern (> once per week)
7. How often do you exercise in your personal time?
   a. Never/ very rarely
   b. Rarely (1-5 times per year)
   c. Occasionally (1-5 times every few months)
   d. Often (at least once a year)
   e. Very often (at least once a week)
   f. Daily
8. What motivates you to attend Sports class at the University (*you can select multiple answers*)?
   a. Improving my health / physical shape
   b. Reducing stress
   c. Socializing
   d. My grade
   e. I don't know/ NA

Please explain your answer: _____

9. Would you attend Sports class at the University if they were not mandatory?
   a. Yes
   b. No
   c. I don't know/ NA

Please explain your answer: _____

C. Your experience during Sports class

10. How would you describe your experience during Sports class (rate it from 0 to 5, 0 corresponding to a very unpleasant experience and 5 corresponding to a very pleasant experience)?
    Very unpleasant O O O O O Very pleasant
11. How would you describe your experience during Sports class (rate it from 0 to 5, 0 corresponding to a not useful experience and 5 corresponding to a very useful experience)?
    Not useful O O O O O Very useful
12. How would you describe the equipment made available by the University for Sports classes (rate it from 0 to 5, 0 corresponding to unsatisfying and 5 corresponding to very satisfying)?
    Unsatisfying O O O O O Very satisfying
13. What are the main reasons for your rare/ lack of attendance of Sports class (*if applicable*)?

a. Schedule is too packed
b. Sports classes overlap with lectures/seminars
c. I am working/ I am involved in other activities (e.g. volunteer work, internships, etc.) which keep me from attending the Sports class
d. I don't like to exercise
e. I don't like to exercise at the University
f. I cannot participate in sports (due to medical or accessibility reasons), and the alternatives provided by the university do not meet my needs (if this is your answer, please mention in the space below how the University could provide the necessary conditions for you to participate in sports activities, e.g., access ramps, special equipment, suitable physical exercises/sports activities, etc.)
g. I can't afford to cover the expenses associated with my participation (e.g. buying individual sporting attire and equipment).
h. Another reason: _____

14. What could UniBuc do to encourage you to participate more frequently in sports classes (*you can select multiple answers*)
    a. Further diversifying the types of sports offered
    b. Improvement of the schedule / better alignment with the schedule of lectures/seminars
    c. Organization of more sports competitions within the faculty
    d. Promotion of sports activities (offline/online)
    e. Other ways: _____

References

Dominguez et al. (2021). Nutrition, Physical Activity, and Other Lifestyle Factors in the Prevention of Cognitive Decline and Dementia. *Nutrients 13 (11)*, 1-60.

Kandola et al. (2018). Moving to Beat Anxiety: Epidemiology and Therapeutic Issues with Physical Activity for Anxiety. *Curr Psychiatry Rep.*, 20-63.

Leslie, E., Sparling, P., & Owen, N. (2001). University campus settings and the promotion of physical activity in young adults: lessons from research in Australia and the USA. *Health Education*.

Pop TL, M. D. (2021). Prevalence of Underweight, Overweight and Obesity in School-Aged Children in the Urban Area of the Northwestern Part of Romania. *Int J Environ Res Public Health 18 (10)*, 51-76..

Portugal et al. (2013). Neuroscience of Exercise: From Neurobiology Mechanisms to Mental Health. *Neuropsychobiology 68*, 1-14.

Stephens, R. (2002). *Social Cognitive Determinants of Physical Activity in Young Adults: A Prospective Structural Equation Analysis.* Virginia Tech University Agenția Națională pentru Sport - https://sport.gov.ro/

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 17-24
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-3

THE IMPACT OF USING SMART WATCHES ON STUDENTS' EFFORT CAPACITY: A COMPARATIVE STUDY

Monica GULAP[1*]
[1] *Department of Physical Education and Sport, University of Bucharest*
* Corresponding author: monica.gulap@g.unibuc.ro

Abstract. The increasing use of smartwatch technology among university students has raised questions about its potential impact on physical health and effort capacity. This study aims to evaluate the influence of smartwatch usage on the physical performance and effort capacity of students, focusing on those who utilize these devices for monitoring physical activity and health functions.
In this comparative study, we employed a questionnaire to assess the adoption and usage patterns of smartwatches among students. The research sample was divided into two groups: a control group and an experimental group. Both groups participated in weekly aerobic gymnastics classes. However, the experimental group, equipped with smartwatches, was tasked with achieving a daily goal of 13,000-15,000 steps or expending 600 kcal.
At the conclusion of the experiment, we evaluated the exercise capacity of all students using the Ruffier and Harvard tests. The results revealed significant differences between the two groups, with the experimental group demonstrating notably higher effort capacity. This suggests that the regular use of smartwatches, combined with specific fitness targets, can enhance physical performance and overall health among students. Our findings underscore the potential benefits of integrating wearable technology into student lifestyles, particularly in promoting physical activity and improving exercise capacity. This study contributes to the growing body of literature on the impact of smartwatches on health and fitness, highlighting their role as valuable tools for monitoring and enhancing physical performance in an academic setting.
In conclusion, smartwatches can be useful tools for students, but they must be used with discernment. It is important to strike a balance between the benefits and distractions these devices bring. Students' effort capacity may be influenced by how they integrate smartwatches into their daily routine.

Keywords: smartwatch, physical activity, effort capacity, students, aerobic gymnastics.

Introduction

Physical activity and an optimal effort capacity represent the essential pillars of students' health and well-being (Gulap, 2015), exerting a profound impact on the physical, mental and emotional aspects of their lives (Colectiv DEFS, 2014):

Physical health: Regular physical activity has many benefits for students' physical health. This includes strengthening the cardiovascular system, reducing the risk of chronic diseases such as diabetes and cardiovascular disease, maintaining a healthy weight, and improving muscle endurance and flexibility (Collins, 2012).

Mental health: Exercise is recognized for its ability to improve mood and reduce stress, anxiety and depression. For students, who may be under high levels of stress due to academic tasks and other pressures, physical activity can be an effective way to maintain mental balance and improve emotional well-being.

Improving academic performance: There is evidence to suggest that regular physical activity can improve memory, concentration and learning ability. By increasing blood and oxygen flow to the brain, exercise can enhance cognitive functioning, which can have a positive impact on students' academic performance.

Healthy lifestyle: Promoting a healthy lifestyle among students can help establish long-term healthy habits. By learning to make physical activity an integral part of their daily routine, students can develop habits that support their long-term health and well-being, thereby reducing the risk of disease and health problems later in life.

Social Interaction and Belonging: Participating in physical activities can provide students with opportunities to interact and socialize with their peers outside of the academic environment. These positive social interactions can help improve self-esteem, social relationships and a sense of belonging to the university community.

It is recognized that smart devices have become an integral part of modern life, influencing various aspects of human behavior, including physical activity and effort capacity (Diachenko et al., 2021). In recent years, research has investigated how the use of these devices affects the level of physical activity and effort capacity of individuals, with a particular focus on young people, including students.

Recent research has revealed that the use of smart devices such as smartphones and tablets can have both positive and negative effects on users' physical activity. On the one hand, these devices provide easy access to apps and technologies that promote physical activity, such as fitness apps and health monitors. Studies have shown that using these apps can increase motivation and engagement in physical activity by providing goals, feedback and social support (Shuang Wu et co, 2023; Siepmann et co, 2021; Zahrt et co, 2023).

The research organization

The purpose of the paper

The purpose of this paper is to investigate and compare the level of effort capacity and motivation for physical activity between students who wear smartwatches and those who do not. The study aims to provide a deeper understanding of how the use of these smart devices can influence physical behavior and motivation among students enrolled in aerobics classes.

The hypothesis of the research

The use of smartwatches contributes to a better motivation for practicing physical exercise and, implicitly, to a better effort capacity of students.

The objectives and the tasks of the research

To achieve the proposed goal, the following research *objectives* were set:

- establishing the research sample – 30 students, 1st year at various faculties, enrolled in aerobic class: 15 who wear smartwatches - the experimental group, 15 students who do not use such devices;
- elaboration of the opinion questionnaire about the students' perceptions regarding smartwatches, using the Google Forms platform;

The *tasks* of the research:

- the evaluation of the effort capacity of the two groups, using the Ruffier test and the Harvard test;
- The online administration of the questionnaire;
- Analyzing and interpreting the results.

The research stages

Our approach took place during the first semester of the academic year 2023–2024.

Out of 100 female students enrolled in the aerobic gymnastics course, only 25 use smartwatches and only 15 female students wanted to be part of our experiment.

Thus, we set up a control group that does not use such devices, composed of 15 female students, and the experimental group, made up of 15 female students who wear smartwatches.

In the first two weeks of October, the initial testing of the two groups took place.

In addition, those in the experimental group were administered the online questionnaire regarding the students' perception of the use of smartwatches.

Also, the students in the experimental group, apart from the aerobic gymnastics lesson they attended weekly, set daily goals of 13,000-15,000 steps or a consumption of about 600 kcal.

At the end of the semester, in January, the final evaluation of the effort capacity of the two groups took place.

The research methods

In our approach we used the following research methods:

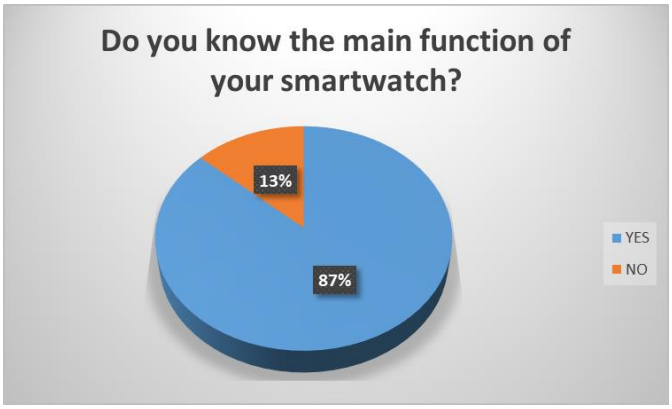
- The study of the specialized literature;
- The statistical-mathematical method;
- The experimental method;
- The graphical method;
- The questionnaire-based survey method;

The spectrum of questions of our questionnaire included aspects related to:

- demographic information such as age, year of study, frequency of using smartwatches;
- knowledge about the main functions of smartwatches, the motivation for using them;
- perceptions and attitudes towards the influences of smartwatches in everyday life, the advantages/disadvantages of their use;
- perceptions regarding the role and the importance of these devices.

Results

13% of the participants in our survey do not know all the functions of the smartwatch they wear, while for the rest these devices have no unknowns.



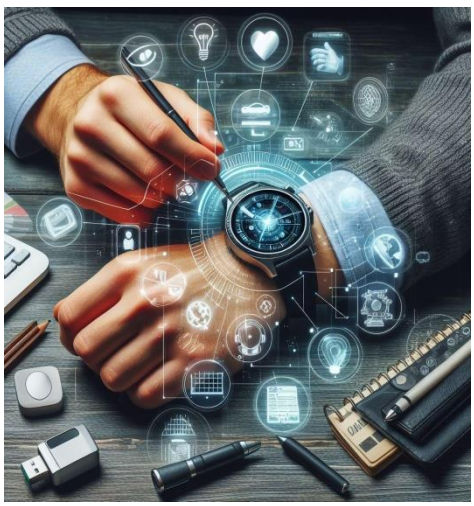


Figure 1. The percentage of those who know all the functions of their smartwatch

✎ Most of our subjects (46%) have been wearing the watch for more than 2 years, 27% between 1 and 2 years and only 7% have been using this device for less than 6 months.

✎ Among the main reasons for using this gadget, the monitoring of physical activity and the accessibility of notifications were the first, followed by the integration with other devices (laptop) and the health functions.

Figure 2. Motivation for using smartwatche

✎ Being asked how wearing a smartwatch influences their daily life, an overwhelming majority answered that it improves their efficiency and organization, fewer believe that it brings them extra stress due to notifications and only 7% that it has no significant impact on their lives.

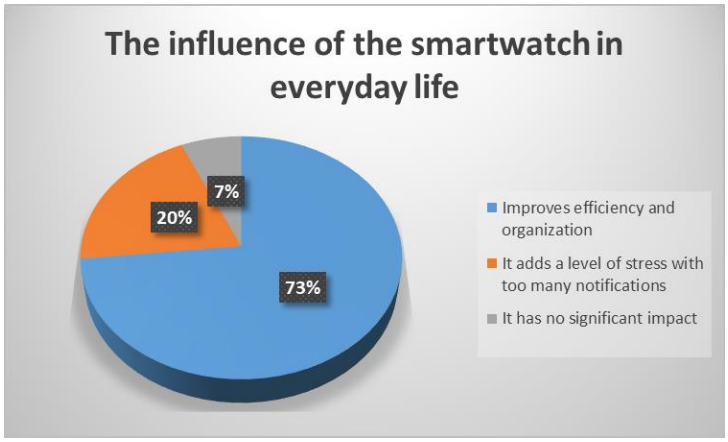


Figure 3. The influence of smartwatch in everyday life

✎ Many of those interviewed (93%) believe that the use of smartwatches does not negatively influence socialization, on the contrary, they believe that it makes them more connected with those around them.

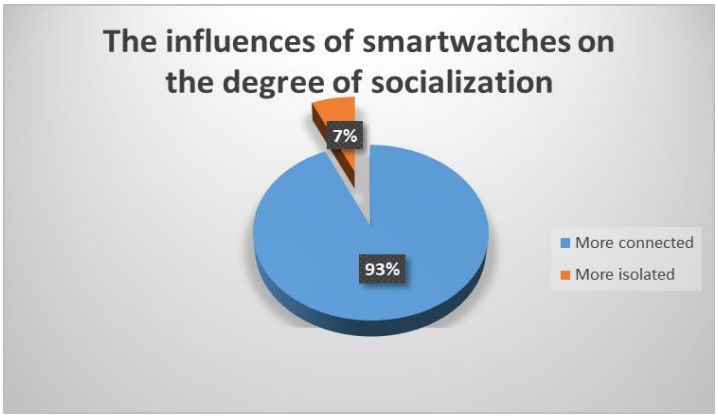


Figure 4. The influence of smartwatches on the degree of socialization

✎ The overwhelming majority of those who participated in our study consider the use of smart watches a necessity, and not a luxury.

✎ How do you think smartwatches impact a student's academic life?

The spectrum of answers to this question is very wide, the students considering that increasing *productivity and organization* is particularly important. Features such as alarms, reminders, notifications, and time management apps can help students better manage their academic schedules and daily tasks.

Another important aspect in the view of those interviewed was the *accessibility of information*. Smartwatches provide quick access to important information such as emails, messages and class notes. This can save time and help with quick responses to academic requests.

Also in the top of the benefits that derive from the use of smartwatches is *health monitoring*. Students can use smartwatches to track their physical activity, sleep and other aspects of their health, which can contribute to a more balanced lifestyle and, implicitly, to a better academic performance.

Regarding ***the functional evaluation***, we present in table 1 the calculated statistical indicators.

Table no. 1 – statistical indicators, functional evaluation (final test) – **control group – experimental group**

Test	**Indicatori statistici (n=8)**					
	Control group $\overline{XX}$	**Experimental group** $\overline{XX}$	**statistical T**	**Tabular T**	**p**	**Significant/insignificant at p=0,05**
Ruffier	9.2	7.3	6.8	2.26	<0,001	Significant
Harvard	79	85.7	8.6	2.26	<0,001	Significant

To calculate the Ruffier index, we used the heart rate dynamics at a standard effort (squats) and, by applying a formula (3 pulses), a mathematical value results, easy to follow in dynamics and to interpret.

As can be seen in table 1, the Ruffier index recorded an average value of 9.2 in the control group and 7.3 in the experimental group, values that place the students at average adaptability to effort. The t-student test indicates a value of 6.8 for $p<0.05$, which leads to the validation of the hypothesis, so the recorded differences are statistically significant. In other words, both the participation in the aerobic lessons, but also the rigorous monitoring with the help of smartwatches of various parameters of the daily effort, led significantly to the improvement of the capacity to adapt to the effort of the subjects included in the research.

The scatter of the data from the mean in the Ruffier test is small, which reveals that the homogeneity of the group is very good.

The values recorded by the subjects of our research in this test, from the two groups, are graphically represented in figure no.5.

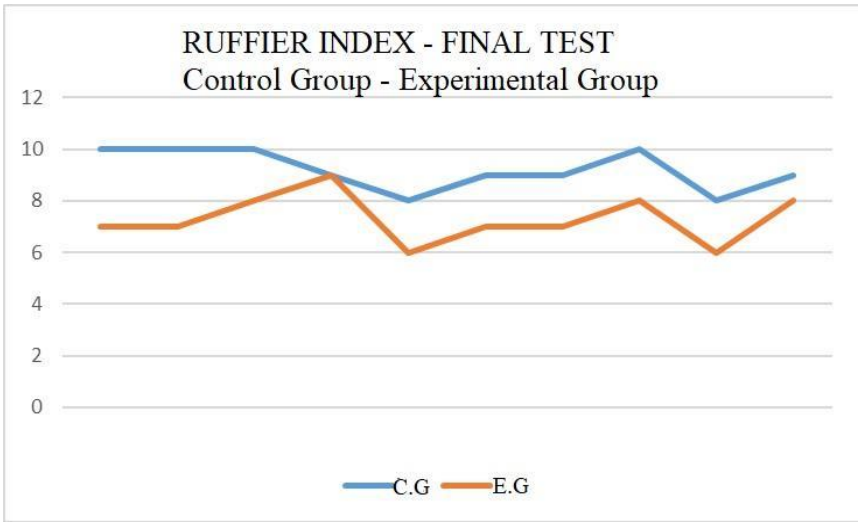


Figure 5. Graphical representation of the Ruffier index values recorded by students at the final test, comparison – control group – experimental group

In the case of the functional indicator measured, the Harvard index, an average value of 79 was recorded by the control group and 85.7 by the experimental group, at the final test, values that place the students at a "good" effort capacity. The t-student test indicates a value of 8.6 for $p<0.05$, which leads to the validation of the hypothesis, so the recorded differences are statistically significant. In other words, both the means used in the aerobics lessons, but also the monitoring of the effort on the other days led significantly to the improvement of the cardiovascular resistance of the female students included in the research.

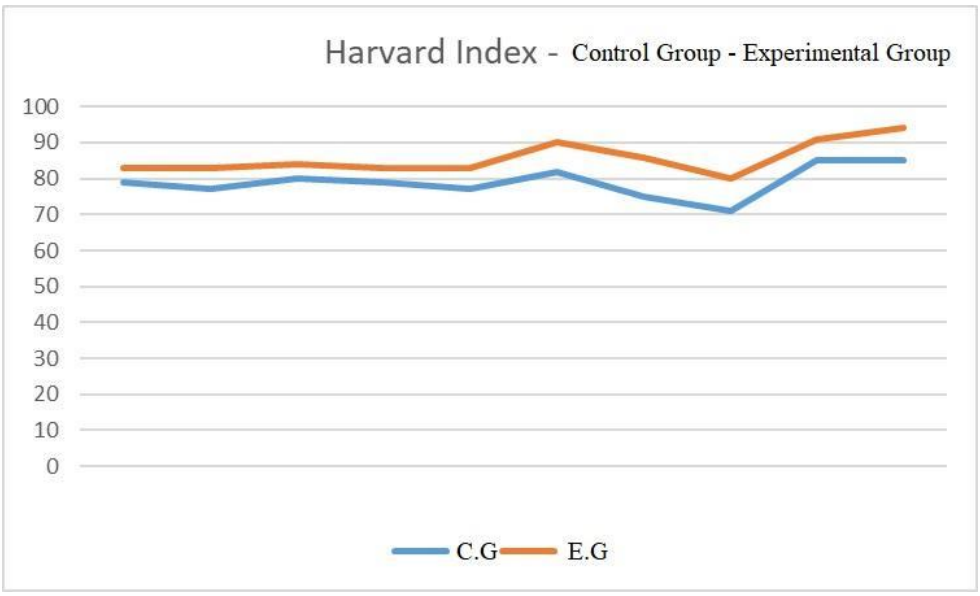


Figure 6. Graphical representation of the Harvard index values recorded by students at the final test, comparison – control group – experimental group

The values recorded by the subjects of our research in Harvard test, from the two groups, are graphically represented in figure no.6.

Conclusions and proposals

Enhanced Physical Performance: Students in the experimental group who regularly used smartwatches and adhered to daily physical activity goals (13,000-15,000 steps or 800 kcal) demonstrated significantly improved effort capacity compared to the control group. Higher scores on both the Ruffier and Harvard tests evidenced this improvement.

Positive Influence on Health Monitoring: The integration of smartwatches into daily routines facilitated better monitoring of physical activities and health metrics. This continuous feedback likely motivated students to maintain or increase their physical activity levels.

Behavioral Changes: The data suggests that the use of smartwatches promotes positive behavioral changes towards physical health. Students using these devices were more inclined to meet and exceed their fitness targets, contributing to overall better physical health and fitness.

Potential for Broader Applications: Given the significant benefits observed, there is potential for broader application of smartwatch technology in educational institutions to foster healthier lifestyles and improve students' physical performance.

Further Research: Studies that are more comprehensive should be conducted to explore the long-term effects of smartwatch usage on physical health and academic performance. Future research could also investigate the psychological impacts, such as motivation and stress levels, associated with the use of these devices.

Educational Workshops: Conduct workshops to educate students on the effective use of smartwatches for health monitoring. Providing training on interpreting data and setting realistic goals can empower students to make the most of these technologies. By leveraging the capabilities of smartwatches, educational institutions can play a crucial role in promoting healthier lifestyles and enhancing the physical effort capacity of their students, leading to improved overall well-being and academic success.

In conclusion, smartwatches can be useful tools for students, but they must be used with discernment. It is important to strike a balance between the benefits and distractions these devices bring. Students' effort capacity may be influenced by how they integrate smartwatches into their daily routine.

References

Colectiv D.E.F.S. (2014). *Curs de Educatie Fizica pentru studenţii Universităţii din Bucureşti*, Ed. Universităţii din Bucureşti, Bucureşti.

Collins, A., (2012). *Functional Training,* Bloomsbury Publishing, London.

Diachenko, A. A. & Antoniuk, A. E. (2021). *Using fitness applications as a means of increasing students' motivation for regular physical activity. Modern technologies in the field of physical education, sports, physical therapy and erchotherapy*, National Academy of the National Guard of Ukraine, 14–16.

Gulap, M. (2015). *Studiu privind contribuţia disciplinelor sportive asupra calităţii vieţii studenţilor Universităţii din Bucureşti*, Teza de Doctorat, Şcoala Doctorală UNEFS Bucureşti.

Santana, J., (2016). Functional Training, Human Kinetics, Florida.

Shuang Wu, Guangkai Li, Litao Du, Si Chen, Xianliang Zhang, Qiang He. (2023). *The effectiveness of wearable activity trackers for increasing physical activity and reducing sedentary time in older adults: A systematic review and meta-analysis*, Digital Health.

Siepmann, C., Kowalczuk, P. (2021). U*nderstanding continued smartwatch usage: the role of emotional as well as health and fitness factors*. Electron Markets 31, 795–809. https://doi.org/10.1007/s12525-021-00458-3

Zahrt, O. H., Evans, K., Murnane, E., Santoro, E., Baiocchi, M., Landay, J., Delp, S., Crum, A. (2023). *Effects of Wearable Fitness Trackers and Activity Adequacy Mindsets on Affect, Behavior, and Health: Longitudinal Randomized Controlled Trial*, Journal of Medical Internet Research, doi:10.2196/40529

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 25-30
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-4

FIGHTING EXERCISES AGAINST MANY OPPONENTS IN PHYSICAL EDUCATION LESSONS, SPECIFICALLY KARATE-DO, AT THE UNIVERSITY OF BUCHAREST

Marius LEŞTARU[1*]
[1]*Department of Physical Education and Sport, University of Bucharest, Romania*
* Corresponding author: marius.lestaru@unibuc.ro

Abstract*. Background*. During the Karate lessons with the advances students of the University of Bucharest, one specific method of training it is represented by the exercise of Happo Kumite. It is practiced with great pleasure by the high ranking colour belts students because the defender must block and counter-attack continously against eight adversaries surrounding him. (The word „Happo" refers to the eight main directions of possibilities for an attack).
Objectives. This Kumite is based on a principle of self-defence. One should be able to defend himself against any directions of an attack. It is possible to face such an encounter in life. If unaccustomed to this kind of exercise, a student who can successfully defending himself against one opponent would be helpless against many adversaries and the techniques used would not be effective if he fails to realise this important requirement of self-defence. In order to face, a period (30 seconds to 2 minutes) surrounded by adversaries, this Kumite, more than others, requires the following qualities: promptness, endurance, proper breathing, smoothness (Tenshin, Tai Sabaki) and physical and mental control such as: timing, balance, relaxed attitude, concentration, acuteness, etc. Special attention must be given to this method for developing these qualities.
Methods. In the initial stage, for the correct acquisition of motor skills specific to the respective theme, a wide range of methods is applied, in accordance with pedagogical principles:
The method of explanation. It is used in all stages of preparation. One of the basic requirements of the explanation is that it should be short and understandable to those who have to learn it.
The method of demonstration. It can be used in the discipline of karate through several procedures: the procedure of direct real demonstration and mediated demonstration procedure.
Exercise method. The exercise method in Happo Kumite includes several procedures: the procedure of the constructively decomposed exercise, global exercise procedure and the procedure of full exercise under the conditions of additional efforts.
Results. In performance of the Happo Kumite during physical education lessons at the University of Bucharest, the students will improve the coordination of mind and body, timing, balance, agility, endurance and fluidity of movement between techniques. To avoid the hazard of being winded, the students will also learn how to give special attention to the rhythm of breathing as this will greatly influence physical endurance and self-confidence.
Conclusion. Because Happo Kumite involve the use of the whole body, these movements are an ideal form of physical exercise. They can be learned first individually and after that, practiced in groups of physical education classes by students – young, old, male or female. With this kind of exercise, the physical educational lessons will be more attractive and the progress of the students of University of Bucharest will be notable. Efficiency is acquired by practise. This important point should not be forgotten.

Keywords: Happo Kumite**,** Kumite against many opponents, self defence, Karate do Shotokan.

EDITURA UNIVERSITĂȚII DIN BUCUREȘTI
BUCHAREST UNIVERSITY PRESS

Introduction

Confronting a large number of opponents in Happo Kumite is one of the most difficult tests of a karate student and the expression of techniques in such situations proves his true mastery. In order to achieve such a performance, superior physical qualities and thoroughly acquired specific motor skills are required, but above all, mental strength and a perfect knowledge of the tactics of fighting in numerical inferiority. During physical educational classes, specifically Shotokan karate, Happo Kumite it is practiced with great pleasure by the high-ranking color belts students because the defender must block and counterattack continuously against eight adversaries surrounding him. (The word „Happo" refers to the eight main directions of possibilities for an attack, Fig.1-2). It does not matter if the number of adversaries exceeds ten or twenty. It is possible to face such an encounter in life. If unaccustomed to it, even a person who can successfully defending himself against one opponent would be helpless against many adversaries and the techniques used would not be effective if he fails to realise this important requirement of self-defence and karate practice as a martial art and not only as a sport. This kumite belongs to the same group as *Kumite Kata: Oyo Kumite* and is based on a principle of self-defence (Kanazawa H., 2023). Until this stage of preparation, the defender was facing a single attacker as in Tanren, Kihon, Yakusoku and Jiyu Kumite (all being exercises intended for pre-set combat with a single opponent). The acquisition of technical attack, defense and countermeasures practiced by students in this type of exercise, as well as their transformation into deep automated skills, up to the stage of perfected motor skills, is the object of this study and an attractive challenge for the karate lessons held in sports classes of the University of Bucharest (Epuran M., 2011).

Figure 1

Figure 2

Method

If the three methodical stages (*the learning stage, the consolidation stage and the perfection stage*) are applied to the acquisition of karate techniques for the usual Kihon exercises, as well as their transformation into deep automated skills, *from a physical and technical point of view referring to Happo Kumite, the following requirements are required* for the defending student:

1. A sufficiently wide and well-suited technical skill;
2. The ability to correctly position the body according to the opponent's attack (Tai Sabaki).
3. The transition without any pause, fluid, of the body from one opponent to another;
4. Developing the speed of reaction expressed in promptly choosing the appropriate response;
5. Development of resistance in the effort mode;
6. Breath control;

7. Returning to guard (Kamae) as soon as possible after a technical execution and preparing for the next counterattack.

Mentally, the following requirements are required:

1. Keeping the body relaxed, but in a state of deep alertness, always ready for action;
2. The ability to sense the next offensive action;
3. Constant maintenance of a distributive attention;
4. Resistance to a discomfort caused by a certain pain;
5. Maintaining calm and lucid thinking as the heart rate increases during exercise;
6. Maintaining and concentrating Ki (vital energy) in the lower abdomen (Tanden).

For the attacking student, from a physical and technical point of view, the following requirements are necessary:

1. A varied and well-acquired technical skill;
2. Correct execution of attack techniques (rhythm, precision, speed, Kime as explosive force);
3. The development of endurance in the effort regime;
4. Correct assessment of combat distance.

Mentally, the following requirements are required:

1. Maintaining a calm but alert and goal-oriented spirit;
2. Maintaining the fighting spirit;
3. Constant maintenance of a distributive attention;
4. Resistance to a discomfort caused by a certain pain;
5. Breath control and proper application of Kime.

In the initial stage, for the correct acquisition of motor skills specific to the respective theme, a wide range of methods is applied, in accordance with pedagogical principles (Enache I., 1992):

Explanation method:

- It is used in all stages of preparation. It precedes all other methods and represents the means of which, based on the teacher's logical and reasoned presentation, the student in general acquires thorough specialized knowledge, that is established along the way in the norms or requirements of his next activity. One of the basic requirements of the explanation is that it should be short and understandable to those who have to learn it.

Demonstration method:

- In short, it is said that "the way is long through teaching, short and effective through example";
- It consists in the presentation of technical elements and procedures in order to ensure a perceptive support, sufficiently suggestive to make accessible the correct acquisition of certain knowledge and skills specific to karate techniques;
- It can be used in the discipline of karate through several procedures:

1. *The procedure of direct real demonstration*:

Presents the advantage that it reproduces the concrete image of the motor action to be learned. A technical process can be demonstrated by successively going through the stages from global to partial as follows:

- The global or integral demonstration of an element or several technical procedures in combination, without explanations, providing the real rhythm required by the practical activity and in the most correct form for the formation of an overall representation, being fixed in the visual memory of the students.

- The global demonstration identical to the previous methodical procedure, but the execution being done with reduced force and speed, several times and from several angles (to be observed by all students), in order to form the clearest possible image, on the basis of the perception of the rational chaining of the component elements of the motor action.
- The demonstration in parts, with slowed down speed and accompanied by explanations, to give the trainees the opportunity to notice more easily the details of execution and the sequence of movements in time and space.
- The explanations that accompany the demonstration of the parts will be clear and precise, focused on the main components of the action being learned. The methodical process is used especially when teaching a more complicated technical element and when working with a collective with a more modest previous training or with limited possibilities from a physical point of view. Newly taught material will be demonstrated (rehearsed) and explained until it is understood by all students.

2. *The process of mediated demonstration* – is used for the formation of anticipated representations about specific Happo Kumite motor actions, rules and conditions of execution. Mediated demonstration is done with the help of drawings, sketches and diagrams or through video sequences.

Exercise method

It presupposes performing an activity repeatedly, active and consciously, in order to acquire a skill, a habit, and is the main means for acquiring the technical and tactical content of karate discipline (Nakayama M., 2012).

The exercise method includes several procedures:

• *The procedure of the constructively decomposed exercise*

In the case of very complicated karate techniques that require a special coordination of body segments, they must be simplified by breaking them down into parts and performed separately. The parts will then be joined close to close (step by step), until the global execution of the action in question is achieved. The constructive decomposed exercise procedure is indicated especially in the initial phase of learning. It will also be used afterwards, whenever it is desired to connect more quickly some basic mistakes found in practitioners.

• *Global exercise procedure*

It presupposes the learning from the beginning, in the global form, of a motor action. The procedure is used only when the motor action in question is simple and easy or, although complex, has a structure that does not allow its breakdown into component elements.

• *The procedure of the full exercise under the conditions of additional efforts*

It is specific to the stages of consolidation and refinement, to chisel the technical karate execution and improve their quality base. Global training is done with strength, speed and coordination, scaled up to the actual demands during combat.

Practical method

The defender student stands at the center of a circle in Kamae position. The radius of this circle of eight equally separated attackers is approximately 2 meters (Fig.3). There is no set order for attacking. Nevertheless, the level and technique used must be mentioned before each attack. As soon as the attack is executed he must quickly return to his initial position. One attack each time is the rule. As soon as the attacking students notice the defender has executed his counter attack with Kime, they attack successively without stopping so that the defender is not given any chance to pause.

The defender must not be overwhelmed. He must always keep one foot at the center of the circle and move his body swiftly (Fig.4). He will maintain his composure against the next attack, the

body relaxed, the Ki concentrated in the Tanden and fully alert. He will execute his movement of Tenshin or Tai Sabaki according to the technique and position of the attacker (direction and mutual distance) and with an optional block, counter-attacks immediately, then quickly resumes the position Kamae for the next attack.

To avoid the hazard of being winded, special attention must be paid to the rhythm of breathing as this will greatly influence physical endurance and self-confidence. Confronting an adversary, even under conditions of compliance with predetermined rules, the student begins to get used to his reactions, feel him and decode his intentions more quickly. The themed exercise rounds are scheduled around the middle of the lesson (two-three rounds between 30 seconds and 2 minutes for each student) and are supervised by the teacher, who intervenes every time he notices serious mistakes in execution or exceeding the limits in the application of certain procedures, which could cause some trauma to the students participating in the lessons. For other minor observations, the break between exercises will be used (Kanazawa H., 2023).

Figure 3

Figure 4

Results

In performance of the Happo Kumite during physical education lessons at the University of Bucharest, the students will improve their motivation, the coordination of mind and body, timing, balance, agility, endurance and fluidity of movement between techniques (Bompa T., Buzzichelli C., 2021). To avoid the hazard of being winded, the students will also learn how to give special attention to the rhythm of breathing as this will greatly influence physical endurance and self-confidence.

Conclusions

Because Happo Kumite involve the use of the whole body, these movements are an ideal form of physical exercise. They can be learned first individually and after that, practiced in groups of physical education classes by students – young, old, male or female. With this kind of exercise, the physical educational lessons will be more attractive and the progress of the students of University of Bucharest will be notable. Efficiency is acquired by practise. This important point should not be forgotten.

References

Bompa Tudor O., Buzzichelli Carlo A., (2021). *Periodizarea, Teoria şi Metodologia Antrenamentului*, Ed. Lifestyle Publishing, Bucureşti, p. 311.
Epuran M., (2011). *Motricitate şi psihism în activităţile corporale*, vol.1, Ed. Fest, Bucureşti, p. 81-84.
Enache I., (1992). *Autoapărarea fizică*, Ed. Romfel, Bucureşti, p. 238.
Nakayama M., (2012). *Best Karate Volume 1: Comprehensive*, Ed. Kodansha, America, Inc; 2nd edition, p.112-124.
Kanazawa H., (2023). *S.K.I Kumite Kyohan*, Publisher: Warrener Entertainment, SUA, p.149-153.

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 31-41
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-5

THE MOTIVATION OF PRACTICING SPORTS DANCE DURING PHYSICAL EDUCATION LESSONS IN ORDER TO IMPROVE THE SELF-IMAGE

Costinel MIHAIU[1*], Daniela ADUCOVSCHI[2]
[1,2] *University of Bucharest, The Department of Physical Education and Sport, Romania*
* Corresponding author: costinmihaiu@yahoo.com

Abstract. *Background*. Motivational dynamics is always manifested at the level of global behavior, which means that understanding the motivational orientation of behavior requires a systemic view of it.
Objectives. Sports dance - whose specific means we used in the experimental study, are effective ways to develop the self-image, the motivational system and the motivation to achieve the self-image.
70 subjects participated in the research, students from different faculties within the University of Bucharest, based on registration in the sports dance class. Among them, 50 female students and 20 male students, aged between 19 and 25, first-year students at the University of Bucharest. All of them opted for the sports dance class at the beginning of the 2022-2023 academic year. Sports dance lessons were held throughout the academic year according to the curriculum.
Methods. The observation method: were monitored the indicators related to the efficiency of the execution, the improvement of the posture, of the body attitude, the efficiency of the communication, the relationship with the others, as relevant elements for the studied phenomenon.
In addition to direct observation, the video camera and the computer were used.
Speaking: using dialogue to obtain useful information.
For the present research, the preferred subjects are: knowledge of the particularities of the motivational system; hierarchical organization of motives; knowledge of the conditional determinative and inhibiting factors for practicing of sports dance; evaluation and knowledge of the relationship between achievement motivation and self-image.
Questionnaire-based survey: the questionnaire was developed to study self-image and self-esteem. It was developed and applied in order to study the importance that the subjects give to the sports dance practiced in the physical education class for the development of the motivation to realize the self-image.
Statistical-mathematical method – statistical-mathematical processing of the data resulting from the questionnaire.
Graphical representation method: Microsoft Excel was used.
Results. The obtained results were ranked according to the score, tabulated, interpreted and presented graphically.
Conclusion. The processing of the subjects results from the initial and final testing, highlights *the awareness that has occurred on the benefits that the practice of physical exercises, in general and sports dance, in particular, brings to personal development*. *From the results of the study, it emerged that Sports Dance* develops social intelligence, interpersonal relationships, communication ability, emotional intelligence, the ability to make voluntary effort, perceptive qualities.

Keywords: motivation, sports dance, physical exercise, self-image

Introduction

The motivation for physical education and sports activities is subordinate to the general meaning of the concept of motivation and represents the totality of the body's internal mobiles that energetically support, activate and direct the performance of physical education and sports activities.

The motivational process and self-realization within physical education and sports activities represent a very complex aspect, forming in ontogenesis, at the level of the individual's personality, a complex system, hierarchically organized.

It has a unique and original structure and organization, in relation to:

- the personal background;
- the educational influences of the environment;
- the structure and characteristics of personality;
- the maturation level;
- the level of involvement in physical education and sports activities (student, athlete, performance athlete. etc)

M. Bouet (1973), quoted by M. Niculescu (2000), highlights a series of reasons for sports activity, among which we mention:

- the need for movement;
- self-affirmation;
- complementary and balancing compensation;
- affiliation, belonging, relationship and integration needs;
- the need for social status;
- the interest for competing, the need for success, the need to compare with others, the need to oppose others, the desire for the unpredictable, etc.

And also the research carried out in our country reached similar conclusions. Thus, V. Horghidan and I. Holdevici (1977) believe that the reasons which determine the activity carried out by the student in physical education class can be grouped into external and internal reasons, these in turn being grouped into:

- native tendencies;
- social tendencies;
- tendencies related to self-affirmation of the Ego;
- interests in sports activity

It is possible to act in order to develop the self-image by developing the motivational system. An important part of the reasons for sports activity are from the category of achievement reasons, their weight and dynamic organization being directly related to the personality structure.

That is why we consider motivational analysis and the use of motivational procedures as being particularly useful methods and techniques for the specialist in Physical Education and Sport, regardless of the level at which they operate (pre-university education, university, performance sports).

Personal development and performance optimization are highly influenced by the management of resources, among which the energetical ones are of particular importance. Like any other component of the human psychic system, the evolution of the energy activating subsystem is multi-determined, education having a special role in this sense (along with genetic and environmental factors). The importance of motivation in human activity is of internal causality, having functions of energy support, activation, dynamization (together with affectivity), regulator/mediator of human activity. At the same time, motivation is the most significant intermediate variable that intervenes between the task and its realization, thus, it also has the role of mobilizing all the other psychic phenomena and processes (cognitive, psychomotor, etc.) in order to successfully realize the activity.

The interconditioning between the somatic components, the functional capacity of the body's mechanisms and systems, the motor component and the psychic processes, determine the individual's involvement in the exercise. As the body copes with the more and more increased and/or varied motor solicitations, the subject`s motivation for exercise increases, being revised the limits of the self-image regarding the effort capacity and the achieved and the achieved motor capacities.

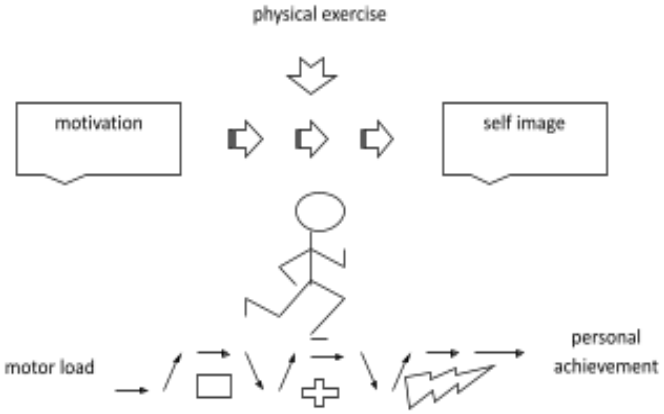


Figure 1. Physical exercise and motivation to adjust the self-image

In this context, physical exercise develops the motivational system, becoming an effective tool that acts by improving the general state of health and physical condition, in order to prevent stress, as well as to prevent the onset of numerous diseases.

The way you see yourself is crucial, because this will affect your behaviour, your thinking and how you relate to others. People respond to you either in a positive or in a negative way, depending on how confident you are. Your confidence in relationships depends on your self-perceived image. (Nair, 2016, quoted by Popovici, Moraru, 2019). Self-perception of competence in a certain domain has a substantial motivational component: those who believe that they are competent in that domain are more persistent and show more interest in it (Gouveia É.R., Ihle A., Gouveia B.R., at al, 2019, quoted by Pavlović, Pelemiš, Marković, Dimitrijević at al, 2023)

Motivation is one of the psychological factors that, along with the personality traits and aptitudes, direct and regulate the individuals' behavior. Believed by Atkinson & Hilgard (2005, p. 507) to be "a state that energizes the behavior, offering it a direction, motivation is lived subjectively as a conscious desire," to do or to achieve something, to perfect oneself, to reach an expected goal. (Dobrescu,T., 2016)

Under the student motivation approach, studies have pointed out that the way in which the teacher organises the sessions, involves students in decision kind, provides execution alternatives, recognises the students' feelings and provides quality feedback, are aspects that have important motivational implications (Hagger & Chatzisarantis, 2007; Hein & Koka, 2007;Standage et al., 2007; Koka & Hagger, 2010; Amado, Sánchez Miguel, Gónzalez Ponce, Pulido, González & Del Villar, 2016)

Physical exercise is accompanied by a wide range of positive experiences, which can determine the widening of the motivational range. Dancing develops direct communication skills, empathic capacity, elimination of inhibitions, especially in the area of non-verbal communication, being an opportune framework for expressing emotional feelings. Good mood, optimism, joy, exaltation, are only some of the affective experiences that accompany practice in general and sports dance in particular. Also, the beauty of the body in motion and the aesthetics of the gestures generate affective states beneficial to a strong psychic tone.

According to M. Epuran, I. Holdevici and F. Toniţa (2001), the interrelationships between the components of the psychobehavioral system are very strong, being possible that, in certain situations, the will acts on the intellect, the intellect on affectivity and motivation, the motivation on feelings.

Although it is not about performance dance, for which the initiation is done from an early age, it is necessary that the approach to the content of this sport within the physical education lessons with the students, be carried out at the initiation level, as corresponding to stage I (Manos, M., 2008)", simultaneously aiming at achieving the general objectives of physical education and influencing the attitude of the practitioners towards dancing, so that they find it as one of the most attractive forms of spending free time.

From the point of view of sports dance characteristics, this is part of the category of aesthetic-artistic sports together with gymnastics and its branches, figure skating, synchronized swimming. It is important that non-verbal language should be expressive, understood by viewers and should create feelings. Within the dance halls there are mirrors for specific exercises, for posture and artistic expressiveness. The other sports disciplines with a playful character do not emphasize these aesthetic characteristics, but have the ability to develop other features.

Research hypothesis

Increasing motivation through the specific means of sports dance in physical education lessons significantly improves self-image.

Subjects and place of research

70 subjects participated in the research, students from different faculties within the University of Bucharest. Among them, 50 female students and 20 male students, aged between 19 and 25, first-year students at the University of Bucharest, at the faculties of: History, Geography, Mathematics, Biology, Foreign Languages, Letters, Public Administration and Business. All of them opted for the sports dance class at the beginning of the 2022-2023 academic year.

Sports dance lessons were held throughout the academic year according to the curriculum.

Research methods

The observation method: the indicators related to the efficiency of the execution, the improvement of the posture, of the body attitude, the efficiency of the communication, the relationship with others, etc., were followed, as being relevant elements for the studied phenomenon. In this sense, the observation protocol, the video camera, the computer were created.

The conversation: using dialogue to obtain useful information.

For the present research, the favorite subjects are: knowledge of the particularities of the motivational system; hierarchical organization of motives; knowledge of the conditional determinative and inhibiting factors for practicing sports dance; evaluation and knowledge of the relationship between achievement motivation and self-image.

Questionnaire-based survey – the questionnaire was developed to study self-image and self-esteem SM. It was developed and applied in order to study the importance that the subjects give to the sports dance practiced in the physical education class for the development of the motivation to realize the self-image. (after SM2, *Mihaiu, C., thesis, 2010)*

Statistical-mathematical method – statistical-mathematical processing of the data resulting from the questionnaire and the applied tests.

Graphical representation method – it was used *Microsoft Excel* program.

The presentation and interpretation of the results obtained by applying the SM questionnaire

The application of the SM questionnaire, in the initial and final testing, allows us to evaluate some aspects regarding the importance that students give in general to the sport practiced in the physical education class and to sports dance in particular.

The answers given to **Item 1** targets the subjects' interest in the field of Physical Education and Sport. This has 5 answer options.

Table no. 1 – Comparative results – Initial testing – Final testing, item 1

Item 1	Subjects` group			
	Initial testing		Final testing	
Answer option	No. sub.	%	No. sub.	%
To a very small extent	5	7.14%	0	0
To a small extent	3	4.28%	1	1.42%
To a certain extent	12	17.14%	7	10%
To a higher extent	19	27.14%	9	12.85%
To a very large extent	31	44.28%	53	75.71%

It is observed that **the interest in the field of Physical Education and Sports** increased in the final testing compared to the initial one.

- *It decreased the number of non-interested* from 7.14% at initial testing to 0 at final testing*;*
- *and increased the number of those showing interest to a very large extent by 31.43%: from 44.28% to 75.71%*.
- *The Physical Education and Sport classes at the University of Bucharest have contributed to increasing students' interest in this field.*

For **item 2** – *"What do you understand by self image?"* Since this item was introduced to evaluate the level of knowledge of the topic, we evaluated the answers with the qualifiers "adequate" or "inadequate".

We can observe from table no. 2, that the group improved their performance, (all subjects accumulating more information and knowledge in relation to the topic of our research in which they were involved) the progress being higher in the case of the final testing.

Table no. 2 – Comparative results – Initial testing – Final testing, item 2

Item 2	Subjects` group			
	Initial testing		Final testing	
Answer option:	No. sub	%	No. sub	%
Adequate	44	62,85%	61	87,14%
Inadequate	26	37,14%	9	12,85%

For **item 3:** *"What do you understand by motivation?"* We evaluated the answers with the qualifiers "adequate" or "inadequate".

We also note that the group has improved its performance. *The range of those who gave correct (adequate) answers increased:*

Table no. 3 – Comparative results – Initial testing – Final testing, item 3

Item 3	Subjects` group			
	Initial testing		Final testing	
Answer option:	No. sub	%	No. sub	%
Adequate	53	71,71%	63	90%
Inadequate	17	24,28%	7	10%

In terms of familiarity with the topic it is noticeable as follows:

- *Students have knowledge that allowed them to issue competent answers* (in the initial testing, the group had a percentage of more than 50%, and in the final testing it increased by 10%);
- *The subjects were cognitively and emotionally involved in the research, as a result they made evident efforts to improve.* Dancing, through its characteristics, determines a great capacity of affective-emotional involvement of the subjects The fact that it is a sport which is performed on music it contributed to the creation of emotional states and feelings that the subjects experienced during the lessons.

Item 4 – "*Which statement fits you best*?"
This item aimed to investigate tendencies in self-assessment, as the subjects sense it.

Table no. 4 – Comparative results – Initial testing – Final testing item 4

Item 4	**Subjects` group**			
	Initial testing		**Final testing**	
Answer option:	**No. sub**	**%**	**No. sub**	**%**
I tend to underestimate myself	31	44,28%	6	8,57%
I have an adequate self-image	39	55,72%	64	91,42%
I tend to underestimate myself	0	0	0	0

From the analysis of the data entered in the table above, it was noticed that:

- *In general, subjects do not perceive themselves as having a tendency to overestimate themselves, rather to underestimate themselves, or to rate themselves adequately;*
- *All subjects achieved improvements in self-assessment, with subjects having a greater progress in the proportion of those who believed they had an adequate self-image, exceeding 90%.* Sports dance contributes to a better knowledge of one's own body, an awareness of posture, of the ability to harmonize movements with music. Through the means used during the dance lessons the self-evaluation of the subjects increased significantly.

Table no. 5 – Scoring method and interpretation of each interval for item 5

Interval	**Formula**	**Interpretation**
350 – 280	5p (which is given for the appreciation "very much") x no. of subjects	At the level of the investigated group, it is considered that sports dance is very important for the development of this factor.
279 – 210	4p (which is given for the appreciation "much") x no. of subjects	At the level of the investigated group, it is considered that sports dance is of great importance for the development of this factor.
209 – 140	3p (which is given for the appreciation "somehow") x no. of subjects	At the level of the investigated group, it is considered that sports dance has some importance for the development of this factor.
139 – 70	2p (which is given for the appreciation "little") x no. of subjects	At the level of the investigated group, it is considered that sports dance has little importance for the development of this factor.
Less than 70	1p (which is given for the appreciation "very little") x no. of subjects	At the level of the investigated group, it is considered that sports dance has very little importance for the development of this factor.

Item 5 is designed to assess the importance that the subject gives to the sport practiced during the physical education class, for his general somatopsychic development:

In item 5, we have calculated and ordered according to the range on which each factor is located. To determine the score, we awarded points for each level of the appreciation scale:

- Very much– 5p; much – 4p; somehow– 3p; little – 2p; very little– 1p

The results obtained and ordered according to the score were tabulated and presented below.

Table no. 6 – Group results – initial testing - item 5

Factorul	Range	Score	Interpretation
To have a harmoniously developed body	1	320	At the level of the investigated group, it is considered that sports dance is very important for the development of this factor.
Health	2	316	
To have more self confidence	3	280	
To integrate better socially	4	260	At the level of the investigated group, it is considered that sports dance is of great importance for the development of this factor.
To relax	5	235	
To correct certain physical deficiencies	6	220	
To develop the personality	7	128	At the level of the investigated group, it is considered that sports dance has little importance for the development of this factor.
To be more efficient in the activity	8	120	
To widen the field of knowledge	9	70	
To correct certain psychic problems	10	16	

Table no.7 – Results of the experimental group – final testing - item 5

Factor	Range	Score	Interpretation
To have more self confidence	1	316	At the level of the investigated group, it is considered that sports dance is very important for the development of this factor.
To have a harmoniously developed body	2	306	
Health	3	288	At the level of the investigated group, it is considered that sports dance is of great importance for the development of this factor.
To be more efficient in the activity	4	251	
To integrate better socially	5	227	
To widen the field of knowledge	6	195	At the level of the investigated group, it is considered that sports dance has some importance for the development of this factor.
To relax	7	170	
To develop the personality	8	158	
To correct certain physical deficiencies	9	153	
To correct certain psychic problems	10	150	

Item 6 is designed to assess the importance the subject attaches to the sport practiced in physical education class, for the development of his motor qualities: speed, strength, resistance, flexibility, coordination, balance, precision.

For the establishment of the score we have appreciated as follows:

- Very much– 5p; much – 4p; somehow– 3p; little – 2p; very little – 1p

Also, the intervals for the qualitative interpretation were established by the same formula (no. of points awarded x no. of subjects), being the following:

- 350–280 – very important;
- 279-210 – important;
- 209–140 – somehow important;
- 139–70 – little important;
- 0–69 – very little.

Thus, the points were calculated and the corresponding range was established for each factor and they were passed in the descending order of the range (and the resulting score), interpreting the importance of each factor. The following results were obtained:

Table no. 8 – Group results – initial testing – item 6

Factor	Range	Score	Interpretation
Suppleness	1	342	The investigated group believes that sports dance is very important for the development of this factor.
Coordination	2	305	
Balance	3	286	
Speed	4	262	The investigated group believes that sports dance is of great importance for the development of this factor.
Strength	5	136	The investigated group believes that sports dance has little importance for the development of this factor.
Resistance	6	122	
Precision	7	115	

Table no. 9 – Group results – final testing - item 6

Factor	Range	Score	Interpretation
Suppleness	1	342	The investigated group believes that sports dance is very important for the development of this factor.
Coordination	2	326	
Balance	3	335	
Precision	4	315	
Resistance	5	304	
Strength	6	286	
Speed	7	280	

Item 7 is designed to assess the importance the subject attaches to the sport practiced in physical education class, for the development of his mental qualities.

In item 7, we have calculated and ordered according to the range on which each factor is located. To determine the score, we proceeded as in the case of items 5 and 6, as follows:

We awarded points for each step on the appreciation scale:

- Very much – 5p; much – 4p; somehow – 3p; little – 2 p; very little – 1 p

The scores obtained in this way helped us to qualitatively assess the results of the group of subjects. The intervals for the qualitative interpretation were established by the same formula (no. of points awarded x no. of subjects), being the following:

- 350–280 – very important;
- 279–210 – important;

- 209-140 – somehow important;
- 139-70 – little important;
- 0-69 – very little.

Thus, the points were calculated and the corresponding range was established for each factor and they were passed in descending order of range (and the resulting score), interpreting the importance of each factor.

The following results were obtained:

Table no. 10. – Group results – initial testing – item 7

Factor	Range	Score	Interpretation
The aesthetic sense	1	310	The investigated group believes that sports dance is very important for the development of this factor.
The ability of self-control	2	290	
The ability to put voluntary effort	3	278	The investigated group believes that sports dance is of great importance for the development of this factor.
The development of interpersonal relationships	4	273	
The ability to communicate	5	264	
Social intelligence	6,5	260	
Emotional intelligence	6,5	260	
Perceptive qualities	8	262	
The qualities of attention	9	246	
The ability to recover after effort	10	243	
Emotional stability	11	232	
Team spirit	12	226	
Intellectual qualities	13	220	
Imagination	14	214	

Table no. 11 – Group results – final testing – item 7

Factor	Range	Score	Interpretation
The aesthetic sense	1	323	The investigated group believes that sports dance is very important for the development of this factor.
The ability of self-control	2	318	
Social intelligence	3	310	
The development of interpersonal relationships	4	304	
The ability to communicate	5	290	
Emotional intelligence	6	289	
The ability to put voluntary effort	7	282	
Perceptive qualities	8	260	
The qualities of attention	9	254	The investigated group believes that sports dance is of great importance for the development of this factor.
The ability to recover after effort	10	250	
Emotional stability	11	246	
Team spirit	12	238	
Intellectual qualities	13	230	
Imagination	14	227	

The processing of the subjects` results in **items 5, 6 and 7***, from the initial and final testing, highlights the awareness that was produced over the benefits which practicing physical exercises, in general, and sports dance, in particular, brings for personal development and for self-esteem.*

Therefore, for **item 5** – which assessed the general somatopsychic development, it was noticed that, if at the initial testing the subjects considered that sport dance had little importance for: personality development, performance in the activity to widen their field of knowledge and to correct certain mental problems, in the final testing no element was included in the categories of little and very little importance.

For **item 6** – *the group of subjects* considered at the initial testing that sports dance had little importance for the development of strength, resistance, and precision, compared to the final testing when they considered that sports dance has a very high importance for the development of all motor and psychomotor qualities (suppleness, coordination, precision, balance, resistance, strength, speed).

For **item 7** - regarding the assessment of the importance of sports dance for the development of mental qualities, both at the initial and final testing, *the group of subjects* considered that sports dance has a very high and great importance for the development of all the mental qualities presented as answer options. At the final testing, the great importance of sports dance was recognized for the development of the following qualities: social intelligence, the development of interpersonal relationships, communication ability, emotional intelligence, the ability to make voluntary effort, perceptive qualities.

Conclusions

The students involved in the research have the necessary knowledge to enable themselves to issue competent answers. They had a positive attitude and were involved in the research.
It was highlighted the efficiency of the response systems applied for:

- increasing the subjects' interest in the field of physical education and sport;
- improving the ability of self-assessment;
- awareness of the benefits that practicing sports dance brings for personal development: general somatopsychic development, development of motor and psychomotor qualities; development of psychic qualities.

The reasons which have the highest frequency are the ones that have the highest activator-energetic force. The first three ranges indicate those reasons that guide the conduct. The orientation towards the practice of sports dance could be related to the satisfaction of these needs which often, "the strongest needs" indicate, in fact, "the most unsatisfied needs".

References

Diana Amado, Pedro A. Sánchez Miguel, Inmaculada Gónzalez Ponce, Juan J.Pulido Gonzále & Fernando Del Villar, 2016, *Motivation towards dance within physical education according to teaching technique and gender,*
from:*https://www.researchgate.net/publication/308906436_Motivation_towards_dance_within_physical_education_according_to_teaching_technique_and_gender,* South African Journal for Research in Sport, Physical Education and Recreation, 2016, 38(2):1-16.

Dobrescu,T., 2016, *The motivation of high-school pupils for participating in the curricular physical education activitie*s, 2016, Science, Movement and Health, Vol. XVI, ISSUE 2, 2016, pg. 255.

Dragnea, A., şi colab. 2006, *Educaţie fizică şi sport – teorie şi didactică.* Editura FEST, Bucureşti EPURAN, M., 2005, *Metodologia cercetării activităţilor corporale*, Ediţia a II-a. Editura FEST, Bucureşti EPURAN, M., Horghidan, V., 1994, *Psihologia educaţiei fizice,* Editura A.N.E.F.S., Bucureşti.

Gouveia É.R., Ihle A., Gouveia B.R., Rodrigues A.J., Marques A., Freitas D.L., Kliegel M., Correia A.L., Alves R., Lopes H., 2019, *Students' Attitude Toward Physical Education: Relations With Physical Activity, Physical Fitness, and Self-Concept. Phys. Educ.* 2019;76:945–963.
DOI: https://doi.org/10.18666/TPE-2019-V76-I4-8923
from:https://js.sagamorepub.com/index.php/pe/article/view/8923

M. Epuran, I. Holdevici, F. Toniţa, 2001, *Psihologia sportului de performanţă*, Editura Fest, Bucureşti, p. 321.
Horghidan, V., 2000, *Problematica psihomotricităţii*. Editura Globus, Bucureşti, p. 30.
Iluţ, P., 2001, *Sinele şi cunoaşterea lui. Teme actuale de psihosociologie.* Editura Polirom, Iaşi.
Iluţ, P., 2004, *Valori, atitudini şi comportamente sociale.* Editura Polirom, Iaşi.
Manos M., 2008, *Gimnastica ritmică de performanţă*, Edit. Bren, Bucureşti p. 179.
Mihaiu, C., 2010, *Contribuţia dansului sportiv la creşterea motivaţiei de realizare şi îmbunătăţirea imaginii de sine, Teză de doctorat,* p.183.
Popovici, I.M., Moraru, C. E., *The role of self-image and motivation in sports performance,* International Proceedings of Human Motricity/ ICPESK 2019 Supplementary Issue of Discobolul – Physical Education, Sport and Kinetotherapy Journal, 2019, p. 195, DOI: 10.35189/iphm.icpesk.2019.30, from:https://discobolulunefs.ro/media/ICPESK2019DJ30.pdf.
Slobodan Pavlović, Vladan Pelemiš, Jovan Marković, Marko Dimitrijević, Marko Badrić, Sabolč Halaši, Ivko Nikolić, and Nebojša Čokorilo, 2023, *The Role of Motivation and Physical Self-Concept in Accomplishing Physical Activity in Primary School Children,* Sports (Basel). 2023 Sep; 11(9): 173., Published online 2023 Sep 5.
doi:10.3390/sports11090173, from:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10535512/#B23-sports-11-00173

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 42-46
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-6

STUDY CONCERNING THE IMPROVEMENT OF SPEED THROUGH BASKETBALL SPECIFIC TRAINING

Robert SAKIZLIAN[1*], Monica SAKIZLIAN[2]
[1,2]*University of Bucharest, The Department of Physical Education and Sport, Romania*
* Corresponding author: sakizlian@yahoo.com

Abstract*. Background.* The major importance of physical education lessons in higher education is achieved through their contribution to maintaining health, to compensating for the increased intellectual efforts generated by passing exams. Basketball training helps in the positive development of the general and specific motor capacity required by the subsequent professional activity, as well as to the achievement of the necessary framework for recreation and the practice of the favorite sport. Therefore, at this level, the achievement of the following objectives will be mainly pursued:

– maintaining health and increasing the ability to adapt to changing conditions;
– the development of the general motor capacity necessary to carry out the sports activity;
– improving the somato-functional indices and optimizing the relationship between them.

Physical training is a component of sports training that constitutes the pivot for all other components, constituting the starting point for the entire training process (Ardelean. T, 1996). General physical training has different weightages in training, depending on the experience of the students and for the training of beginner students it is very important that the time allocated is much greater than in the training of students from older years.

Objectives. This study aims to find and offer, through specific basketball exercises, how to improve the quality of speed. Speed should be present in the equipment of the "motric luggage" of each student, considering the evolution of our modern society, to dynamic games. This speed quality motor offers several advantages to basketball players:

– allows the execution of thechnical and tactic actions in a sustained rhythm.
– gives the player a high degree of complexity and dynamic adaptation to playing basketball.
– develops the player's thinking, attention, rationality and ability to concentrate.

Methods. For this study we used the following research methods: documentation, observation method, statistical method, graphical representation method and experimental method.

Results. For checking the motility of students enrolled in educational experiment we chose the following control samples: speed running 15m, speed running 20m and dribbling through cones.

Conclusion. The results of this test depend both on the execution speed and the technique in performing the dribbling. We therefore recommend that these results can be improved both by increasing the speed of movement and the execution technique.

Keywords: physical education, basketball, speed.

***Introduction*.** Basketball as a sport, is a natural harmonious movement with simple and affordable motor skills. This game takes place against a background of intense physical demands, with a strong formative character.

Each period of physiological development is determined by the morpho-functional changes from the previous period and conditions the further development of the organism. At the same time, each period of development represents in itself a perfect physiological form that allows an adaptation of man to the environment or of the athlete to effort.

According to studies by Epuran M; Holdevici I. (1980) "Mental training combined with a series of exercises can be particularly effective in performance sports, both in learning and in improving performance, because the execution of action in the imaginative plan fully engages participation the body in terms of physiological indicators".

The demand for energy systems differs in stand by or effort. In stand by, the aerobic system is required, the oxygen consumed being equal to the amount of oxygen required in basal conditions, not being a matter of oxygen duty.

During exercise both aerobic and anaerobic systems, contributing to ATP resynthesis in the effort. Their contribution during exercise depends on the duration and intensity of effort.

In the training process of basketball players, we must also take into account the physiological parameters of the body, because they can tell us if the training is appropriate or not.

Specialists (Olăroiu M., 1998; Bota C., 2002) specify that in order to test the functional capacity of the organism, it is necessary to use exploration techniques that can target several body systems:

- Respiratory system: respiratory rate, vital capacity, Lorentz index;
- Cardiovascular system: heart rate Ruffier test, test Sargent.

Basketball is included in the notion of collective game. Sports game is a complex of exercises played as a game with a few object (ball, ball, puck, etc.), In this direction two teams compete under some rules and aims to achive the tasks of physical education (in this case becomes its means) or making sports performance (in this case it becomes a form of competition and sports show), and as a means of recreation.

***Environment**:* Physical education and sport

Assumptions. By studying the training of a university basketball team, data and observations can be recorded that will allow the interpretation and appreciation of the following parameters:

1. the level of physical training in general

2. the level of development and manifestation of specific motor qualities, respectively speed in our case.

Following the course of the lessons where some exercises corresponding to our study are also included – the improvement and development of speed motor quality – we can highlight certain conclusions about the content but also the way of manifestation of this motor quality.

Research methods For this study we used the following research methods: documentation, observation method, statistical method, graphical representation method and experimental method.

Content. For checking the motility of students enrolled in educational experiment we chose the following control samples:

1. speed running, standing start – 15m. 2X
   – best record attempt
2. speed running, standing start – 20m. 2X
   – best record attempt
3. dribbling through cones, right hand and left hand, 2X
   – the best one will be noted.

The results were statistically analyzed and are presented in Table 1, and Fig.1.

Table 1. Results of tested samples

	CP	MA	BI	ZAM	BI	SI	CA	GF	MO	CS	MAM	MI		CA	GS	CC	RD	AVG
Speed 15m	2.8	3.1	2.8	3	2.8	2.8	3.9	3.8	3.8	3.1	3.2	3.8		3.4	2.8	2.7	3.4	3,4
Speed 20m.	3.9	4.2	4.4	4.7	4.5	4.3	5.3	4	4.8	3.9	4	4.8		4.6	4.6	4.5	4.6	4,6
Dribbling through cones	7.1	7	8.5	8.2	7	7.4	7	7.1	8.2	8.4	8.8	8.4		9.2	8.2	8.4	8	8

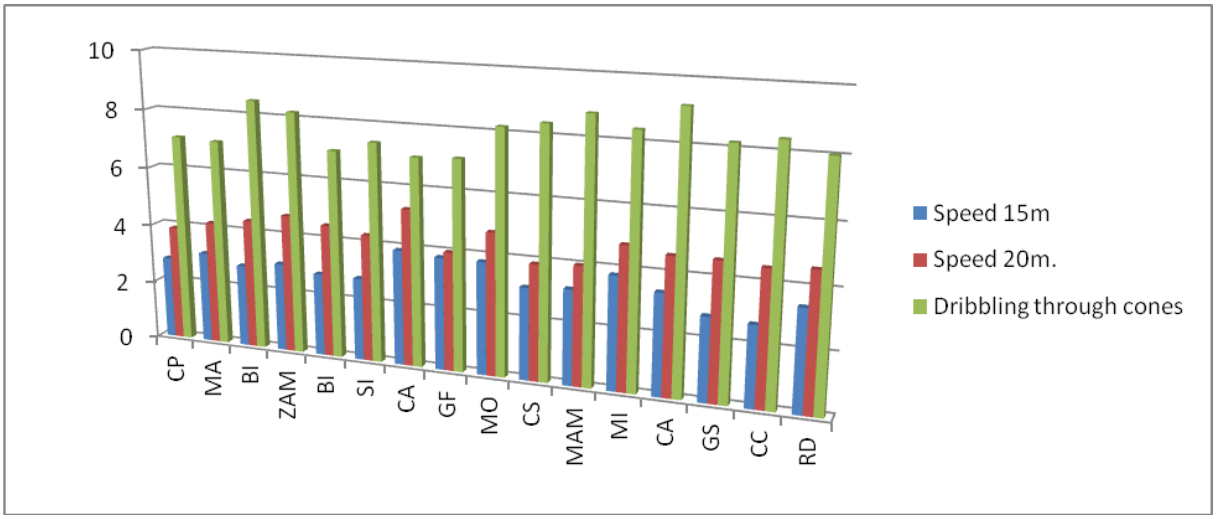


Figure 1. Results of tested samples

In the 15m sprint test - we measured reaction and movement speed – the team's average is 3.2 sec. Because there is no data in the specialized literature to compare this value, we took the best value from the recorded results as the term of comparison. This is 2.7 s recorded for the student Ceaparu Clara. A difference of 0.5 s is observed between the average value of the team and the best value. From the 16 student members of the team, 9 players have a value between 2.7 and 3.2, one player has the average value of the team, 6 players have values higher than the average of the team – up to 3.9.

We appreciate, taking into account that at this age there are no comparative data for female basketball players, the following: because 10 of the students have values between the best value and the average value, the speed is quite homogeneously developed. The other 6 student members of the team have values up to 3.9. Taking into account the particularities of the development of this quality, we consider that in the future, using appropriate means, this motor quality can be further developed.

Table 2. First six values at the test speed running on 15 m

Name	CC	BI	BI	SI	GS	ZAM
Speed test 15m	2.7	2.8	2.8	2.8	2.8	3.01

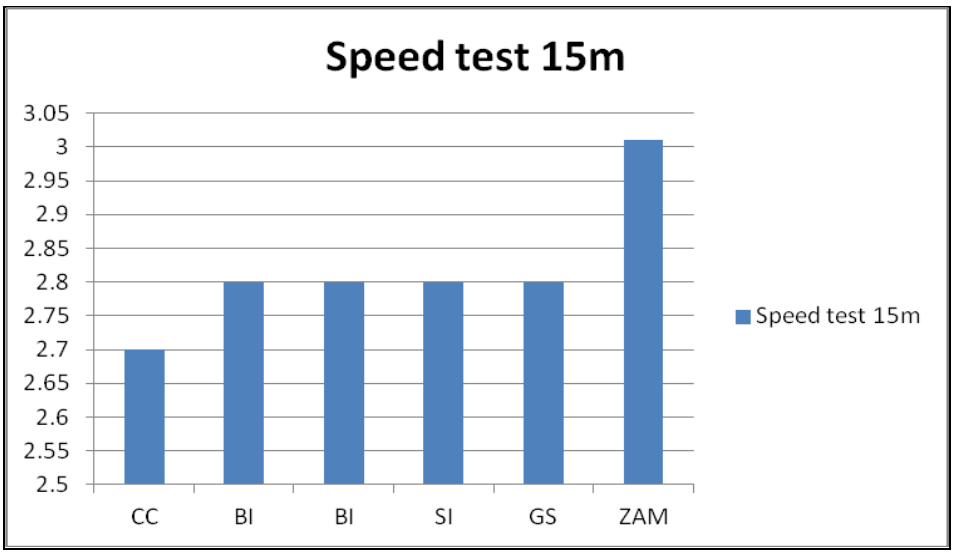


Figure 2. First six values at the test speed running on 15 m

The best value of 2.7s recorded in the 15m speed run test belongs to the CC student and the results of the first six values at the test speed running on 15 m, are shown in the following table and the table no.2 and Fig.2.

In the 20m sprint test – we also tested reaction and movement speed – the team's average is 4.4 sec. For the same reasons – the lack of data – to compare this value we took as the term of comparison the best value from the recorded results. This is 3.9 sec. registered with players C.P. and C.S. A difference of 0.5sec is observed between the average value of the team and the best value. From the 16 players, 6 players have a value between 3.9 and 4.4, one player has the average value of the team, 9 players have values higher than the team average – up to 5.3 sec.

Because 7 of the players have values between the best value and the average value, a change is observed compared to the 15m sprint test, regarding the number of players with the best value and the average value, 10 respectively 7. The other 9 student members of the team have values up to 5.3.

The best value of 3,9s recorded in the 20m speed run test belongs to the C.P. and C.S. students and the results of the first five values at the test speed running on 20m, are shown in the following table and the chart no3:

Table 3. The first five values to test speed running on 20 m

Name	CP	CS	GF	MAM	MA
Speed test 20m	2.7	2.8	2.8	2.8	2.8

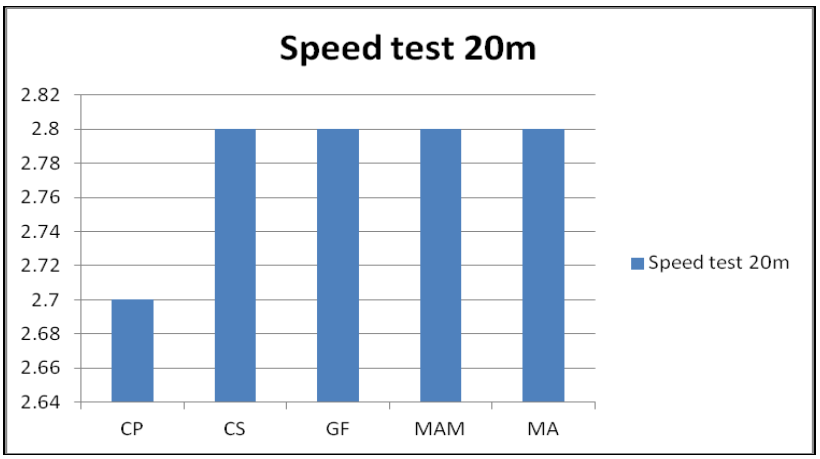


Figure 3. First five values at the test speed running on 20 m

In the test of dribbling between cones, we evaluated the speed of dribbling execution. This parameter is also dependent on the dribbling execution technique. The average value is 8.02 and the best value is 7.02.

A number of 6 students were above the average. The results of this control sample can be improved both by increasing the movement speed and the execution technique. The best value in the dribbling test among the cones belongs to the CA student and the results of the first five values at the dribbling test, are shown in the following table and the chart no4:

Table 4. The first five sample values recorded at dribbling through cones

Name	CA	MA	BI	CP	GF
Dribbling test	7.02	7.03	7.03	7.09	7.09

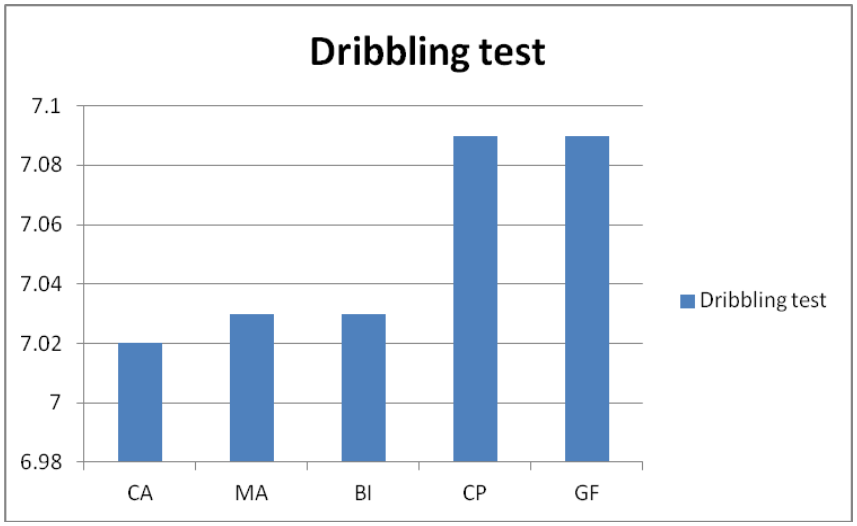


Figure 4. Dribbling test

Conclusions

In the 15 m sprint, the average is 3.2 s and the best value is 2.7 s. There is a difference of 0.5 s between the team average and the best value, and out of a number of 16 female students, 9 students have a value between 2.7 and 3.2, one student has the average value of the team, which allows us to conclude that the speed is quite homogeneously developed, that the means used in the preparation the students were mostly good.

In the 20 m sprint test, the average is 4.4 s, and the best value is 3.9 s. The same difference is observed between the overall average and the best value – 0.5 s – but the number of subjects with values between these averages begins to decrease. For this reason, we propose an increase in the homogeneity of speed at the level of all female students in the team by alternating short-distance training with longer-distance training.

In the test of dribbling between the cones, the average is 8.02 s, and the best value is 7.02 s. The results of this test depend both on the execution speed and the technique in performing the dribbling. We therefore recommend that these results can be improved both by increasing the speed of movement and the execution technique.

References

Bota, C., 2002. *Fiziologie generală. Aplicaţii la efortul fizic*, Editura Medicală, Bucureşti, 96-101.
Cârstea,G., 1999. *Educaţie fizică – Fundamente teoretice şi metodice*, 35-67.
Moanţă, A.,2000. *Pregătirea fizică în jocul de Baschet*, Pro Editura, 80-103.
Epuran M., Holdevici, I., 1980. *Compendiu de psihologie pentru antrenori.* Editura Sport-Turism, Bucureşti, 50-57.
Sakizlian, R., 2012. *Optimizarea capacităţii de efort a studenţilor baschetbalişti*, Editura Universităţii Bucureşti, 46-78.
Pufulete E., Orha I., 1994. *Sistemul cardiovascular. Medicina sportivă aplicată*, Editura Editis, Bucureşti, 15-23.

SPORT PERFORMANCE

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 48-55
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-7

EVALUATING THE LATERALITY OF MARTIAL ARTS PRACTITIONERS THROUGH THE KINEMATIC ANALYSIS OF STRIKING TECHNIQUES

Robert DELIU[1*]

[1]*DEFS, University of Bucharest*
*Corresponding author: robdel277@gmail.com

Abstract. The purpose of this study was to objectively measure and highlight laterality differences of high-performance martial arts athletes with hitting techniques and comparing the results registered by each subject. The hypothesis of this research is that through kinematic analysis on both fighting stances (dominant and non-dominant) we can highlight the differences in laterality for each subject. We used a system of inertial measurement units based on 17 motion tracking sensors composed of 3D gyroscopes, 3D accelerometers and 3D magnetometers namely the MVN Xsens Awinda system. We acquisitioned data from 8 high-performance athletes practicing martial arts with hitting techniques. We calculated and analyzed kinematic parameters for some of the most frequently used techniques in this category of martial arts, more specific direct and circular kicks. In order to obtain information related to the level of laterality of the monitored athletes, we compared the values of these parameters for the technical executions on the dominant and non-dominant side and highlighted the significant differences through the Wilcoxon Signed Rank nonparametric significance test. To facilitate comparisons between subjects in terms of laterality, we drew up an original evaluation scale and created diagrams based on the scores obtained by them. Based on these evaluations, directing and individualizing training and choosing combat tactics can be made much more informed.

Keywords: martial arts, kinematic, laterality, MVN Xsens.

Introduction

Technology has undergone a major evolution in all fields of activity in the past century. Such improvements were felt not only in everyday life, but also in the field of sports. We considered that these innovative solutions are necessary and auspicious in Romanian martial arts as well.

There are two types of martial arts (as sports disciplines) competitions: the one that involves direct confrontation between practitioners, the fight being subdued to the specific rules of each style, and the one in which the ranking of the athletes is based on a score given by the referees for their individual or team performances without an active opponent. More specific, the last one refers to Kata. Kata comes from Japan and it means a fight with imaginary opponents. Some katas remained in the same form since the founder of the style created them and some katas are created by coaches and practitioners based on their skills and preferences.

Both attack and defense techniques in martial arts must be performed based on a set of motor qualities, the most important of which are speed, precision (in all styles) and strength (in full contact styles). As a consequence, performance-oriented techniques are trained to achieve the highest level of speed and the highest level of strength in the shortest possible time.

Fighting with an imaginary partner/targets, widely referred as “shadow fighting” is a very popular part of a martial artist's entire training. In this type of training, athletes try to perform their techniques as quickly and correctly as possible from the point of view of form.

Due to the very high execution speeds of the techniques specific to martial arts, it is impossible for the trainers to make a totally objective and complete analysis, considering the fact that many of the details of the execution evade human perception.

In order to increase the chances of winning in competitive fights, the athletes' arsenal must be as rich as possible. This is achieved both by increasing the number of known techniques and combinations, as well as by the fact that they can be performed bilaterally, involving both hands and feet.

Therefore, a very useful quality of fighters is ambilaterality and it is targeted in their training from the beginning of their sports career.

Laterality can be considered an asset that is used in the choice of fighting tactics.

An athlete who executes the same techniques as well as possible also on the non-dominant side can easily surprise the opponents, can adapt to various opponents, can find solutions more easily even after the appearance of injuries in the fight or fatigue.

For this reason, we consider the possibility of objectively knowing the degree of technical correctness and the performance level of the executions on both sides for each athlete to be essential both for the individualization of the training and for choosing the optimal tactics.

Although laterality has been of major interest to neuroscientists over time, studies on the laterality of martial arts fighters are much more recent. Considering that we planned to carry out an analysis of the laterality of martial arts athletes starting from a kinematic analysis of the techniques performed by them, we started from the study of specialized research from the national and international literature that focused on both kinematics and laterality in this field and also the ones that referred to different means of acquiring data in this field.

Mikheev, M., Mohr, C., Afanasiev, S., Landis, T., & Thut, G. (2002) investigated the differences in the specialization of the cerebral hemispheres in high-performance judoka and a control group with no experience in the sports field. Their conclusions were that the analyzed athletes also perform tasks with the non-dominant arm more often, as opposed to the control group. The higher the level of technicality, the use of the non-dominant part is even higher. They attribute this behavior to neuroplasticity of the brain.

Gursoy R. (2009) analyzed the number of defeats in relation to the total number of fights of boxers with experience of 4-15 years, divided by the criteria of the dominant arm (left-handed and right-handed). The result of this research was that the left-handers had a defeat percentage of 19.32 out of an average of 120.6 matches and the right-handers a defeat percentage of 42.25 out of an average of 127.8 matches. Statistically, left-handed boxers are more successful.

Sterkowicz, S., Lech, G., Blecharz, J. (2010) proved that at a high level of technicality, left-handed judokas have significantly higher chances of winning battles. They showed the effect of the laterality of the upper and lower train on the preferred directions of attack.

Baker J, Schorer J (2013) tried to correlate the orientation of the fighting stance with the success in MMA (mixed martial arts). They studied 1468 cases from a reliable database. They took into consideration not only the position of the fight and the percentage of victories, but also the number of fights, comparing the athletes with a similar number of fights. A first conclusion was that those who adopt the southpaw stance (17%) are more than the average left-handed in the general population (10-12%). Statistically they did not prove a significant difference in terms of percentage of victories between the two guards. They also couldn't conclude whether the victories were due to attacks or defenses, therefore reactions, not actions on that stance. The authors stated that MMA are very complex, that it is difficult to correlate success with a single factor and that there are few databases in this regard.

Băiţel, I., Pătru, L. M. (2019) in this study, the influence of practicing sports on children is highlighted. For the 2 groups of children, the ruler test and touch the plates test were applied and also they measured the reaction speed to visual and auditory stimuli. The results recorded by the athletes were better (both the reactive times and the laterality differences were lower) than in non-athletes.

Witte, K., Emmermacher, P., Bystrzycki, S., Potenberg, J. (2007) studied the mawashi geri and ura-mawashi geri kicks executed with both the front foot and the rear foot using the VICON data capture system based on 8 MX 40 cameras with a purchase rate of 250 Hz. The aim of the study was to find kinematic similarities and differences between the 4 variants of techniques. They found that

the relationships between them depended on the subject, instead, for all the subjects analyzed, the shortest duration of execution was of the mawashi geri kick with the front foot.

Kim, Jae-Woong, Kim, Jemin, Lee, Sang-Woo, Han, Ki-Hoon, Kwon, Young-Hoo. (2010) set out to study the effect of the distance at which the target is located on the twist angle of the hip, torso, pelvis and on the attack movement in the circular taekwondo kicking technique. Twelve holders of black belts performed this shot over 3 distances, small, medium and large. They obtained data using a three-dimensional video analysis. It was found that the adjustment for different distances was accompanied by hip rotation, hip flexion and twisting to the left of the hip. The distance of the target especially influences the achievement of the control function of the pelvis and the balance function of the trunk.

Kimm, D., Thiel, D. (2015) using an accelerometer based on a micro-electro-mechanical system, built by the SABEL laboratories of The University of Griffith, the authors measured the jab and cross strikes executed by 16 athletes. From the recorded accelerations, they calculated the speeds of the punch techniques. Their conclusions were that the speed of the fist depends more on experience than on age or gender, it is significantly influenced by the scale. A shortcoming of the study mentioned by the authors is that based on the accelerometer and video images one cannot fully highlight the withdrawal movement.

Gavagan, C. J., Sayers, M. (2017) compared athletes from 3 different styles and tried to show the correlation between the attack foot speed at mawashi geri and the force of impact, using 7 Qualisyss Motion Capture System cameras with a purchase rate of 500 Hz and an 8SP PowerLab pressure plate synchronized with an AD converter system. Differences were found in the duration of execution between the muay thai group and the taekwondo group. It also determined the angular velocity in the knee extension which was significantly higher in the taekwondo and karate group than in muay thai. Despite these differences, they also highlighted common movement patterns and concluded that the effectiveness of the kick is conditioned by the axial rotational speed of the pelvis, the flexion speed of the hip and the speed of extension of the knee along with rapid movements of the center of mass towards the target.)

Hölbling, D., Preuschl, E., Hassmann, M., Baca, A. (2017) used a 3D-motion Vicon capture system as a method of data acquisition and tracked several parameters of the doubled side kick, such as: the height of the kicking leg, the distance from the advanced shoulder of the foot at the end of the reinforcement phases, the speed of the foot during the reinforcement phases and the total duration of the kick.

With the help of 3D video analysis, Diniz, R., Del Vecchio, F. B., Schaun, G. Z., Oliveira, H. B., Portella, E. G., da Silva, E. S., Formalioni, A., Campelo, P., Peyré-Tartaruga, L. A., Pinto, S. S. (2021) followed several kinematic parameters of the circular kick performed by subjects from 3 different styles. Their conclusions were that in order to improve their technique, athletes in muaythai must increase the strike distance, while athletes in taekwondo and karate must reduce it.

Polak, E., Kulasa, J., VencesBrito, A., Castro, M. A., Fernandes, O. (2016) state that there are few studies published in recent years about the possibility of using motion analysis systems in sport and that not a single one in combat sports, so they have carried out an approach with the aim of determining which of the devices or methods may be applicable in this field. Next, the authors presented several systems of motion analysis, with the advantages and disadvantages of each one, and concluded that not all of them are suitable for the peculiarities of movements in martial arts and combat sports.

Kim, Y., Baek, S. and Bae, B.-C. (2017) compared the accuracy of data acquisitions related to human movement using dance and taekwondo techniques. For this they used the MVN Xsens equipment as a reference system and one, then a system consisting of 8 Microsoft Kinect cameras with a purchase rate of 30 fps. The conclusion of the study was that when using a single Microsoft Kinect camera, the accuracy is around 60%, when using the system, around 80%. However, the system could not faithfully record the rapid movements either.

The purpose of this study was to objectively measure and highlight laterality differences of high-performance martial arts athletes with hitting techniques and comparing the results registered by each subject.

The objectives of the study were the following: the selection of the subjects based on the criteria of experience and competitive records, the selection of techniques to be analyzed among the most used in competitions, the calculation of the values of the kinematic parameters relevant to our purpose, the calculation of the differences recorded between the dominant and the non-dominant sides, designing a scale for evaluating the laterality and creating diagrams to facilitate the comparison between the subjects.

The hypothesis of this research is that through kinematic analysis on both fighting stances (dominant and non-dominant) we can highlight the differences in laterality for each subject.

Methodology

The subjects of the research were 8 senior athletes, national and international champions (European and World Championships) practitioners of three of the most popular martial arts styles: karate, kempo and kickboxing. They were informed about the purpose of the study and they expressed their informed consent regarding participation. All necessary measures have been taken to protect private data.

The study was carried out within the National Research Institute for Sport from Bucharest. The equipment used for data acquisition was the Awinda version of MVN Xsens that uses 17 wireless sensors with an acquisition frequency of 60 Hz.

The striking techniques for which the data acquisition was made were among the most used at the competition level, namely direct and circular kicks.

The kinematic parameters chosen for calculation and comparison were: the maximum speed of the hitting segment, the flexion-extension angle of the knee at the moment of impact and the duration of the execution of the technique.

After a standard warming up program, the subjects were equipped with the MVN Xsens gear and it was calibrated for their anthropometric parameters. Each one executed according to his own style as quickly and technically correct as possible 10 executions of each mentioned technique, both with the right leg and with the left one. The techniques were executed towards an imaginary target, as in shadow fighting training. All subjects have as their dominant side the right one.

The recorded data were converted to .xslx format and the mentioned parameters were calculated starting from the positions of the sensors in the 3D space. The results were statistically processed using the Wilcoxon Signed Rank nonparametric significance test.

Results

In order to validate the differences in the recorded values of the monitored parameters, a conventional significance threshold, called alpha threshold, was established with a value of 0.05 ($p \leq 0.05$), representing a confidence level of 95%.

Table 1. The maximum velocity of the hitting leg

Spor	Subject	Fist	Cases	Am	Me	Stdv.	CV	p
Karate	S1	Right	10	10.99	10.80	0.49	4.4%	**0.047**
		Left	10	12.04	12.21	1.28	10.6%	
	S2	Right	10	13.43	13.40	0.69	5.1%	0.799
		Left	10	13.34	13.88	1.15	8.6%	
	S3	Right	10	10.68	10.82	1.46	13.7%	**0.017**
		Left	10	10.18	9.91	1.50	14.7%	
	S4	Right	10	11.46	11.55	0.32	2.8%	**0.009**

Kempo	**S5**	**Left**	10	12.39	12.43	0.59	4.8%	0.445
		Right	10	11.90	12.00	0.57	4.8%	
	S6	**Left**	10	11.58	11.83	0.74	6.4%	**0.037**
		Right	10	8.88	8.58	0.76	8.5%	
Kickbox	**S7**	**Left**	10	9.34	9.25	0.45	4.9%	0.285
		Right	10	11.43	11.35	0.67	5.9%	
	S8	**Left**	10	11.62	11.62	0.57	4.9%	0.575
		Right	10	10.98	11.06	0.52	4.8%	
		Left	10	10.83	10.91	0.55	5.1%	

Cases – Recorded values (10 values per subject); Am – Arithmetic mean; Me – Median; Stdv. – Standard deviation; CV – Coefficient of variation; p- Asymp. Sig. (2-tailed) of the Wilcoxon Signed Ranks Test;

Analyzing the executions of the 8 athletes included in the analysis (Table 1), on both guards, both those made with the right foot and those made with the left foot, it is found that the maximum speed recorded per kick with the right foot does not statistically significantly differ from that made with the left foot in half of the athletes. Exceptions were registered in the case of an athlete practicing karate (S1), an athlete practicing kempo (S4) and an athlete practicing kickboxing (S6), situations in which the speeds recorded with the left leg are significantly higher than those made with the right foot. Likewise, in the case of the karate athlete (S3), the difference between the two kickers is statistically significant, but the higher value is recorded for kicks with the right foot.

Table 2. The maximum knee extension of the hitting leg

Sport	Subject	Fist	Cases	Am	Me	Stdv.	CV	p
Karate	**S1**	**Right**	10	163.54	162.89	8.79	5.4%	0.721
		Left	10	165.29	165.34	6.50	3.9%	
	S2	**Right**	10	169.38	170.88	5.08	3.0%	0.445
		Left	10	167.07	166.82	8.90	5.3%	
	S3	**Right**	10	158.09	158.24	5.64	3.6%	**0.005**
		Left	10	149.27	148.10	4.86	3.3%	
Kempo	**S4**	**Right**	10	176.53	176.97	1.69	1.0%	0.878
		Left	10	176.91	176.69	1.40	0.8%	
	S5	**Right**	10	174.96	175.14	1.81	1.0%	**0.028**
		Left	10	177.20	177.78	1.74	1.0%	
Kickbox	**S6**	**Right**	10	176.64	177.86	2.91	1.6%	0.285
		Left	10	177.81	178.17	1.15	0.6%	
	S7	**Right**	10	176.60	176.97	1.89	1.1%	0.959
		Left	10	176.36	176.83	1.51	0.9%	
	S8	**Right**	10	176.84	176.94	1.14	0.6%	0.093
		Left	10	175.63	176.00	1.83	1.0%	

Cases – Recorded values (10 values per subject); Am – Arithmetic mean; Me – Median; Stdv. – Standard deviation; CV – Coefficient of variation; p – Asymp. Sig. (2-tailed) of the Wilcoxon Signed Ranks Test;

Analyzing the executions of the 8 athletes included in the analysis (Table 2), both those made with the right foot and those made with the left foot, it is found that the knee angle recorded per kick

with the right foot does not statistically significantly differ from that made with the left foot at most athletes. Exceptions were recorded in the case of an athlete practicing karate (S3) – in which the angle value is statistically significantly higher when kicking with the right leg and in a kempo athlete (S5) – a situation in which the angle value is significantly higher big on the left foot shot.

Table 3. The duration of the foot techniques

Sport	Sportiv	Picior	Cazuri	Ma	Me	A.std.	CV	p
Karate	**S1**	**Right**	10	0.31	0.30	0.02	5.3%	0.157
		Left	10	0.32	0.32	0.02	5.8%	
	S2	**Right**	10	0.28	0.28	0.03	11.3%	**0.010**
		Left	10	0.30	0.32	0.04	12.1%	
	S3	**Right**	10	0.27	0.28	0.02	8.8%	**0.031**
		Left	10	0.29	0.29	0.04	14.6%	
Kempo	**S4**	**Right**	10	0.28	0.28	0.04	14.6%	**0.004**
		Left	10	0.26	0.26	0.04	16.3%	
	S5	**Right**	10	0.29	0.30	0.04	14.8%	**0.011**
		Left	10	0.32	0.31	0.05	15.1%	
Kickbox	**S6**	**Right**	10	0.30	0.30	0.01	4.4%	0.083
		Left	10	0.29	0.28	0.01	5.1%	
	S7	**Right**	10	0.30	0.30	0.01	3.8%	0.083
		Left	10	0.31	0.31	0.03	8.6%	
	S8	**Right**	10	0.28	0.28	0.02	8.8%	0.890
		Left	10	0.28	0.28	0.04	12.8%	

Cases – Recorded values (10 values per subject); Am – Arithmetic mean; Me – Median; Stdv. – Standard deviation; CV – Coefficient of variation; p – Asymp. Sig. (2-tailed) of the Wilcoxon Signed Ranks Test;

Analyzing the executions of the 8 athletes included in the analysis (Table 3), on both guards, both those made with the right foot and those made with the left foot, it is found that the duration recorded per kick with the right foot does not statistically significantly differ from that made with left leg in half of the athletes. Exceptions were registered in the case of two karate athletes (S2 and S3), situations where the duration is statistically significantly shorter for the right leg kick and two kempo athletes, one of them registering a statistically significantly lower duration with the left leg (S4) and one of them recording a statistically significantly shorter duration with the right leg (S5).

Discussions

Although there are differences between the level of execution of a motor action on the dominant side compared to the non-dominant one, for performance athletes the expectations are that performing the same tasks in the same conditions, they perform them identically or with the smallest possible differences. We consider that in sports with an opposing opponent this is very valuable, being a factor that can bring victory.

For an easier follow-up of the existence or lack of significant differences between the values of the kinematic parameters recorded by the dominant side and the non-dominant side, we present the results of the values of p for each statistical calculation (Table 7). The bolded values indicate significant differences.

Compared to other studies regarding laterality, we have included several kinematic parameters of the same techniques and we have shown that it is possible for some parameters to register significant differences, while for others they do not.

Table 4. Value of p for each kinematic parameter

Subject	The maximum velocity of the hitting leg	The maximum knee extension of the hitting leg	The duration of the foot techniques
S1	**0.047**	0.721	0.157
S2	0.799	0.445	**0.010**
S3	**0.017**	**0.005**	**0.031**
S4	**0.009**	0.878	**0.004**
S5	0.445	**0.028**	**0.011**
S6	**0.037**	0.285	0.083
S7	0.285	0.959	0.083
S8	0.575	0.093	0.890

We can observe, for instance, the ideal cases are represented by Subjects 7 and 8 where are no significant differences registered in any of the monitored kinematic parameters. In terms of laterality, their non-dominant side has executed the task with the same level of performance like the dominant one.

Conclusions

The hypothesis of this research is that through kinematic analysis on both fighting stances (dominant and non-dominant) we can highlight the differences in laterality for each subject.

We consider the purpose of the study achieved.

Also, the hypothesis that through kinematic analysis on both fighting stances (dominant and non-dominant) we can highlight the differences in laterality for each subject is confirmed.

With the help of MVN Xsens system, we were able to measure and highlight the differences in laterality very precisely and very thoroughly, referring to various kinematic parameters of some of the most representative martial arts techniques.

We drew up an original laterality evaluation scale with the help of which we managed to make a diagnosis of the subjects and facilitate comparisons between them.

In some of the athletes, in the case of the same technique, differences were recorded for certain parameters, while for others there were not.

Based on these evaluations, directing and individualizing training and choosing combat tactics can be made much more informed.

References

Mikheev, M., Mohr, C., Afanasiev, S., Landis, T., Thut, G. (2002). *Motor control and cerebral hemispheric specialization in highly qualified judo wrestlers.* Neuropsychologia, 40(8), 1209–1219. https://doi.org/10.1016/s0028-3932(01)00227-5

Gursoy R. (2009). *Effects of left- or right-hand preference on the success of boxers in Turkey*. British Journal of Sports Medicine, 43(2), 142–144. https://doi.org/10.1136/bjsm.2007.043547

Sterkowicz, S., Lech, G., Blecharz, J. (2010). *Effects of laterality on the technical/tactical behavior in view of the results of judo fights*. Archives of Budo. 6. 173-177.

Baker J, Schorer J (2013). *The Southpaw Advantage? - Lateral Preference in Mixed Martial Arts*. PLOS ONE 8(11): e79793. https://doi.org/10.1371/journal.pone.0079793

Băițel, I., Pătru, L. M. (2019). *Influence Of Sport On Laterality In Children Aged 9-11 Years*. In V. Grigore, M. Stănescu, M. Stoicescu, L. Popescu (Eds.), Education and Sports Science in the 21st Century, vol 55. European Proceedings of Social and Behavioural Sciences (pp. 648-657). Future Academy. https://doi.org/10.15405/epsbs.2019.02.80

Witte, K., Emmermacher, P., Bystrzycki, S., Potenberg, J. (2007). *MOVEMENT STRUCTURES OF ROUND KICKS IN KARATE.*

Kim, Jae-Woong & Kim, Jemin & Lee, Sang-Woo & Han, Ki-Hoon & Kwon, Young-Hoo. (2010). *The Effect of Target Height on the Trunk, Pelvis, and Thigh Kinematics in the Taekwondo Roundhouse Kick*. International Journal of Exercise Science: Conference Abstract Submissions.

Kimm, D., Thiel, D. (2015). *Hand Speed Measurements in Boxing*. Procedia Engineering. 112. 502-506. 10.1016/j.proeng.2015.07.232. https://doi.org/10.1016/j.proeng.2015.07.232

Gavagan, C. J., & Sayers, M. (2017). *A biomechanical analysis of the roundhouse kicking technique of expert practitioners: A comparison between the martial arts disciplines of Muay Thai, Karate, and Taekwondo*. PloS one, 12(8), e0182645. https://doi.org/10.1371/journal.pone.0182645

Hölbling, D., Preuschl, E., Hassmann, M., & Baca, A. (2017). *Kinematic analysis of the double side kick in pointfighting, kickboxing*. Journal of sports sciences, 35(4), 317–324. https://doi.org/10.1080/02640414.2016.1164333

Diniz, R., Del Vecchio, F. B., Schaun, G. Z., Oliveira, H. B., Portella, E. G., da Silva, E. S., Formalioni, A., Campelo, P., Peyré-Tartaruga, L. A., & Pinto, S. S. (2021). *Kinematic Comparison of the Roundhouse Kick Between Taekwondo, Karate, and Muaythai.* Journal of Strength and Conditioning Research. 35(1), 198–204. https://doi.org/10.1519/JSC.0000000000002657

Polak, E., Kulasa, J., VencesBrito, A., Castro, M. A., & Fernandes, O. (2016). *Motion analysis systems as optimization training tools in combat sports and martial arts*. Revista De Artes Marciales Asiáticas, 10(2), 105–123. https://doi.org/10.18002/rama.v10i2.1687

Kim, Y., Baek, S. and Bae, B.-C. (2017). *Motion Capture of the Human Body Using Multiple Depth Sensors*. ETRI Journal, 39: 181-190. https://doi.org/10.4218/etrij.17.2816.0045

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 56-64
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-8

THE EVOLUTION OF PERFORMANCES ON A NATIONAL LEVEL IN AEROBIC GYMNASTICS

Alexandra GHEZEA[1*], Cozeta MINCULESCU[2], Mircea BRATU[3], Oana STOIAN[4], Marius STOICA[5]
[1, 2, 3, 4, 5] *National University of Physical Education and Sport, 060057, Bucharest, Romania*
* Corresponding author: ghezea_alexandra@yahoo.com

Abstract. *Background*. Performance aerobic gymnastics is, indeed, a form of art in motion, harmoniously blending elements from gymnastics, dance, and aerobics. Focusing on aspects such as coordination, mobility, strength, and endurance, this discipline challenges both the physical and mental abilities of athletes. The hallmark of performance aerobic gymnastics is the ability to execute quick and precise movements without compromising technique and accuracy. This requires a unique combination of strength, flexibility, and grace, as well as a good understanding of rhythm and music. Through this combination of traits, performance aerobic gymnastics becomes not just a form of training but also a captivating spectacle, attracting both athletes eager to test their limits and the audience with its dynamism and complexity. It is a discipline that manages to blend technical perfection with artistic expressiveness, thus creating an impressive and memorable spectacle.
Purpose: The research aimed to assess the level of preparedness of aerobic gymnastics practitioners from the second category in Romania in relation to the specific requirements of technical, artistic, and execution components imposed by the scoring code. Additionally, the study aimed to identify any errors that athletes may have presented within these components.
Methods: The research utilized bibliographic study to obtain a comprehensive understanding of the field of aerobic gymnastics and relevant points for evaluating athletes' performance. Statistical method was applied to analyze and interpret the results obtained by female athletes at the National Aerobic Gymnastics Championships, allowing us to highlight their evolution and identify performance trends. Additionally, graphical method was employed to visually represent the data of our analysis, facilitating their comprehension and interpretation.
Subjects: The research period covers the evolution of athletes between the years 2019 and 2021, within the national championship. Our objective is to highlight and analyze the progress, stagnation, or regression of athletes participating in competitions over the course of the three years of study.
Results: It is interesting to observe the evolution of the UNEFS sports club over these years and the fluctuations in their positions in the competition's ranking. Although there have been changes in the ranking from year to year, with a variation in the positions occupied, it is remarkable that UNEFS has generally remained in the upper part of the ranking. In 2019, the UNEFS club occupied positions 1, 4, and 6 in the ranking, and the following year, they managed to rise to positions 1 and 2, signifying an improvement in their performance. However, in 2020, they experienced a decline, dropping to 7th place. In 2021, the sports club once again managed to rank in the top two positions, but also found themselves in 6th place in the ranking.
Conclusions: These fluctuations in the ranking can be influenced by a variety of factors, such as changes in athletes' training, training strategies, the level of competition, or even external conditions, such as changes in regulations or unexpected events. A detailed examination of these fluctuations can help identify patterns or trends that may affect the performance of the UNEFS club in the future. Based on these analyses, adjustments can be made in training and competition strategies to improve performance and ensure that the club remains competitive in the national championship and other future competitions.

Keywords: performance aerobic gymnastics, second category, individual female competition

Introduction

Aerobic gymnastics is the sports discipline that emerged during the "fitness explosion" of the 1970s–1980s. This sport is a fusion of specific aerobic movements from aerobic maintenance gymnastics, resulting from the combination of the seven basic steps with upper limb movements and gymnastic elements of difficulty, transitions, constructions, interactions, and collaborations between partners.

Aerobic gymnastics exercises are inspired by music, so the melody and theme of the song should be viewed and used as a "whole". Their execution must be in accordance with the rhythm of the selected song phrases.

Competitive aerobic gymnastics offers several possibilities for exploiting the variety, creativity, originality, and complexity of this sport. Both female and male gymnasts can compete in events such as: individual (female/male), mixed pairs (one girl and one boy), trio (3 members), group (5 members), aerobic dance (8 members), and/or step aerobic (8 members).

Since the appearance of aerobic gymnastics on the world stage under the auspices of the International Gymnastics Federation (FIG), Romania has emerged as a leading country in rankings, consistently appearing on the podiums of awards. However, the performances of Romanian athletes present certain deficient characteristics, especially in the “artistic” component, which has contributed over time to the loss of several medals.

Currently, the fiercest opponents that Romania's representatives must surpass in major competitions are distinguished by a complex and complete performance (maximum difficulty, outstanding artistry, clean execution). The progress of other countries, which has overlapped in recent times with a slight stagnation recorded nationally, makes achieving excellence in aerobic gymnastics increasingly difficult for Romanians.

In order to propose and apply a variety of means to improve the results of athletes, it is necessary to initially establish their level of performance. Therefore, by conducting a comparative analysis between the performances of Romanian athletes and those of foreign athletes, both their level of preparation and the causes that determine significant differences in the final ranking (final score) can be identified.

Numerous specialists have made extensive presentations regarding the technique of difficulty elements, in relation to the implications manifested in sports training management, which include descriptive elements as well as methodical recommendations.

Aerobic gymnastics gained popularity in Romania in the 1990s and quickly became an appreciated performance sport, with a strong tradition in international competitions. The Romanian Gymnastics Federation (FRG) plays an essential role in promoting and developing this sport at the national level.

Since the first national competitions organized in the 1990s, Romanian aerobic gymnastics has evolved steadily, becoming a benchmark in the national sports landscape. Sports clubs in major cities such as Bucharest, Arad, Iasi, and Constanta have significantly contributed to the popularity of this sport by training specialized coaches and attracting an increasing number of young athletes.

The National Aerobic Gymnastics Championship, organized annually by the Romanian Gymnastics Federation (FRG), is the most important event in the competition calendar for this sport in Romania. This championship represents the main opportunity for athletes of all ages and levels to demonstrate their skills and compete for the national title. The event attracts the participation of the best gymnasts in the country and serves as a showcase for their talent and hard work.

In addition to the National Championship, there are numerous other regional and local competitions that play a crucial role in discovering and promoting new talents. These offer opportunities for young and beginner gymnasts to test their skills in less formal but still competitive contests. Sporting events are essential for the development of the sport at grassroots level and for ensuring a steady flow of talent that ultimately reaches national and international levels.

Thus, the competitive structure in aerobic gymnastics in Romania is well-balanced, with events from local to national level, contributing to the growth and evolution of athletes at all stages of their careers.

Romania boasts several centers of excellence in aerobic gymnastics, where athletes benefit from intensive training and the support of elite coaches. These coaches are often former performance gymnasts who bring extensive experience and technical knowledge to the training of the new generation of gymnasts.

Romania has achieved remarkable results in international aerobic gymnastics competitions, such as the World and European Championships, bringing home numerous gold, silver, and bronze medals. Among the athletes who have excelled are Izabela Lăcătuş, Mircea Zamfir, and Corina Constantin, who have become role models for young gymnasts.

Despite notable successes, aerobic gymnastics in Romania faces challenges related to funding, infrastructure, and attracting new talent. Greater involvement of authorities and sponsors is needed to ensure the resources necessary for the continued development of this sport. However, the outlook for aerobic gymnastics in Romania remains optimistic. The sustained efforts of the FRG, together with the passion and dedication of athletes and coaches, will continue to contribute to keeping Romania on the map of performance aerobic gymnastics.

The purpose of the research consists of evaluating the level of preparation of aerobic gymnastics practitioners from the second category in Romania in relation to the specific requirements of the technical, artistic, and execution components imposed by the scoring code. Additionally, the aim was to identify any errors that athletes may have presented within these components.

The research objectives refer, on the one hand, to assessing the level of preparation of aerobic gymnastics practitioners from the second category in Romania regarding the specific requirements of the technical, artistic, and execution components imposed by the scoring code, and on the other hand, to identifying potential or real errors encountered by athletes within these components, with the aim of providing constructive feedback and improving their performance in the future.

The research tasks consist of:

1. Selecting a representative sample of aerobic gymnastics practitioners from the second category from various sports clubs in Romania;
2. Conducting a systematic and objective evaluation process of athletes' performance regarding the scoring of components (technical, artistic, and execution);
3. Identifying and documenting errors observed during the evaluation, highlighting aspects that require improvement and development;
4. Analyzing the obtained results and interpreting them in the context of the research objectives and requirements;
5. Developing practical and specific recommendations for improving athletes' preparation in aerobic gymnastics, considering the identified errors and assessed level of preparation;
6. Disseminating the research results and conclusions within the academic and sports community, thus contributing to the continuous development of this field.

Research Hypothesis: There is a significant correlation between the level of preparation of aerobic gymnastics practitioners from the second category in Romania and their ability to meet the specific requirements of the technical, artistic, and execution components imposed by the scoring code.

This hypothesis assumes that there is a connection between the athletes' level of preparation and their ability to correctly and efficiently perform the technical, artistic, and execution components required according to the scoring code. Therefore, the research would investigate whether athletes with a higher level of preparation make fewer errors and achieve higher scores in aerobic gymnastics competitions from the second category in Romania.

Evaluation methods used in the research included a literature review to gain a comprehensive understanding of the field of aerobic gymnastics and relevant points for assessing athletes' performance. Additionally, a statistical method was applied to analyze and interpret the results obtained by female athletes at the National Aerobic Gymnastics Championships, so as to highlight their progress and identify performance trends. The graphical method included in the research aimed to visually highlight the data of our analysis, facilitating their understanding and interpretation.

The study took place over a period of three years, between 2019 and 2021, and aimed to analyze the evolution of athletes participating in the national championship, providing a detailed perspective on their progress and performances during this time frame.

Results

Tables 1, 2, and 3 highlight the performances of various sports clubs in the competitions of 2019, 2020, and 2021, presenting the scores obtained for the execution, artistic, and difficulty components, as well as the total score and ranking position.

Table 1. Results of the women's individual event for the year 2019

2019					
SPORTS CLUB	**TOTAL EXECUTION SCORE**	**TOTAL ARTISTIC SCORE**	**TOTAL DIFFICULTY SCORE**	**TOTAL SCORE**	**PLACEMENT IN RANKING**
C.S. UNEFS BUC.	**8.150**	**8.350**	**2.050**	**18.550**	**I**
C.S. UNIV. ARAD	7.850	8.250	2.050	18.150	II
C.S.M. ARAD	7.800	8.400	1.900	18.100	III
C.S. UNEFS BUC.	**7.950**	**8.050**	**2.000**	**18.000**	**IV**
C.S. UNIV. ARAD	7.600	8.200	2.000	17.800	V
C.S. UNEFS BUC.	**7.650**	**8.350**	**1.700**	**17.700**	**VI**
L.P.S. CETATE DEVA	7.750	7.900	1.950	17.600	VII
C.S. FARUL CTA.	7.550	8.100	1.900	17.550	VIII

In Table 1, the results obtained by sports clubs in the women's individual event in 2019, at the National Aerobic Gymnastics Championship, Junior II category, can be observed. Each club is evaluated based on three components: execution, artistic, and difficulty, and the respective scores are combined to obtain the total score. The final ranking of the clubs is based on these total scores, from highest to lowest, indicating the placement in the competition. C.S. UNEFS BUC. Club ranks first with a total score of 18.550, followed by C.S. UNIV. ARAD and C.S.M. ARAD.

Table 2. *Results of the women's individual event for the year 2020*

2020					
SPORTS CLUB	**TOTAL EXECUTION SCORE**	**TOTAL ARTISTIC SCORE**	**TOTAL DIFFICULTY SCORE**	**TOTAL SCORE**	**PLACEMENT IN RANKING**
C.S. UNEFS BUC.	**8.700**	**8.450**	**2.050**	**19.200**	**I**
C.S. UNEFS BUC.	**8.600**	**8.450**	**2.050**	**19.000**	**II**
C.S.S. TRIUMF BUC.	8.500	8.400	1.950	18.850	III

C.S. FARUL CTA.	8.450	8.150	2.050	18.650	IV
C.S. UNIV. ARAD	8.300	8.200	2.000	18.500	V
C.S.S. TRIUMF BUC.	8.325	8.150	2.000	18.475	VI
C.S. UNEFS BUC.	**8.100**	**8.250**	**1.950**	**18.300**	VII
C.S. UNIV. ARAD	8.200	8.000	2.000	18.200	VIII

Table 2 provides an overview of the performance of sports clubs in the 2020 competition. Scores for execution, artistic, and difficulty, along with the total score and ranking of each club, are presented. Participants include C.S. UNEFS BUC., C.S.S. TRIUMF BUC., C.S. FARUL CTA., and C.S. UNIV. ARAD.

Table 3. Results of the women's individual event for the year 2021

2021					
SPORTS CLUB	**TOTAL EXECUTION SCORE**	**TOTAL ARTISTIC SCORE**	**TOTAL DIFFICULTY SCORE**	**TOTAL SCORE**	**PLACEMENT IN RANKING**
C.S. UNEFS BUC.	**8.650**	**8.400**	**2.050**	**19.100**	**I**
C.S. UNEFS BUC.	**8.450**	**8.500**	**2.050**	**19.000**	**II**
C.S.M. ARAD	8.450	8.350	2.050	18.850	III
C.S.M. ARAD	8.350	8.400	2.050	18.800	IV
C.S. UNIV. ARAD	8.300	8.400	2.050	18.750	V
C.S. UNEFS BUC	**8.300**	**8.350**	**2.050**	**18.700**	**VI**
C.S. FARUL CTA.	8.350	8.300	1.950	18.600	VII
C.S. UNIV. ARAD	8.350	8.200	2.050	18.600	VIII

Table 3 provides details about the performances recorded at the 2021 National Aerobic Gymnastics Championship, within the Junior II category, women's individual event. After each athlete's presentation, the panel of judges analyzed the execution, artistic aspects, and level of difficulty of the exercises, providing scores accordingly.

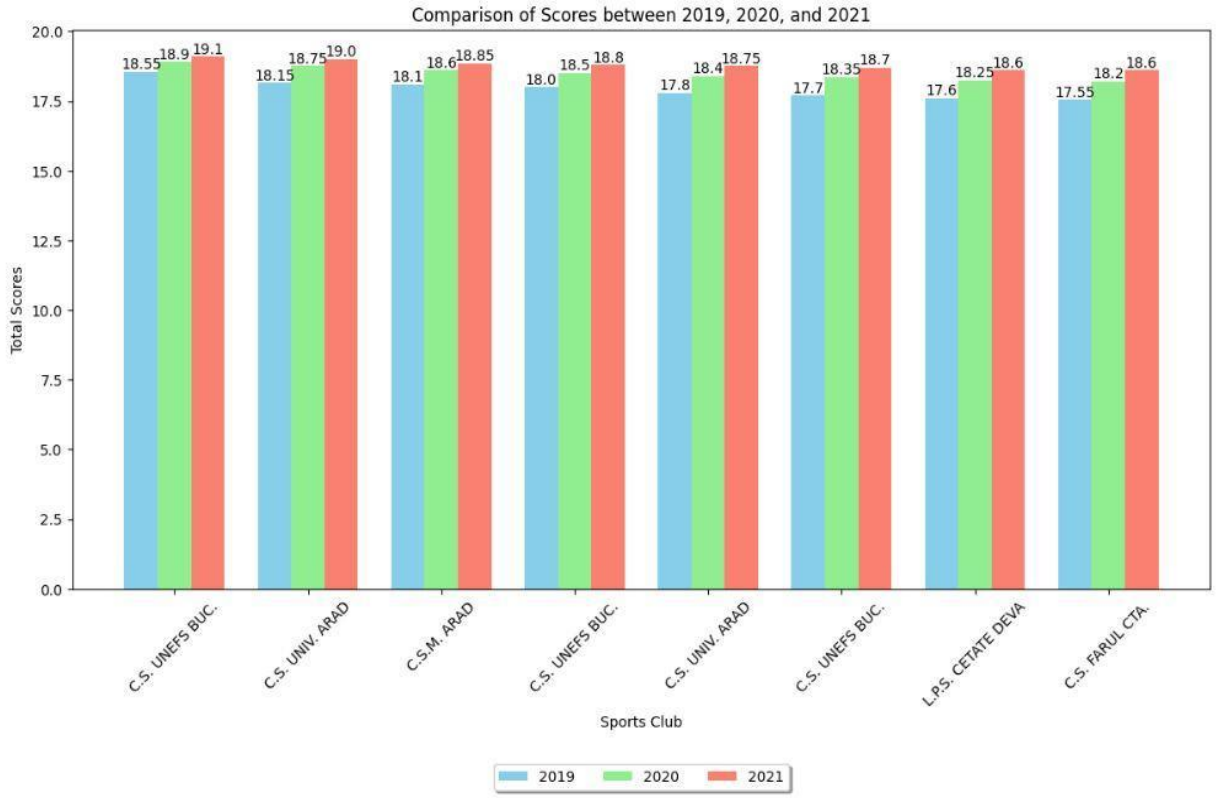


Figure 1. Comparison of Scores in the Period 2019–2021

The above graph presents a comparison of the total scores obtained by different sports clubs at the National Aerobic Gymnastics Championships for the years 2019, 2020, and 2021.

We observe that the majority of sports clubs have recorded an increase in scores from one year to another. For example, the sports club "C.S. UNEFS BUC." has consistently increased its total scores each year, reaching a peak in 2021. On the other hand, "L.P.S. CETATE DEVA" and "C.S. FARUL CTA." experienced a slight decrease in scores in 2020 but managed to recover in 2021.

Overall, there is a trend of improvement in performance at the level of sports clubs from year to year, suggesting a continuous development of competition level at the National Aerobic Gymnastics Championships.

The analysis reveals the constant commitment of sports clubs to improving the quality and performance in aerobic gymnastics over the years, thus emphasizing the importance of sustained effort and dedication in this sport discipline.

Regarding the statistical analysis, for a clearer highlighting of trends and variations over time in the evolution of performances and analyzed variables throughout the three years investigated, the means and standard deviations were calculated for each variable (Table 4).

Table 4. Analysis of the Evolution of Performances and Variables Included in the Research

VARIABLE	2019 (MEAN ± SD)	2019 (SE)	2020 (MEAN ± SD)	2020 (SE)	(MEAN ± SD)	2021 (SE)
EXECUTION	43.28 ± 0.638	0.225	45.21 ± 0.321	0.113	44.63 ± 0.456	0.161
ARTISTIC	45.33 ± 0.887	0.313	44.15 ± 0.527	0.186	44.35 ± 0.403	0.142
DIFFICULTY	10.94 ± 0.530	0.187	10.74 ± 0.117	0.041	10.85 ± 0.215	0.076
TOTAL	18.25 ± 0.270	0.096	18.63 ± 0.246	0.087	18.51 ± 0.295	0.104

From the interpretation of the data included in the table, we can affirm that among the three years investigated, the score of the "Execution" component increased in 2020, followed by a decrease in 2021. "Artistic" had a negative evolution in 2020, followed by an increase in values in 2021. Regarding the "Difficulty" variable, it remained almost constant, with minor variations. The "Total" score increased in 2020, followed by a decrease in 2021. These presented values highlight the trends and fluctuations in performance during the period 2019-2021.

Through the statistical method of ANOVA test (Table 5), the means of the targeted components in the three years included in the research were compared to determine the existence of possible significant differences between them.

Table 5. Statistical Analysis of Data through ANOVA

ONE - WAY ANOVA (WELCH'S)

CRITERION	F	df1	df2	p
EXECUTION	31.665	2	21	4.574
ARTISTIC	14.604	2	21	< .001
DIFFICULTY	0.118	2	21	0.888
TOTAL	19.447	2	21	1.662

The ANOVA analysis indicates that the tested factors have a significant effect on artistic performance ($F = 14.604$, $p < 0.001$), but they do not have a significant effect on difficulty ($F = 0.118$, $p = 0.888$). Regarding execution, the F value of 31.665 and the p value of 4.574 indicate a significant effect of the factors on this criterion. For the total score ($F = 19.447$, $p = 1.662$), the F value suggests a significant effect. Thus, this statistical processing highlights a continuous development and increasingly challenging competition in aerobic gymnastics, reflected both in the total scores obtained by clubs and in the statistical analysis of performance.

In the context of data analysis, we can assert that the hypothesis is confirmed because there is a possible link between the level of preparation and performance in aerobic gymnastics competitions.

The statistical analysis also required the Levene test (Table 6) to assess the similarity of dispersion within each analyzed variable.

Table 6. *Levene Test*

VARIABLE	F VALUE	P VALUE	APPROXIMATE DEGREES OF FREEDOM (DF)	OBSERVATION
EXECUTION	1.105	0.350	2	Not significantly different
ARTISTIC	5.613	0.011	2	Significantly different
DIFFICULTY	1.321	0.288	2	Not significantly different
TOTAL	1.841	0.183	2	Not significantly different

We can state that for the execution variable, the results indicate an F value of 1.105, with a p-value of 0.350 and 2 approximate degrees of freedom (DF), leading to the conclusion that there is no significant difference between the analyzed years. However, for the artistic variable, an F value of 5.613 was recorded, with a p-value of 0.011 and 2 approximate degrees of freedom, suggesting a significant difference between the years of the analyzed period. For the difficulty and total variables, the F values were 1.321 and 1.841, and the p-values were 0.288 and 0.183, indicating no significant difference between the aspects subjected to statistical processing.

From the analysis conducted through the Levene test, we can observe that the level of preparation of aerobic gymnasts significantly influences their ability to execute the artistic requirements imposed by the scoring code.

Conclusions

In general, the results obtained in the National Aerobic Gymnastics Championships indicate a significant improvement in the performance of all athletes in the second category. Most clubs have recorded increases in total scores each year, suggesting that the level of competition in this field has continued to develop.

The data interpretation reveals a strong association between the athletes' level of preparation and their ability to meet the scoring code requirements at the technical, artistic, and execution levels. The better prepared the athletes are, the more points they obtain and the fewer errors they make in aerobic gymnastics.

We observe an improvement in athletes' performance over time, and data analysis has highlighted some fluctuations in scores obtained in different components (execution, artistic, difficulty) over the research period.

Identifying and documenting errors observed during evaluation is a crucial part of the process of improving athletes' performance in aerobic gymnastics. Constructive feedback and specific recommendations for training improvement can significantly contribute to their development and refinement.

The research conducted makes a significant contribution to understanding the evolution and performance of athletes in aerobic gymnastics in Romania, providing relevant data and information for coaches, athletes, and other stakeholders in the sports field. Therefore, it is essential to continue investigating and monitoring athletes' performance in aerobic gymnastics, aiming for the continuous development of this field and performance enhancement.

Authors' Contributions

All authors have equally contributed to this study.

References

Andersen, J. C., & Hoskins, E. B. (1990). *Aerobics Today*. Human Kinetics.
Biscontini, L., & Manocchia, P. (1989). *The Complete Guide to Aerobic Dancing*. Fireside.
Cooper, K. H. (1982). *Aerobics Program For Total Well-Being: Exercise, Diet, And Emotional Balance*. Bantam Books.
Cooper, K. H. (1985). *Aerobics*. Bantam Books.
Donnelly, J. E., & Nowacek, J. (2006). *Aerobic Dance and Physical Fitness*. Jones & Bartlett Learning.
Galpern, A. L., & Jackowski, E. (2003). *The Everything Guide to Aerobics*. Adams Media.
Pittman, R. (1993). *Aerobic Dance Exercise*. Human Kinetics.
Seals, M., & Seals, J. (1990). *Aerobic Dance: Exercise Without Effort*. Leisure Press.
Thacker, L. R. (1994). *Aerobics: Instructor Manual*. Kendall/Hunt Publishing Company.

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 65-74
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-9

WOMEN'S FOOTBALL FROM THE PLAYERS' PERSPECTIVE

Bogdan GOZU[1], Maria ŞCHIOPU[2*], Lorena SPULBER[3]**
[1]*University of Bucharest, Department of Physical Education and Sport, Bvd. Kogălniceanu, 36-46, Bucharest, Romania*
[2]*University of Bucharest, Faculty of Letters, 5, Edgar Quinet Street, 010017, Bucharest, Romania*
[3]*University of Bucharest, Faculty of Chemistry, 4-12, Bvd. Regina Elisabeta, 030018, Bucharest, Romania*
* Corresponding author: maria.schiopu2003@gmail.com
** Corresponding author: spulberlorena04@gmail.com

Abstract. *Background:* Women's football is known to be played at professional level in a lot of countries. In Romania, women started playing football in unofficial matches in 1960, and only after 30 years, in 1990, the Women's National Football Team was founded. Being a very competitive and accessible sport and taking account of his multiple benefits, women's football became more and more solicited by the students of the University of Bucharest.
Objectives: Due to its importance and recent evolution and because we find it attractive, we decided to make women's football the main subject of this presentation. Along with the theoretical part of this project, we administered a questionnaire to some former/actual women's football players in order to find out their personal perspective related to this sport.
Purpose: Understanding the benefits that come along with this sport, how it has been promoted and how accessible they think it is to women. Moreover, we want to link the answers and experience of others, to our own experience in this wonderful sport.
Methods: For our study we have asked 24 female subjects aged 13 to 22 years old, out of which 13 are professional players and 11 are amateurs. Our questionnaire is made up of 14 questions, which together highlight the personal perspective regarding the practice of women's football, from three different directions: benefits, promotion and accessibility.
Results: In the past years, regardless the area we may refer to (professional, academic, amateur), a fast evolution can be noticed in all three main directions we have researched (benefits, promotion, accessibility). Our research shows that most of the players who have been encouraged by their family or friends to play football kept playing at a professional level. On the other hand, those that were not supported by their family, have lost their enthusiasm, and now they only play for fun or not at all.
Conclusions: From a really long list of sports, we chose to play football in college because it is a big and important part of our lives even though we did not choose to do this professionally. Analyzing the answers from the questionnaire, we can conclude that players benefited a lot by playing football, most of them saying that their lifestyle has improved dramatically since they started practicing this sport.

Keywords: women's football; perspective, benefits, promotion, accessibility

Introduction

Women's football is known to be played at professional level in a lot of countries, but only 187 of them have a national team. In Romania, women started playing football in unofficial matches in 1960, and only after 30 years, in 1990, the Women's National Football Team was founded.

At the beginning of the 19th century, football started to become popular among female factory workers, forming feminine football teams in various places. It started to develop more in the first quarter of the 20th century.

The women who worked at the Dick, Kerr & Co. factory. were boosted after winning matches against the men, forming Dick, Kerr Ladies F.C. .

In 1921, women's football encounters obstacles after attracting a record audience (53,000 spectators), the Football Association (FA) imposes a ban on women's football that lasted for 50 years.

The FA claims that football is *"unsuitable for women"* and that *it "should not be encouraged"*. This decision was made in order not to overshadow the men's football teams. The women continued to play on non-FA grounds, avoiding the media. There were also possible political reasons as the teams raised money for charity and were involved in fundraising for miners protesting wage cuts. Thus, women's football has become a politically dangerous sport. In other countries, women's football was banned, for example in Germany, France and Brazil for 15, 30 or 40 years.

According to *Federatia Romana de Fotbal*, in 2015, the World Cup became the subject of a "turf war" lawsuit. A group of female football players who participated in the final of the last World Cup sued FIFA over the decision to play the match on artificial turf, because they believe is unsafe and does not provide a level playing field compared to the men's championship, who always play on grass. FIFA denied the allegation of discrimination and the players eventually dropped the case. This shows that the discrimination among men and women is not over yet, but people are trying to make a change.

In the past years, regardless the area we may refer to (professional area, academic area, amateur area), a fast evolution can be seen, which we have noticed in all three main ideas we have researched (benefits, publicity, accessibility) for this presentation. These days, women's football is more known to the public and more supported by people around the world because people understood that is not only a men's sport, women are free to practice any sport they like and in the same terms as men are.

Football is an excellent way to spend your free time, it brings joy to its players and a lot of benefits. For example, football improves your heart activity, your strength, mobility and resistance. While playing football you switch from one physical state to another (walking, running, sprinting) and that helps maintaining an optimal state of health.

Also, football helps you find fast and good solutions in difficult times, so after playing football for a while your ability to take decisions under pressure will be improved; plus, it helps you with your concentration, perseverance and self discipline.

Besides that, football is a great way to socialize, to make new friends and it enhances your confidence and reduces the level of anxiety.

Football is easy to learn, but you need a lot of motivation and practice to be good at it, but if you just want to play it for fun, you can do that too.

We decided to make women's football the main subject of this presentation because we also find it attractive and we have always liked it. From a really long list of sports, we chose to play football in college because it is a big and important part of our lives even though we did not choose to do this professionally. Had we been encouraged to play football when we were kids, or at least when we started playing it for fun, we would have combined work with passion. Even though we are not playing at a professional level, we still give our best at every practice and match.

Objectives

Along with the theoretical part in this project, we thought that it would be a great idea to have something more specific, so we put together some questions for a quiz. We tried to reach out to some women who could answer our questions from their personal perspective.

Our work targets girls and women of all ages because we want to understand their perspective on the benefits that come along with this sport, how it has been promoted and how accessible they think it is to girls and women (whether they can play it/practice at school/high school/college, not only in competitions).

For our study we have asked 24 girls and women aged 13-22, out of which 13 are professional players and 11 are amateurs. Our research was based on a 14-question quiz asking them about the players' perspective regarding some specific football aspects.

In our presentation, we are going to present the statistics and we hope it will give you another perspective on women's football.

First, we are going to present all 14 questions from the quiz:

1. Do you practice football?
2. Where do you practice football?
3. How old were you when you started to play football?
4. How old are you?
5. Where did you find out, for the first time, about football?
6. Why did you choose this sport?
7. Were you encouraged to play football?
8. If the answer to the previous question was YES, who encouraged you and how did they do it?
9. Have you taken part in sports competitions? At school/ high school/ college?
10. Has practicing football helped you to develop any new social relationships?
11. Do you consider that, in your group of friends, your image has improved as a result of practicing football?
12. How has playing football benefited you? (socially, health wise)
13. Do you have a favorite football player?
14. Would you like to add anything? (e.g.: a personal experience)

Results

1. At the first question, 54% of the respondents are professional players, the other 46% are amateurs.

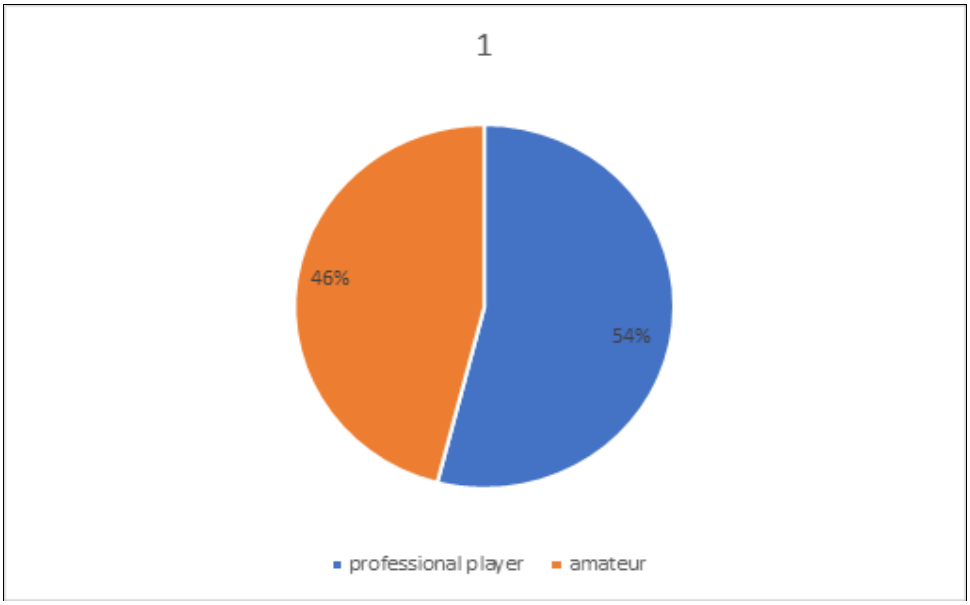


Figure 1 – Question 1

2. At the second question, the answers were as it follows: 59% play at a professional level, 8% play at college, 4% play at school, 8% at high school and 21% did not mention.

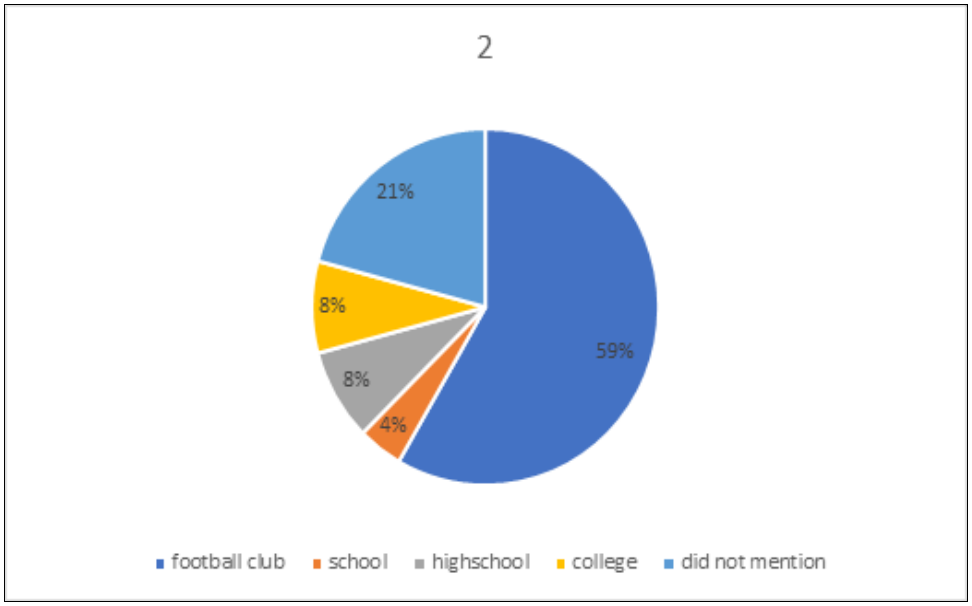


Figure 2 – Question 2

3. As far as their age was when they started: 13% were between 4 and 8 years old, 33% started when they were 9 to 12 years old, 46% at the age of 13 to 16 years old and 8% were older than 17.

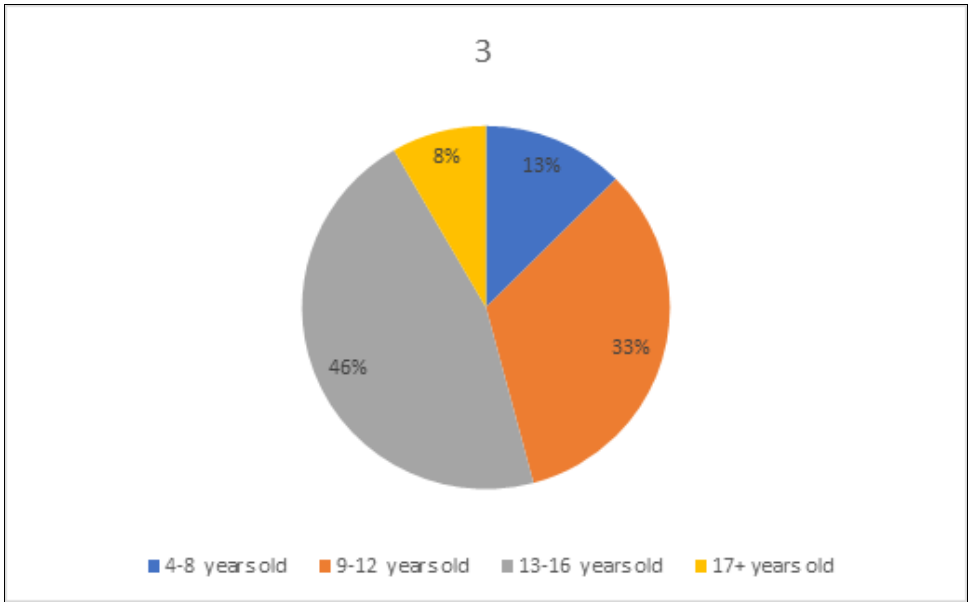


Figure 3 – Question 3

4. Our respondents, when they answered, were aged between 13 and 22, out of which 8% were 15 years old, 17% were 16, 21% were 18, 17% were 17, 8% were 19, 17% were 20, and only 4% were 13, 21 and 22 years old.

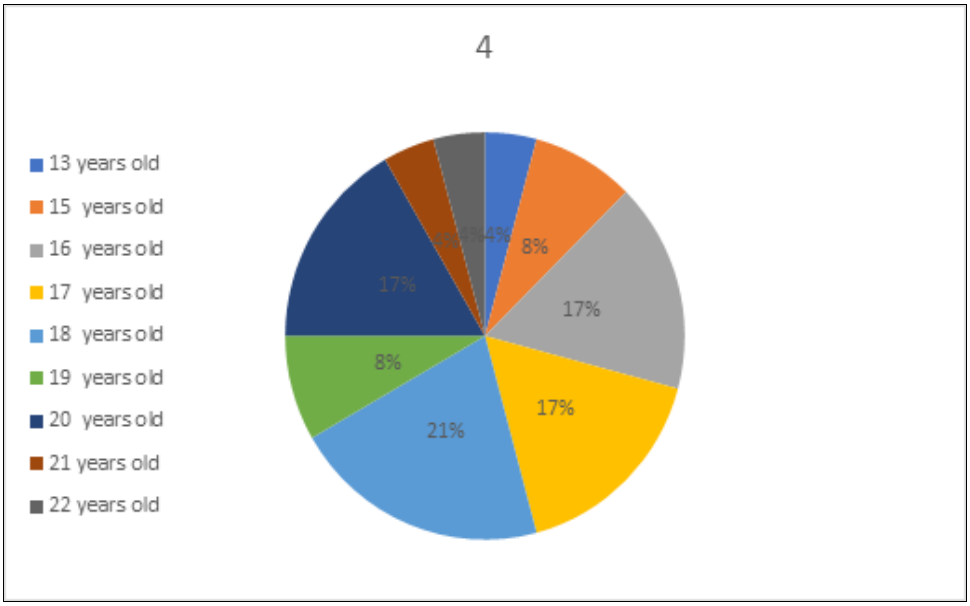


Figure 4 – Question 4

5. Players found out about football from different sources: 50% from friends, 29% from school, 8% in high school, 13% from sources such as family and social networks.

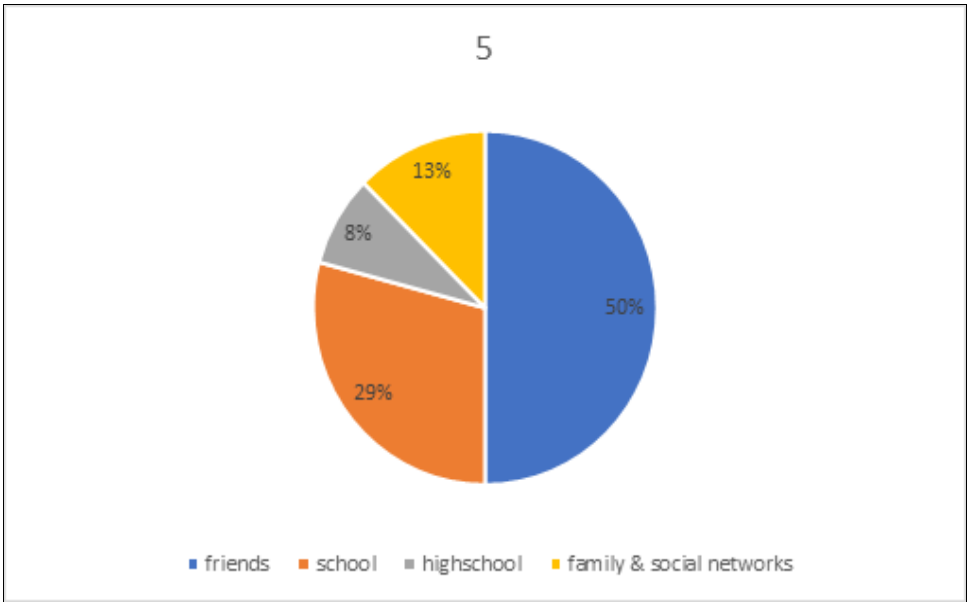


Figure 5 – Question 5

6. There are numerous reasons why women started playing football among which: 12% find it fun, 75% consider that it is the only sport they love and 13% chose it because it is a team sport.

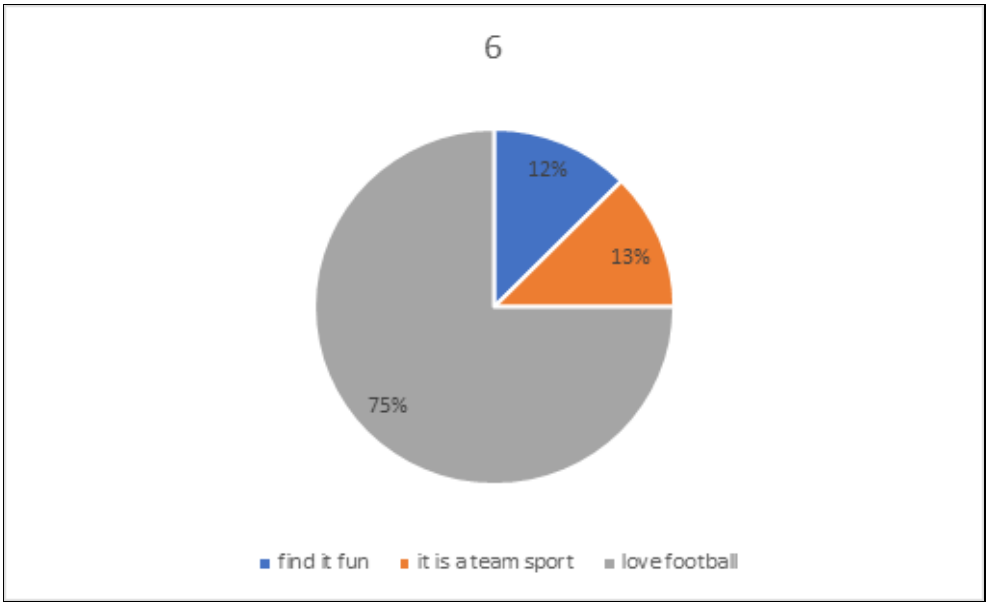


Figure 6 – Question 6

7. Most of our respondents were encouraged to play football, more accurately 75%, while 25% were not.

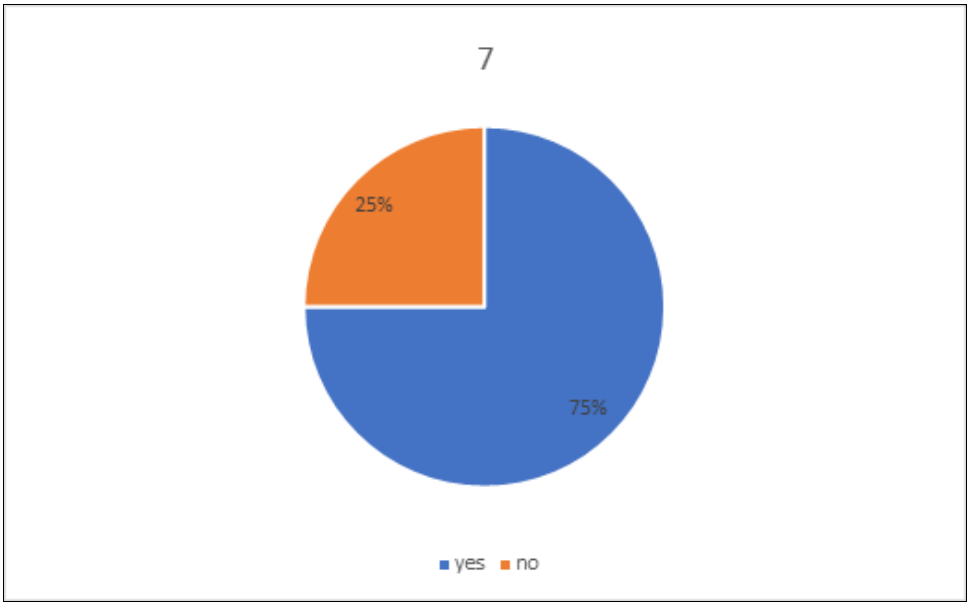


Figure 7 – Question 7

8. Here, the answers were various too: 68 % were encouraged by their family and friends, 8 % by their teachers and 24 % were not encouraged at all.

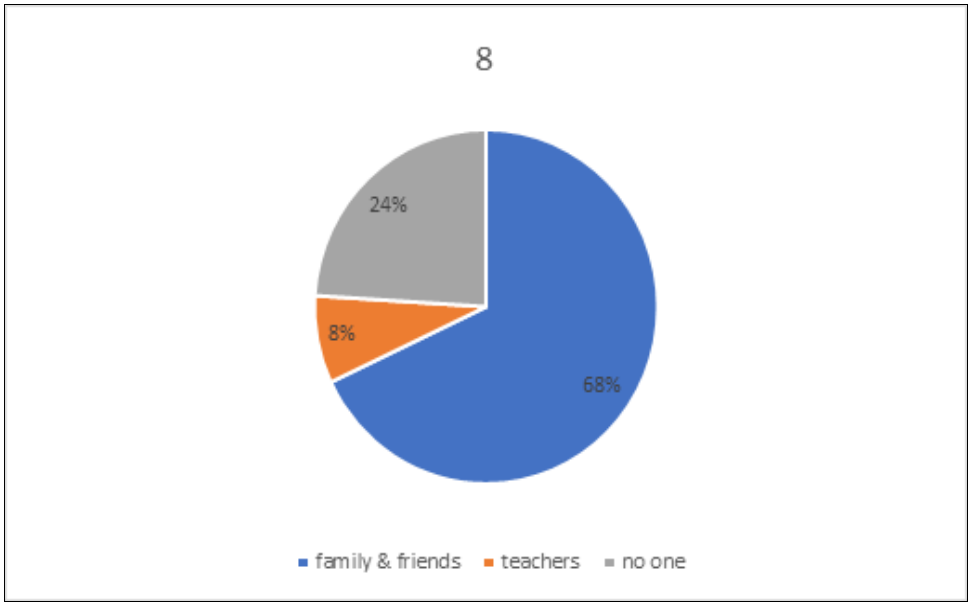


Figure 8 – Question 8

9. 96 % of our respondents participated in school competitions, while 4% did not.

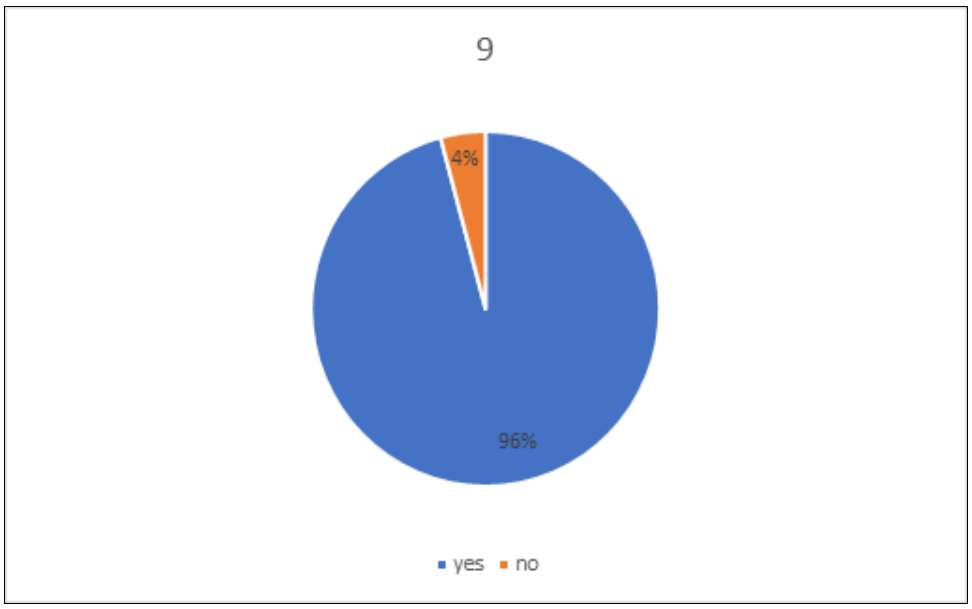


Figure 9 – Question 9

10. Most of the respondents said they developed new social relationships while practicing football, more exactly 92%, but 8% did not.

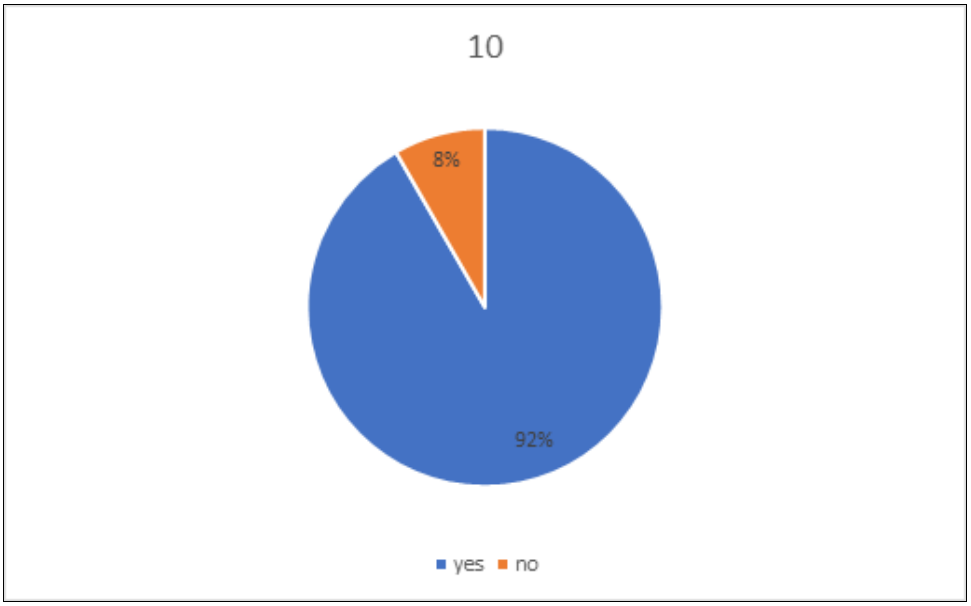


Figure 10 – Question 10

11. 67% consider that their image has improved in their group of friends due to practicing football, 25% consider there is no difference and 8% saw a difference, but not a very significant one.

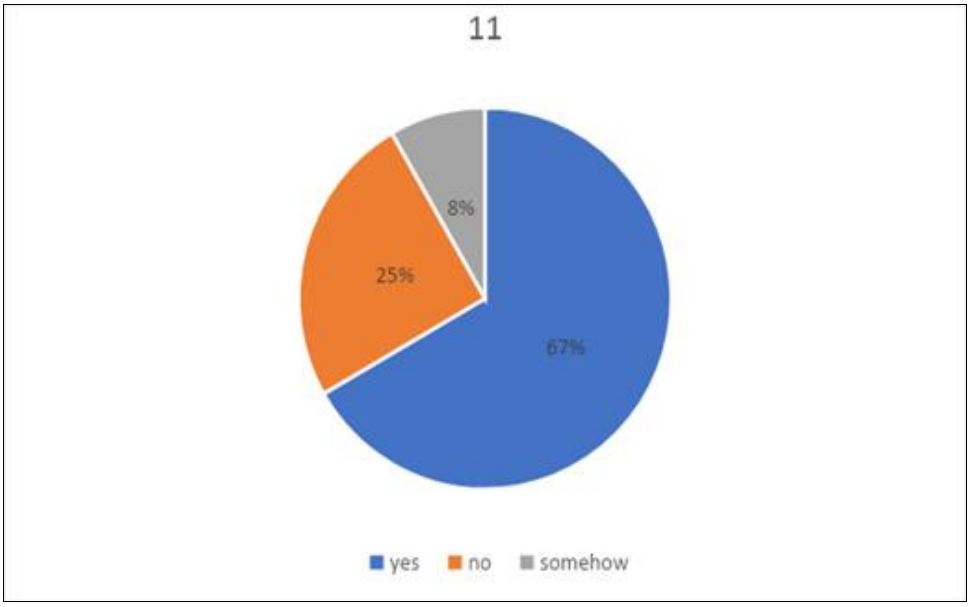


Figure 11 – Question 11

12. Football helped women by improving their health (42%), their physical strength (8%), their self-image (8%), it developed their social life (34%) and made them more responsible (4%). Also, 4% of the women said there was no change at all.

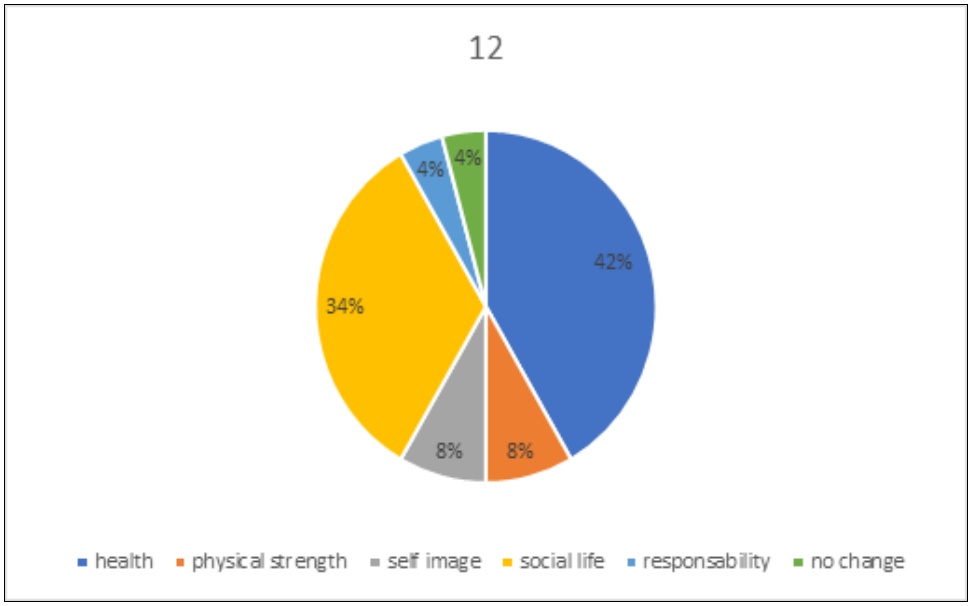


Figure 12 – Question 12

13. 13. + 14. In our quiz, besides the questions that targeted the three directions we were interested in, we also had two open questions. Referring to the first question, most of the answers were about Messi, Cristiano Ronaldo, Neymar Jr. and Sergio Ramos. Referring to the second question, the answers were more diverse.

Conclusions

Analyzing the answers from the questionnaire, we can conclude that players benefited a lot by playing football, most of them saying that their lifestyle has improved dramatically since they started practicing this sport.

Football brings a lot of benefits, physically and mentally. From the physical perspective, it increases your resistance, your coordination and your reflexes. Along with the physical benefits, we have the mental benefits, which are: adaptation to critical situations which involve fast thinking, social skills and team spirit.

Through the current research, there are concluded, once again, the multiple educational and formative values of women's football, both from the perspective of the school sports discipline, as well as from the perspective of performance sports. All this within a favorable context in which this sports discipline is at the moment, especially in the direction of its promotion and accessibility.

When we are speaking about accessibility, the answers highlighted the fact that women's football is established as an offering sport for practitioners, both at the amateur and professional level. This, mainly, being due to its structure and elements of content characteristic of team sports.

Based on the interpretation of the questionnaire regarding the promotion component, we can conclude that women's football is becoming increasingly present in everyday life and as a leisure activity. The main vectors of promotion are: family, friends and school.

Year by year, women's football, and football in general, becomes more and more solicited by students from The University of Bucharest because it has multiple benefits, among which physical and psychosocial. Besides that, football is a very competitive and accessible sport and that makes students interested in it; football keeps students active and healthy.

References

Andersson, H. M. (2010). *The physiological impact of soccer on elite female players and the effects of active recovery training*. Orebro University.

Chelcea, S. (2022). *Metodologia cercetării sociologice. Metode cantitative şi calitative*. Editura Pro Universitaria, Bucureşti.

Datson, N., Drust, B., Weston, M., Jarman, I. H., Lisboa, P. J., & Gregson, W. (2017). *Match physical performance of elite female soccer players during international competition*. Journal of Strength and Conditioning Research, 31(9), 2379-2387. https://doi.org/10.1519/jsc.0000000000001575

Ganciu, M. (2010). *Activitatea fizică independentă şi valorificarea prin mişcare a timpului liber.* Editura Universităţii din Bucureşti, vol I, (70-71).

Ganciu, M (coordonator) - Colectiv DEFS (2013). *Curs de educaţie fizică pentru studenţii Universităţii din Bucureşti*. Editura Universităţii din Bucureşti.

Vescovi, J. D., & Falenchuk, O. (2019). Contextual factors on physical demands in professional women's soccer: Female Athletes in Motion study. *European Journal of Sport Science, 19*(2), 141-146.
https://doi.org/10.1080/17461391.2018.1491628

https://www.catchy.ro/o-istorie-a-fotbalului-feminin/176273.

https://en.m.wikipedia.org/wiki/Women's_association_football.

https://fmf.md/noutate/4401/top-cele-mai-interesante-lucruri-despre-fotbalul-feminin.

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 75-80
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-10

OPTIMISING EFFORT CAPACITY IN TRIATHLON

Andrei Vladimir MARICA[1*], Adina Andreea DREVE[2], Vladi IONESCU[3], Marius STOICA[4]
[1,2,3,4] *National University of Physical Education and Sport of Bucharest, Constantin Noica 140, Bucharest, Romania*
* Corresponding author: andrei20062000@yahoo.com

Abstract. *Background*. My personal triathlon practice inspired the creation of a specialized training regimen to improve triathlon training in Romania. This program aims to enhance performance, well-being, and injury prevention for athletes. At the INTERDISCIPLINARY RESEARCH CENTRE (CCI) "Dr. Alexandru Partheniu" of UNEFS, we used AEROSCAN technology to assess exercise capacity, measuring heart and breathing rates with the Bruce Protocol for precise physiological monitoring.
Objectives. This research demonstrates that tailored training cycles for swimming, cycling, and running can significantly enhance triathlon performance. The goal was to create a customizable, comprehensive training program to maximize the overall training process and provide a scientific foundation for triathlon training in Romania. This research aims to demonstrate that tailored training cycles can significantly enhance triathlon performance.
Methods. We used observation, experimental, statistical-mathematical, and bibliographic study methods to interpret the experiment's outcomes. The bibliographic study provided the theoretical basis, while observation and experimental methods enabled real-time data collection. Statistical analysis was crucial for interpreting the data.
Results. Using AEROSCAN and the Polar system, we evaluated exercise capacity and tracked heart rate. The Bruce protocol was applied for both initial and final tests. The data showed significant improvements in endurance, speed, and overall performance, supported by statistical analysis, after implementing the customized training program.
Conclusion: Our research indicates that tailored athletic training regimens for each triathlon discipline can significantly enhance performance and promote athletes' health and longevity. The results highlight the importance of individualized training plans and suggest potential improvements in Romanian triathlon training practices. Individualized training programs lead to notable improvements in performance and athlete well-being.

Keywords: triathlon, effort, Aeroscan.

Introduction

Triathlon is a sport that combines swimming, cycling and running into one. These events are done in that order and consecutively. Triathletes have a period of time before and after each event where they change equipment to prepare for the next event. Athletes must therefore switch from swimming to cycling (T1 – represents the first transition between events) and from cycling to running (T2 – represents the second and final transition between events).

"Triathlon is more than the sum of its parts" (Millet & Vleck, 2000) because it is a multidisciplinary activity. The interactions between the different components of triathlon (swimming, T1, cycling, T2 and running), somatotype, physiology, technique and running strategy are all factors that affect the overall performance of the triathlete (Ofoghi et al., 2016). Although triathlon was introduced into the Olympic program in the late 1990s, researchers focused more on long distance races when they started studying short distances. This was mainly due to the efforts of

a group of French researchers who were recognised as pioneers (Bentley & Bishop, 2008). Since then, many researchers have studied the physiology and anthropometry of triathletes and race strategies. However, many research studies have included amateur or aspiring high performance triathletes rather than professional triathletes. It is essential to understand the elements that influence peak performance and to distinguish levels of performance. It is also necessary to distinguish between female and male triathletes. Thus, a systematic analysis that separates information by gender for top triathletes is of interest for sport development and serves as a reference for their unique characteristics. In order to create effective training programs and identify young talent with the potential to become elite athletes, it is essential to know the baseline characteristics of female and male triathletes who achieve peak performance (Vaeyens et al., 2008). The first step in creating appropriate talent development programs is to understand these characteristics, which combine a variety of elements and components to optimize triathlete performance. Predictors of talent in elite sports, especially women's sports, still have many unknowns (Johnston et al., 2018). Therefore, in order to aid the optimal development of talent identification programs - such as federations, sports institutions, coaches, national selectors, etc. – it is essential to provide valuable and scientifically rigorous information.

The research presents meta-analyses that expose how training alters cardiorespiratory fitness and how these changes affect the performance of triathletes. This is done by examining variations by age, gender, training level and competitive distance. A secondary goal is to develop a results-based training plan so that triathletes will be better in competition. In this branch of research, maximal oxygen consumption (VO2max) is considered a benchmark for assessing cardiovascular capacity (Dolezal et al., 2015). Getting an accurate measurement of VO2max requires specialised techniques that are available in exercise physiology labs and not available to all professionals. Because only one athlete can be assessed at a time, testing an entire team can take a long time. For this reason, alternative parameters for estimating VO2max have been developed, which allows simultaneous testing of multiple athletes without the use of sophisticated laboratory instrumentation (Green et al., 2013). Running efficiency (RE) is the ability of an athlete to maintain a high percentage of VO2max over a long period of time and move efficiently at the same time. A variety of physiological characteristics contribute to both athletic performance and visual perception (Barnes & Kilding, 2014). Oxygen consumption under steady state conditions at a given running speed is known as RE and represents the energy cost required to run at a specific intensity (Mayoralas et al., 2018). Runners who are trained have better REs than those who are less trained, indicating a positive adaptation to regular training. It is possible for an athlete to have good RE by nature, but there are a variety of strategies that can further improve RE by improving metabolic, cardiorespiratory, biomechanical and neuromuscular responses (Barnes & Kilding, 2014).

Research methodology

The research objectives are:

- To highlight important scientific research studies related to the topic under investigation;
- Establishing the research design and identifying appropriate scientific research methods;
- Determining the participants to be included in the research;
- Establishing a training programme with athletic means to optimise exercise capacity;
- Establish the evaluation tests to be applied in the initial and final tests to determine the level of participants;
- Establish methods for data analysis and statistical processing.

Research hypothesis

- "The application of an athletic training program significantly optimizes the effort capacity of triathletes. "

Subjects and research site

The present research was conducted with the participation of 3 male athletes, aged 20–36 years (m = 26), from the triathlon sport branch, with more than 4 years of competitive experience, participating in the National Championship (Table 1.1.).

Table 1.1. Research subjects

Subjects	Age (years)	Test	Competitive experience (years)
1	22	triatlon	5
2	20	triatlon	4
3	36	triatlon	12

Organisation of research

In the present research, written informed consent was obtained from the athletes included in the study. Subjects participated voluntarily, without coercion in any way and without penalty; they were informed that they could withdraw from the study at any time and that the results of the assessments would be used in a research paper. Participants' anonymity was respected and data were treated confidentially.

The research was conducted between December 2022 – initial testing and May 2023 – final testing.

The venues where the training programmes have been applied are specific sports bases for running, swimming pools with a distance of 25 metres and cycling circuits for the smooth running of bicycle training.

Table 1.2. Protocolul Bruce – Test Aeroscan

Nr. crt.	Inclination level
1	Level 1 – 10% Inclination at 2.7 km/h
2	Level 2 – 12% Inclination at 4.02 km/h
3	Level 3 – 14% Inclination at 5.47 km/h
4	Level 4 – 16% Inclination at 6.76 km/h
5	Level 5 – 18% Inclination at 8.05 km/h
6	Level 6 – 20% Inclination at 8.85 km/h
7	Level 7 – 22% Inclination at 9.65 km/h
8	Level 8 – 24% Inclination at 10.46 km/h
9	Level 9 – 26% Inclination at 11.26 km/h
10	Level 10 – 28% Inclination at 12.07 km/h

In the following table present the results obtained by the research participants (3 subjects), regarding the assessment of the cardiac function of the respiratory rate, in the initial test (T.I) and in the final test (T.F.), for all the evaluation samples.

Table 1.3. Aeroscan Results – Initial Testing and Final Testing

Paricipants	AEROSCAN			
	I.T.		F.T.	
	Heart rate	Respiratory rate	Heart rate	Respiratory rate
1	194.87	54.17	187.20	51.40
2	197.14	57.44	191.14	56.90
3	195.66	56.41	190.79	54.11

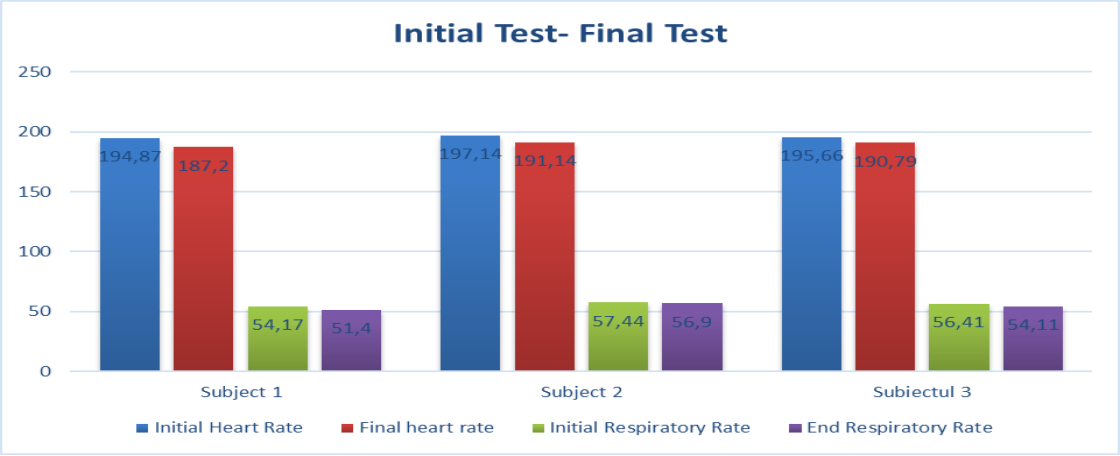


Figure 1. Initial Test – Final Test

Descriptive statistics

The main indicators of descriptive statistics were calculated for the results obtained in the assessment tests taken, both in the initial and final assessments.

Table 1.4. Descriptive statistics – experimental group results – assessment of heart rate and respiratory rate (baseline and end-point testing)

Statistical indicators	Aeroscan		Aeroscan	
	Heart rate	Respiratory rate	Heart rate	Respiratory rate
N	3	3	3	3
Average	195,89	56	189,71	54,13
Standard deviation	0.94	1.36	1.78	2.24
Cv	0,004	0,024	0,009	0,096

We thus present the values of the main statistical indicators: mean (m), standard deviation (S) and coefficient of variability (Cv) for the research group (athletic intervention), for heart rate and respiratory rate coefficients, both (N=3).

Table 1.4. shows the values of the main descriptive statistics indicators for the research group for the evaluation sample (Aeroscan), the initial test and the final test:

In the initial test, regarding heart rate, the participants obtained an average of 195.89 beats per minute, S = 0.94, Cv = 0.004, which indicates that homogeneity is ensured, the participants having close results; regarding respiratory rate coefficient, the average results were 56, S = 1.36, and Cv = 0.024, the results are close to each other.

In the final test, on heart rate, participants averaged 189.71 beats per minute, S = 1.78, Cv = 0.009, indicating that homogeneity is ensured, with participants having close results; on respiratory rate, the mean results were 54.13, S = 2.24, and Cv = 0.096, with similar results at group level.

Interval and variable training can improve exercise capacity: The use of variable-intensity training sessions and intervals of intense effort alternating with periods of active recovery can help increase exercise capacity in triathlon. Interval training allows the body to adapt to the stress caused by high-intensity activities, thus improving endurance and the ability to cope with prolonged competition efforts.

This research examined the training characteristics of high-level triathletes in the 3 months of training leading up to an Olympic distance triathlon. Participants in this study had a training frequency that ranged from 5 to 9 sessions per week. Weekly training duration averaged 6.2 h per week between weeks 1 and 5, with weeks 6 and 10 showing a decrease in training duration. Excluding the athletes' Olympic distance triathlon, week 6 saw a significant reduction in training duration compared to week 1, with athletes averaging just under 3 h of training (Coutts et al., 2007). Compared to athletes training for longer distance triathlons, the average weekly training volume was also lower, as previous research has identified that triathletes participating in Ironman events train an average of 14.1 h per week (Rüst et al., 2013; Rust et al., 2012). The most important goal for coaches and triathletes is to maximize athlete competitiveness and design a well-controlled training program to ensure peak performance is aligned with major triathlon competitions. Traditional training periodization, with the usual division of the training season into hierarchical training, competitive and transition periods, and structural components called macrocycles, mesocycles and microcycles (Matveyev, 1981), provides coaches and athletes with basic guidelines for structuring and planning training. In triathlon, top performances are often associated with periods of intensive training followed by a taper, which involves a sharp reduction in training load for several days before a major competition (Mujika, 2011).

Conclusions

The use of interval and variable intensity training had a positive impact on the triathletes' exercise capacity, adapting the body to intense effort and improving endurance. Participants followed a varied training programme, with between 5 and 9 sessions per week, with a decrease in the weekly training duration as they approached the competition. Structuring training into macrocycles, mesocycles and microcycles, as well as the use of tapering prior to major competitions, was key to maximising top performance, highlighting the differences between Olympic and Ironman distance triathletes in terms of training volume.

Proper scheduling of training sessions, active recovery periods and rest periods can help avoid overtraining and prevent injuries, allowing athletes to improve their performance and maximise their potential in competition.

Finally, by analyzing and interpreting the data obtained from our research, we were able to support with concrete information the hypothesis from which we started, *"The application of a training program with athletic means significantly optimizes the effort capacity of triathletes."* is confirmed.

References

Barnes, K. R., & Kilding, A. E. (2014). Strategies to improve running economy. *Sports Medicine, 45*(1), 37–56.

Bentley, D. J., & Bishop, D. (2008). Science and medicine of triathlon. *Journal of Science and Medicine in Sport, 11*(4), 361–362.

Coutts, A. J., Wallace, L. K., & Slattery, K. M. (2007). Monitoring changes in performance, physiology, biochemistry, and psychology during overreaching and recovery in triathletes. *International Journal of Sports Medicine, 28*(2), 125–134.

Dolezal, B. A., Barr, D., Boland, D. M., Smith, D. L., & Cooper, C. B. (2015). Validation of the firefighter WFI treadmill protocol for predicting VO2max. *Occupational Medicine, 65*(2), 143–146.

Green, M. S., Esco, M. R., Martin, T. D., Pritchett, R. C., McHugh, A. N., & Williford, H. N. (2013). Crossvalidation of two 20-M shuttle-run tests for predicting VO2max in female collegiate soccer players. *Journal of Strength and Conditioning Research, 27*(6), 1520–1528.

Johnston, K., Wattie, N., Schorer, J., & Baker, J. (2018). Talent identification in sport: A systematic review. *Sports Medicine, 48*(1), 97–109.

Matveyev, L. P. (1981). *Fundamentals of Sports Training*. Moscow, Russia: Progress Publishers.

Mayoralas, F. G. M., Díaz, J. F. J., Santos-García, D. J., Castellanos, R. B., Yustres, I., & González-Rave, J. M. A. (2018). Running economy and performance. High and low intensity efforts during training and warm-up. A bibliographic review. *Archivos de Medicina del Deporte, 35*(2), 108–116.

Millet, G. P., & Vleck, V. E. (2000). Physiological and biomechanical adaptations to the cycle to run transition in Olympic triathlon: Review and practical recommendations for training. *British Journal of Sports Medicine, 34*(5), 384–390.

Mujika, I. (2011). Tapering for triathlon competition. *Journal of Human Sport and Exercise, 6*(2), 264–270.

Ofoghi, B., Zeleznikow, J., Macmahon, C., Rehula, J., & Dwyer, D. B. (2016). Performance analysis and prediction in triathlon. *Journal of Sports Sciences, 34*(7), 607–612.

Rüst, C. A., Knechtle, B., Knechtle, P., & Rosemann, T. (2013). A comparison of anthropometric and training characteristics between recreational female marathoners and recreational female Ironman triathletes. *Chinese Journal of Physiology, 56*(1), 1–10.

Rust, C. A., Knechtle, B., Knechtle, P., Wirth, A., & Rosemann, T. (2012). A comparison of anthropometric and training characteristics among recreational male Ironman triathletes and ultra-endurance cyclists. *Chinese Journal of Physiology, 55*(2), 114–124.

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2008). Talent identification and development programmes in sport – Current models and future directions. *Sports Medicine, 38*(9), 703–714.

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 81-96
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-11

COMPARATIVE STUDY ON ANTHROPOMETRIC AND MOTOR DIFFERENCES IN U15 BASKETBALL PLAYERS

Miruna Elena TRIFAN[1*], Alina Mihaela STOICA[2], Adina DREVE[3]
[1,2,3]*University of Bucharest, Bucharest, Romania*
*Corresponding author: trifanmiruna96@gmail.com

Abstract. Basketball is a predominantly aerobic sport during which high-intensity anaerobic actions are performed. In recent years, this characteristic has evolved in terms of demands on the athlete and intensity of the competition, implying an increase in the number and duration of explosive actions. To meet the demands of this sport, good technical, tactical, physical and mental training is required.
The research purpose was to determine the anthropometric and motor differences between two male basketball teams from a private club, both playing in the U15 age category.
The study included 32 athletes who were divided into two groups. One group was made up of 16 players representing the club's elite team, and the other group also consisted of 16 players representing the club's secondary team for this age category. All players were tested in the same sports hall on two different days, during their training for the U15 National Basketball Championship of Romania. Anthropometric and physical characteristics were measured using a test battery with six variables: Height, Weight, Body mass index, 10 m Sprint, Standing long jump, Vertical jump, and Little Marathon. The methods used were: literature review, observation, mathematical statistics, tabular and graphical methods. Differences in anthropometric and physical values between the basketball players of the two teams were determined using the t-Test for independent small samples (Assuming Equal Variances). Our research hypothesis is confirmed, since there are significant anthropometric and motor differences between the players of the two representative club teams, justifying the presence of the elite team in the U15 National Basketball Championship.

Keywords: anthropometric characteristics, physical characteristics, young male basketball players.

Introduction

Team sports are constantly developing, and physical abilities account for a fairly important percentage in increasing performance during game play. The assessment of physical abilities is the most representative method to find out whether the athlete's physical fitness is appropriate. Basketball is an intermittent team sport that requires a wide range of physical qualities among which the ability to perform high-intensity sprints, jumps and runs (Delextrat et al., 2015). As in the other team sports, the improvement of player's performance should be properly addressed, including from a physical, technical, tactical and psychological point of view. Thus, the player's physical fitness will be influenced by the type of training to be performed and should be enhanced according to the specifics of the training programme.

Basketball is a predominantly aerobic sport (Korkmaz & Karahan, 2012) during which high-intensity anaerobic actions are performed (Meckel et al., 2009). In recent years, this characteristic has evolved in terms of demands on the athlete and intensity of the competition, implying an increase in the number and duration of explosive actions (Padulo et al., 2016). This

evolution means that the athlete's physical fitness also develops and, to meet the demands of this sport, good technical, tactical, physical and mental training is required.

Aerobic capacity is essential for players to cope throughout the match, and their anaerobic performance is the most important descriptor of the final result (Ibáñez et al., 2008). Anaerobic capacity allows for energy production through a glycolysis and phosphagen combination, while anaerobic power reflects the ability to use the phosphagen system, which is understood as the relationship between strength and speed during a maximal intensity action performed over a short period of time (Alemdaroğlu, 2012).

In terms of age differences, the pubertal period and related physiological processes have been confirmed to be limiting factors in the development of physical abilities and implicitly the athletic performance of young basketball players (Ramos et al., 2019).

Basketball is characterised by rapid changes of direction that involve complex movements and require a large number of accelerations and decelerations during a game (Ransone, 2016). Consequently, strength, speed and agility are often highly correlated with the athletic performance of basketball players (Ostojic et al., 2006). We believe that an increased level of these motor skills is also a key factor in minimising the risk of injury.

Testing team sports players is an essential component in assessing training programmes and determining player progress during the season. According to the literature (Rodriguez-Alonso et al., 2003), the physiological demands imposed by the game of basketball in the last 20 years have indicated a major dependence on anaerobic metabolism. Indeed, a large number of jumps and sprints are performed during a game, which demonstrates the importance of anaerobic power, and the rather high average blood lactate values recorded in competitions show a significant involvement of the glycolytic energy system, also called anaerobic capacity. Therefore, coaches and scientists have developed various tests to assess both motor skills (strength, speed, endurance) and "the effectiveness of the physical conditioning undertaken by their players" (Delextrat & Cohen, 2008, p. 1066).

Updates to basketball rules following their modification includes shortening the attack time from 30 to 24 seconds, shortening the time allowed to cross the median line from 10 to 8 seconds and subdividing the duration of play into four quarters of 10 minutes each instead of two 20-minute halves, which supports the idea that the new rules change the tactical and physical demands of basketball, leading to an increase in game intensity (Abdelkrim et al., 2007).

Motor skills play an important role in the selection of young basketball players and the performance progress during the game. This is especially true for those skills that are mainly innate and difficult to develop up to a higher level only through training so as to meet the requirements of modern basketball. Explosive strength/power, speed and agility are motor skills that directly contribute to efficient movement with or without the ball, thus playing a major role in basketball technique and tactics (Erčulj et al., 2003). Consequently, the level of these motor skills is most often identified through various tests performed with or without the ball. According to the literature (Dežman et al., 2005), physical tests are considered the most accessible and applicable to the game of basketball, because they are used in the same conditions as those encountered in training and competition.

In the current basketball game, the level of competition is supposed to be higher, which implicitly requires a higher level of motor skills, more rigorous criteria for player selection and a better quality of training. In this regard, we can say that the number of workouts and the importance of integrating physical training have considerably increased in recent years. In addition to motor skills, basketball performance is influenced by many other factors. Among them, height plays an essential role, having a negative impact on the level of certain motor skills, which are less developed than in shorter players (Karpowicz, 2006).

To achieve high performance in the game of basketball, players should be able to cover various distances using continuous accelerations and decelerations, sudden stops and changes of direction while performing game-specific actions (such as dribbling, jumping, throwing) as correctly as possible (Hoffman & Maresh, 2000). In addition, players should be able to repeat these actions during the match, and the rest time between game actions should be used as efficiently as possible.

The ability to perform repeated bouts of short and high-intensity actions during a match has become more and more important in recent years, because the level of amateur and professional

basketball players has developed, thus increasing the demands of competitive basketball. Moreover, it has been demonstrated that the number and duration of "action bouts" increase and decrease with the technical and physical level of players; thus, U19 basketball players perform 55 ± 11 "action bouts" during a match, with an average duration of 2.1 seconds (Abdelkrim et al., 2007), while for professional players, the average number of "action bouts" is 105 ± 52, with an average duration of 1.7 seconds (McInnes et al., 1995).

Numerous scientific studies have investigated the anthropometric characteristics and body composition of athletes, with many researchers reaching the conclusion that specific morpho-functional adaptations occur in the human body following a long process of systematic training based on different types of exercise (Masanovic, 2018). Top-level athletes are expected to show more favourable characteristics in the game of basketball than those who play at a lower level (Hulka & Weisser, 2017). All competitive sports played at a professional level require the body to function at its maximum physiological potential (Leonardi et al., 2018). An accurate assessment of body composition is important in sport, because errors can lead to mistakes in planning workouts and developing dietary programmes, which will affect sports performance (Popovic et al., 2013).

Position-specific tasks and body size characteristics are well established in basketball, indicating that centres are the tallest and heaviest in a team, while playmakers are the shortest and most agile team players (Boone & Bourgois, 2013). Physical differences between playing positions have been analysed for professional basketball by Vaquera et al. (2015). The above studies support the idea that forwards possess advanced qualities of speed and well-developed aerobic capacity. However, the results of studies comparing agility performance between playing positions are unclear. In some cases, better agility and speed performance was reported in forwards than point guards and shooting guards (Köklü et al., 2011). On the other hand, Scanlan et al. (2014) reported opposite results, with frontcourt players (forwards and centres) showing higher agility performance than backcourt players (guards).

This brief review of the literature reveals the existence of a limited number of research studies that present differences between playing positions in basketball due to athletes' body dimension, physical fitness and skills, so their results are inconsistent.

The five playing positions in a basketball team can be classified in various ways. Thus, the most detailed system described in the literature classifies athletes according to their anthropometric and motor profiles as well as their playing positions. Other specialised studies about team sports indicate that a particular type of body profile is needed for each playing position (Ramos-Campo et al. 2014). Basketball players are assigned the following five positions on the court (each one with specific tasks during the game): point guard, shooting guard, small forward, power forward, and centre.

The point guard (also called playmaker) (position 1) has the role of coordinating the team through different schemes. In motor terms, players are characterised by agility, and from an anthropometric point of view, they are not very tall but have a good technical strategy.

The shooting guard (position 2) has a good throwing technique, being the player who scores most points during a match.

The small forward (position 3) and power forward (position 4) are characterised by versatility and the ability to do almost everything on the court, for example, regaining possession and shooting. From an anthropometric and physical point of view, players are tall, fast and show good endurance ability during the game.

The centre (position 5) plays a crucial role in a basketball team, having the major responsibility to regain possession of the ball and prevent the opponents from scoring. Players are the tallest and strongest in the team.

The *purpose* of this research is to determine the anthropometric and motor differences between two male basketball teams from the same club, Laguna Sharks Bucharest, both playing in the U15 age category.

The research *hypothesis* is that team A will outperform Team B in physical testing and anthropometric measurements, and these differences will justify Team A's presence in the U15 National Championship and Team B's presence in the U15 Municipal Championship.

Methodology

Participants

The research sample included 32 male basketball players aged 15 years (U15 category) from the Laguna Sharks Basketball Club of Bucharest, who were divided into two groups. One group was made up of 16 players representing the club's elite team (A) registered in the U15 National Basketball Championship of Romania, and the other group also consisted of 16 players representing the club's secondary or semi-elite team (B) registered in the U15 Municipal Basketball Championship, where players compete against the other clubs from the Bucharest Municipality. Players in the first team (A) had 6-7 years of experience, while those in the second team (B) had 3-5 years of experience. It should be noted that the semi-elite team (B) started playing basketball 1 year before or even during the COVID-19 pandemic, which considerably influenced their training, in the sense their lessons were conducted online for a long time before returning to the basketball court, while the elite team (A) already had a more solid theoretical and practical background acquired prior to the pandemic, so when returning to the sports hall, they had consistent knowledge about the game of basketball.

Testing procedures

Anthropometric measurements and physical tests took place in the same sports hall on two different days. Similar testing equipment and methods were used, and the testing procedures were conducted during the competitive season, when players had reached their peak form.

Anthropometric measurements

The players' somatic and motor profiles were determined by anthropometric measurements (height, weight, arm span), and then their body mass index (BMI) was calculated.

Physical tests

Vertical jump – was used to test the explosive power of the lower limbs. The player was measured in the standing position with the arm outstretched. Then, the athlete performed a vertical leap with the legs outstretched, and the reach height was recorded. The difference between the two measurements represented the player's score. The best time of two attempts was taken into account.

Speed – was measured with the help of Microgate, a portable wireless timing system used to record the values in sprint tests (10 m). Players took a standing start and were timed individually. The time needed to complete the test was measured in seconds and hundredths of a second using a photoelectric cell device. The best time of two attempts was recorded.

Little Marathon – involved running at maximum speed over the distance of 98 m with a standing start. Test description: Players were placed at the end line of the basketball court and, at the signal, started running between the transverse lines of the court. The timer started when the athlete's rear leg was lifted off the ground and stopped when their chest crossed the finishing line. The time was recorded in seconds and tenths of a second.

The test battery also consisted of coordination and explosive power measurements, for example, the Standing long jump test, which was performed with feet apart and tiptoes placed behind the starting line. The instruction for players was to jump as far as possible. The measurement was made with an accuracy of 0.1 cm, using a measuring tape stretched from the starting line to the heel of the rear foot. Two attempts were given, and the jumps where players lost their balance on landing and did not maintain a stationary position were not taken into account, so they had to be repeated.

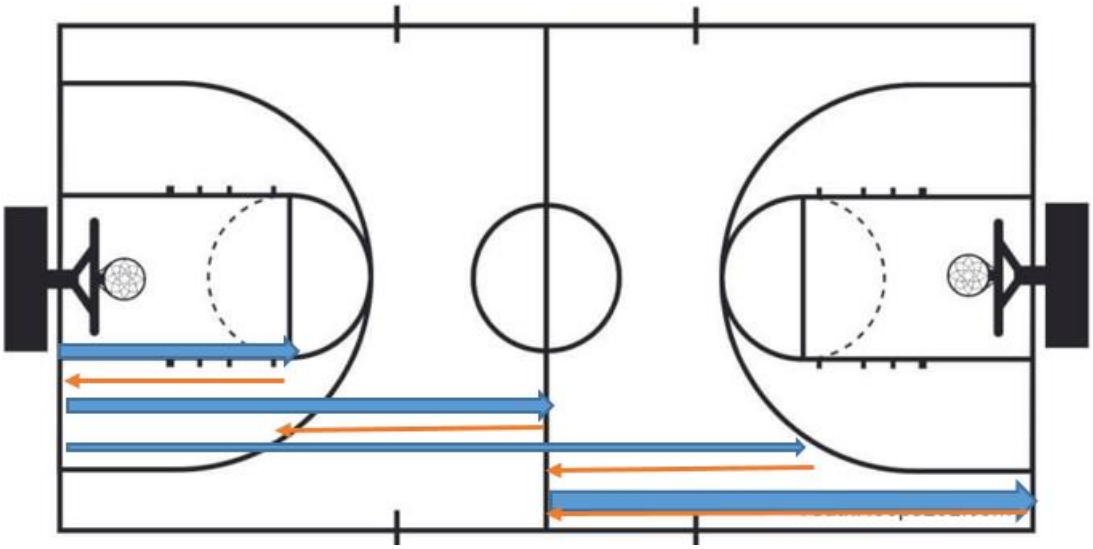


Figura 1. Scheme of the small marathon running event

Results and discussions

The data obtained from our study are of great importance, because they indicate that the research hypothesis is confirmed, which is demonstrated by the fact that the results of basketball players in the club's elite team (A) are significantly better than those obtained by the club's secondary team (B). We considered it necessary to determine whether there were differences in the degree of homogeneity of each group, as the age of 14-15 years is critical for young players, who are in full development. This age is characterised by a rapid increase in muscle mass, a disproportionate bone development and a temporary lack of harmony in movement coordination, all of which are particularly important in the game of basketball.

Monitoring the levels of physical development, motor preparedness and technical/tactical skills of the young basketball players allows for the successful management of the training process and the faster achievement of the sports mastery level (Borukova 2019).

Descriptive statistics

Table 1. Physical test results and somatic characteristics – A comparison between team A and team B Laguna Sharks

Variables	Average A	Std dev A	P-value A	Average B	Std dev B	P-value B
10 m	1.83	0.07	0.93	2.04	0.08	0.14
Height	1.75	0.07	0.90	1.74	0.06	0.37
Weight	61.24	6.31	0.56	63.34	6.33	0.59
Vertical jump	53.56	4.22	0.35	42.38	8.13	0.86
BMI	19.83	1.48	0.90	20.64	1.84	0.47
Small marathon	24.85	1.15	0.12	25.33	1.63	0.34
Standing long jump	2.18	0.20	0.42	2.05	0.23	0.80
Arm span	1.82	0.06	0.88	1.76	0.02	0.68

The Shapiro-Wilk test highlights the following aspects:

- in the 10 m Sprint test, the average score of team B athletes is 2.04, which is higher than the average score obtained by team A athletes, 1.83;

- the difference in height between team A and team B athletes is very small, with team A having an average of 1.75 and team B, 1.74;
- the average weight for team A athletes is 61.24 kg, while for team B athletes, it is 63.34 kg, which indicates that the club's semi-elite team weighs more;
- the average BMI is 19.83 for team A athletes and 20.64 for team B athletes, meaning that those in team B are slightly heavier, so their adipose tissue/muscle mass ratio is positive;
- in the Vertical jump test, the average score of team A athletes is 53.56, therefore it is much higher than that of team B athletes, 42.38;
- in the Little Marathon test, the average score of team A athletes is 24.85, which is much better than the average score achieved by team B athletes, 25.33;
- in the Standing long jump test, the average score of team A athletes is 2.18, therefore it is much higher than that of team B athletes, 2.05;
- the average arm span is 1.82 for team A athletes and 1.76 for team B athletes, and this difference is significantly larger than their difference in height, which is almost similar for the two teams.

A very small standard deviation is observed for most variables in both team A and team B athletes, which reflects the homogeneity of the groups. However, the standard deviation is high for Standing long jump, Little Marathon, Vertical jump, BMI and Body weight, which indicates large differences between team A and team B athletes for these variables.

Table 2. Descriptive statistics for 10m

Team A		*Team B*	
Mean	1.84	Mean	2.03
Standard Error	0.02	Standard Error	0.02
Median	1.83	Median	2.02
Mode	1.86	Mode	1.96
Standard Deviation	0.07	Standard Deviation	0.09
Sample Variance	0.01	Sample Variance	0.01
Kurtosis	-0.05	Kurtosis	–0.84
Skewness	0.26	Skewness	0.53
Range	0.28	Range	0.31
Minimum	1.70	Minimum	1.92
Maximum	1.98	Maximum	2.23
Sum	29.42	Sum	32.55
Count	16.00	Count	16.00

Table 3. t-Test: Two-Sample Assuming Equal Variances

	Team A	*Team B*
Mean	1.84	2.03
Variance	0.01	0.01
Observations	16.00	16.00
Pooled Variance	0.01	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	–6.52	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.04	

Figura 2. Difference between Team A and Team B Laguna Sharks for the 10m sprint

In the 10 m Speed test (Table 2), the level of team A (M = 1.83, SD = 0.07, n = 16) was better than the level of team B (M = 2.04, SD = 0.08, n = 16), which is revealed by the mean difference between them. Statistical significance was set at an alpha level of 0.05. This difference was significant, as the results obtained in the speed test were better for team A, $t(30) = 2.04$ (two-tail), $p = 0.00$ (one-tail). We mention that only two players in team B had better results than those in team A, and we believe that this was influenced by the pandemic period, because team B athletes were more affected than players in the club's elite team (A).

Table 4. Descriptive statistics for Standing Variances

	Variable 1	*Variable 2*
Mean	2.18	2.05
Variance	0.04	0.05
Observations	16.00	16.00
Pooled Variance	0.05	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	1.79	
P(T<=t) one-tail	0.04	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.08	
t Critical two-tail	2.04	

Table 5. t-Test: Two-Sample Assuming Equal long jump

Team A		*Team B*	
Mean	2.18	Mean	2.05
Standard Error	0.05	Standard Error	0.06
Median	2.16	Median	2.08
Mode	#N/A	Mode	2.08
Standard Deviation	0.20	Standard Deviation	0.23
Sample Variance	0.04	Sample Variance	0.05
Kurtosis	–0.46	Kurtosis	0.09
Skewness	0.62	Skewness	–0.59
Range	0.66	Range	0.88
Minimum	1.91	Minimum	1.54
Maximum	2.57	Maximum	2.42
Sum	34.93	Sum	32.73
Count	16.00	Count	16.00

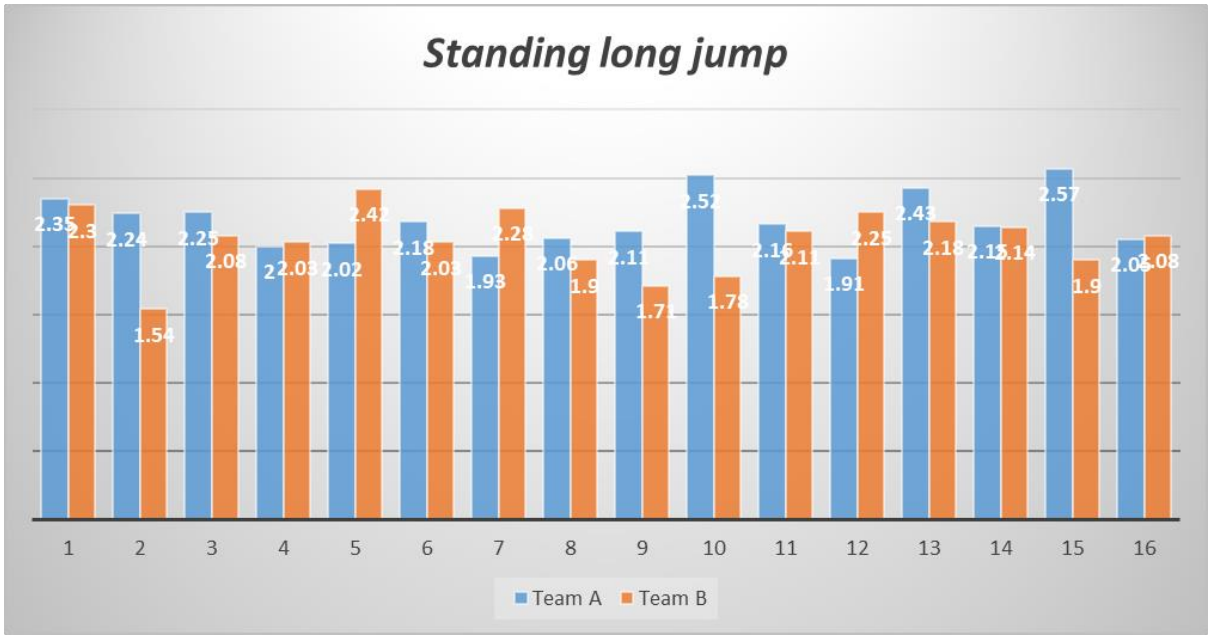


Figure 3. Difference between team A and team B Laguna Sharks for standing long jump

Table 4 shows the difference between the two teams in the Standing long jump test, where the level of team A (M = 2.18, SD = 0.20, n = 16) was better than the level of team B (M = 2.05, SD = 0.23, n = 16). Statistical significance was set at an alpha level of 0.05. It can be seen that the best result of team A was 2.18, and the best result of team B was 2.05. Following the analysis of this test, we can demonstrate the existence of a significant difference, $t(30) = 2.04$ (two-tail), $p = 0.04$ (one-tail)

Table 6. *Descriptive statistics for vertical jump*

Team A		*Team B*	
Mean	53.56	Mean	42.38
Standard Error	1.06	Standard Error	2.03
Median	53.00	Median	43.00
Mode	50.00	Mode	40.00
Standard Deviation	4.23	Standard Deviation	8.14
Sample Variance	17.86	Sample Variance	66.25
Kurtosis	-0.69	Kurtosis	1.15
Skewness	0.52	Skewness	-0.11
Range	14.00	Range	35.00
Minimum	48.00	Minimum	25.00
Maximum	62.00	Maximum	60.00
Sum	857.00	Sum	678.00

Table 7. *t-Test: Two-Sample Assuming Equal Variances*

	Team A	*Team B*
Mean	53.56	42.38
Variance	17.86	66.25
Observations	16.00	16.00
Pooled Variance	42.06	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	4.88	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.04	

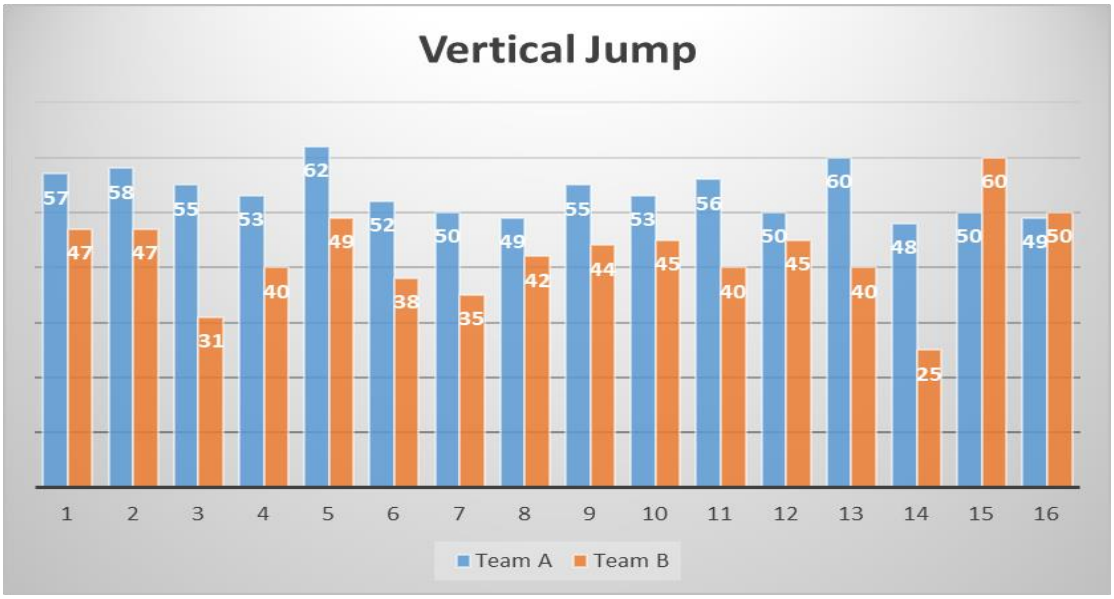


Figure 4. Difference between team A and team B Laguna Sharks for vertical jump

Table 6 indicates major differences in the Vertical jump test, the level of team A (M = 53.56, SD = 4.22, n = 16) being much better than the level of team B (M = 42.38, SD = 8.13, n = 16). Statistical significance was set at an alpha level of 0.05. This difference was significant, $t(30) = 2.04$ (two-tail), $p = 0.00$ (one-tail). From the analysis of this test, it appears that team B athletes are less prepared in terms of strength, which is also confirmed by their results in the Standing long jump test.

Table 8. Descriptive statistics for small marathon

Team A		*Team B*	
Mean	24.85	Mean	25.33
Standard Error	0.29	Standard Error	0.41
Median	24.90	Median	24.81
Mode	25.10	Mode	26.87
Standard Deviation	1.15	Standard Deviation	1.63
Sample Variance	1.32	Sample Variance	2.66
Kurtosis	–0.81	Kurtosis	–1.16
Skewness	0.36	Skewness	0.46
Range	3.60	Range	5.10
Minimum	23.30	Minimum	23.22
Maximum	26.90	Maximum	28.32
Sum	397.60	Sum	405.20
Count	16.00	Count	16.00

Table 9. t-Test: Two-Sample Assuming Equal Variances

	Team A	*Team B*
Mean	24.85	25.33
Variance	1.32	2.66
Observations	16.00	16.00
Pooled Variance	1.99	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	-0.95	
P(T<=t) one-tail	0.17	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.35	
t Critical two-tail	2.04	

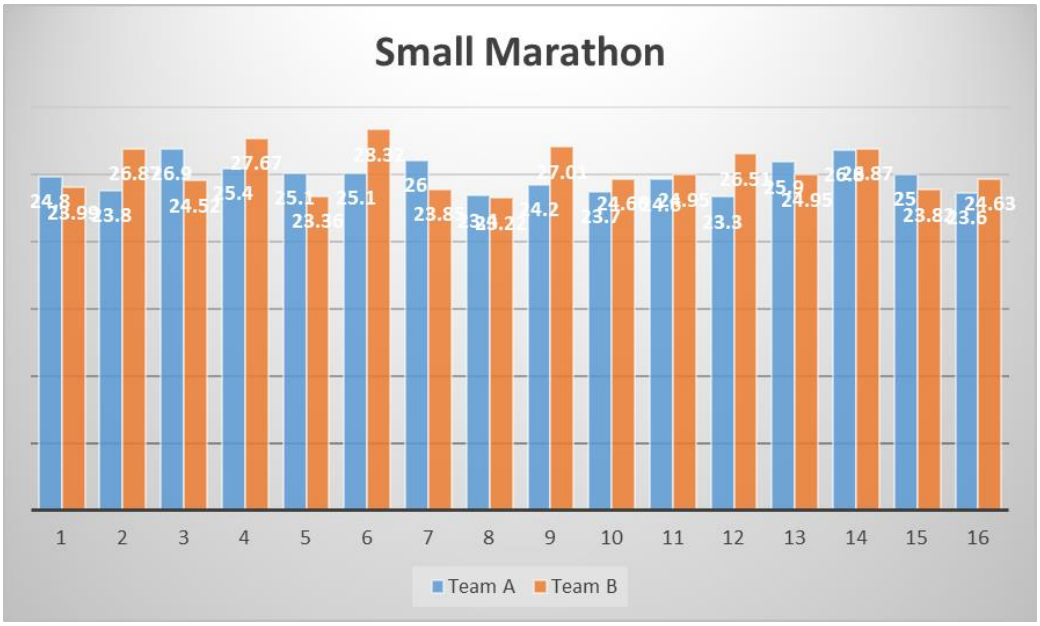


Figure 5. Difference between team A and team B Laguna Sharks for small marathon

Table 8 shows the difference between the two teams in the Little Marathon test, where the level of team A (M = 24.85, SD = 1.15, n = 16) was better than the level of team B (M = 25.33, SD = 1.63, n = 16), although the difference was not very large. Statistical significance was set at an alpha level of 0.05. This difference was significant, $t(30) = 2.04$ (two-tail), $p = 0.17$ (one-tail). From the analysis of this test, it appears that team A is slightly more prepared in terms of endurance than team B, although both of them are very close according to the obtained results.

Table 10. Descriptive statistics for height

Team A		*Team B*	
Mean	1.75	Mean	1.74
Standard Error	0.02	Standard Error	0.02
Median	1.75	Median	1.74
Mode	1.84	Mode	1.78
Standard Deviation	0.07	Standard Deviation	0.06
Sample Variance	0.00	Sample Variance	0.00
Kurtosis	-1.22	Kurtosis	0.27
Skewness	0.00	Skewness	0.04
Range	0.20	Range	0.25
Minimum	1.65	Minimum	1.62
Maximum	1.85	Maximum	1.87
Sum	28.03	Sum	27.80
Count	16.00	Count	16.00

Table 11. t-Test: Two-Sample Assuming Equal Variances

	Team A	*Team B*
Mean	1.75	1.74
Variance	0.00	0.00
Observations	16.00	16.00
Pooled Variance	0.00	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	0.63	
P(T<=t) one-tail	0.27	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.53	
t Critical two-tail	2.04	

Fig. 6. Difference between team A and team B Laguna Sharks for height

Table 10 shows the anthropometric difference in height between the two teams. Thus, the height of team A (M = 1.75, SD = 0.07, n = 16) is slightly greater than that of team B (M = 1.74, SD = 0.06, n = 16). Statistical significance was set at an alpha level of 0.05. This difference was significant, $t(30) = 2.04$ (two-tail), $p = 0.27$ (one-tail). Therefore, in terms of height, we can say that none of the teams has very tall players, and in Romania, the 5th position characterised by tall players is critical because they are totally missing.

Table 12. Descriptive statistics for arm span

Team A		*Team B*	
Mean	1.82	Mean	1.76
Standard Error	0.01	Standard Error	0.02
Median	1.83	Median	1.77
Mode	1.85	Mode	1.79
Standard Deviation	0.06	Standard Deviation	0.07
Sample Variance	0.00	Sample Variance	0.01
Kurtosis	0.87	Kurtosis	0.28
Skewness	–0.85	Skewness	0.31
Range	0.21	Range	0.28
Minimum	1.68	Minimum	1.64
Maximum	1.89	Maximum	1.92
Sum	29.07	Sum	28.14
Count	16.00	Count	16.00

Table 13. t-Test: Two-Sample Assuming Equal Variances

	Team A	*Team B*
Mean	1.82	1.76
Variance	0.00	0.01
Observations	16.00	16.00
Pooled Variance	0.00	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	2.54	
P(T<=t) one-tail	0.01	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.02	
t Critical two-tail	2.04	

Figure 7. Difference between Team A and Team B Laguna Sharks in terms of wingspan

Table 12 shows the results for arm span, indicating that the level of team A (M = 1.82, SD = 0.06, n = 16) is considerably higher than the level of team B (M = 1.76, SD = 0.02, n = 16); to note that, although the height difference between the two teams is very small, team A has better results for the Arm spam variable. Statistical significance was set at an alpha level of 0.05. This difference was significant, $t(30) = 2.04$ (two-tail), $p = 0.1$ (one-tail). Following these results, we assume that both teams have players in full development, who will continue to grow in height.

Table 14. Descriptive statistics for weight

Team A		*Team B*	
Mean	61.24	Mean	63.34
Standard Error	1.58	Standard Error	1.58
Median	60.00	Median	63.00
Mode	56.00	Mode	69.00
Standard Deviation	6.31	Standard Deviation	6.33
Sample Variance	39.86	Sample Variance	40.09
Kurtosis	0.09	Kurtosis	–0.12
Skewness	–0.11	Skewness	–0.27
Range	24.10	Range	24.00
Minimum	47.60	Minimum	51.00
Maximum	71.70	Maximum	75.00
Sum	979.90	Sum	1013.50
Count	16.00	Count	16.00

Table 15. t-Test: Two-Sample Assuming Equal Variances

	Team A	*Team B*
Mean	61.24	63.34
Variance	39.86	40.09
Observations	16.00	16.00
Pooled Variance	39.98	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	-0.94	
P(T<=t) one-tail	0.18	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.36	
t Critical two-tail	2.04	

Figure 8. Difference between Team A and Team B Laguna Sharks in terms of weight

Table 14 reveals the weight difference between team A and team B. Thus, the weight of team A players (M = 61.24, SD = 6.31, n = 16) is lower than that of team B (M = 63.34, SD = 6.33, n = 16). Statistical significance was set at an alpha level of 0.05. This difference was significant, $t(30) = 2.04$ (two-tail), $p = 0.18$ (one-tail). Following these results, we can say that both teams have players within normal weight limits, the differences being very small.

Table 16. Descriptive statistics for BMI

Team A		*Team B*	
Mean	19.83	Mean	20.64
Standard Error	0.37	Standard Error	0.46
Median	19.90	Median	21.15
Mode	19.30	Mode	17.70
Standard Deviation	1.49	Standard Deviation	1.84
Sample Variance	2.21	Sample Variance	3.39
Kurtosis	0.80	Kurtosis	–0.92
Skewness	–0.44	Skewness	–0.17
Range	6.10	Range	6.20
Minimum	16.50	Minimum	17.70
Maximum	22.60	Maximum	23.90
Sum	317.30	Sum	330.30
Count	16.00	Count	16.00

Table 17. t-Test: Two-Sample Assuming Equal Variances

	Variable 1	*Variable 2*
Mean	19.83	20.64
Variance	2.21	3.39
Observations	16.00	16.00
Pooled Variance	2.80	
Hypothesised Mean Difference	0.00	
df	30.00	
t Stat	–1.37	
P(T<=t) one-tail	0.09	
t Critical one-tail	1.70	
P(T<=t) two-tail	0.18	
t Critical two-tail	2.04	

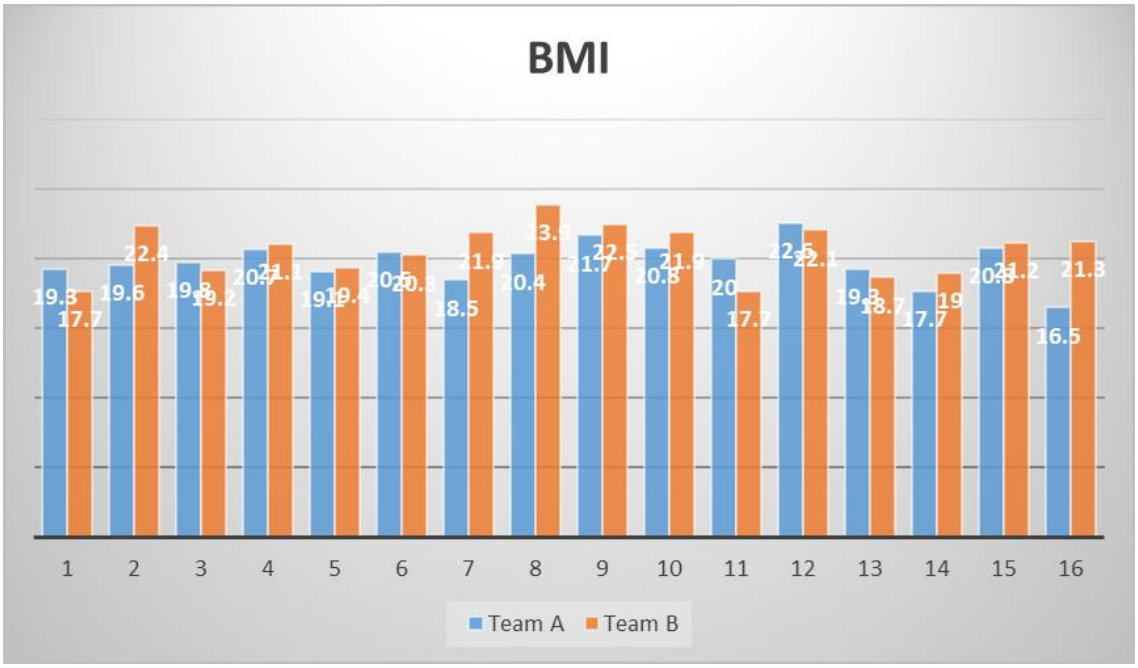


Figure 9. Difference between team A and team B Laguna Sharks in terms of BMI

Table 16 highlights the BMI difference between team A (M = 19.83, SD = 1.48, n = 16) and team B, which has more adipose tissue (M = 20.64, SD = 1.84, n = 16). Statistical significance was set at an alpha level of 0.05. This difference was significant, $t(30) = 2.04$ (two-tail), $p = 0.09$ (one-tail). Although team B has more adipose tissue than team A, their data fall within the normal limits provided by the World Health Organization, so they have healthy weight for their age.

Conclusions

The analysis and generalisations made allow us to draw the following conclusions:

1. Both tested groups are homogeneous in terms of physical development specific to the age addressed in this study.

2. Statistically significant differences can be observed between the two teams as follows: for physical tests – 10 m Sprint, 1.83 (A) < 2.04 (B) and Vertical jump, 53.56 (A) > 42.38 (B); for anthropometric measurements, large differences in arm span are recorded between the two teams, 1.82 (A) > 1.76 (B), despite the small height difference between them, 1.75 (A) > 1.74 (B). As expected, the research hypothesis is confirmed through the significant differences between the results obtained by the two basketball teams in both physical tests and anthropometric measurements.

Given that the results of team A are better than those of team B, we justify the presence of elite team (A) in the U15 National Basketball Championship, where it ranked 5th in the 2022–2023 competitive season, and the presence of semi-elite team (B) in the Municipal Basketball Championship, where only clubs from the Bucharest Municipality participate.

The general conclusion that can be drawn from the research results is that, considering the "cadet" age of our male players, we can improve the future teams by selecting taller athletes (because they are missing in both teams) and by increasing the endurance, running speed (with and without the ball) and lower limb strength of young basketball players during the training process. The number of individual work sessions with the club's players should also be increased.

References

Abdelkrim, B. N., El Fazaa, S., & El Ati, J. (2007). *Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition.* British Journal of Sports Medicine*, 41*(2), 69-75. https://doi.org/10.1136/bjsm.2006.032318

Alemdaroğlu, U. (2012). *The relationship between muscle strength, anaerobic performance, agility, sprint ability and vertical jump performance in professional basketball players*. Journal of Human Kinetics, *31*, 149-158. https://doi.org/10.2478/v10078-012-0016-6

Boone, J., & Bourgois, J. G. (2013). *Morphological and physiological profile of elite basketball players in Belgium*. International Journal of Sports Physiology and Performance*, 8*(6), 630-638. https://doi.org/10.1123/ijspp.8.6.630

Borukova, M. (2019). *Comparative analysis and evaluation of the physical development and specific preparedness of coming up girl basketball players*. In International Scientific Congress "Applied Sports Sciences" and the Balkan Scientific Congress "Physical Education, Sports, Health" (pp. 63-69). http://dx.doi.org/10.37393/ICASS2019/12

Delextrat, A., & Cohen, D. (2008). *Physiological testing of basketball players: Toward a standard evaluation of anaerobic fitness.* Journal of Strength and Conditioning Research*, 22*(4), 1066-1072. https://doi.org/10.1519/jsc.0b013e3181739d9b

Delextrat, A., Badiella, A., Saavedra, V., Matthew, D., Schelling, X., & Torres-Ronda, L. (2015). *Match activity demands of elite Spanish female basketball players by playing position.* International Journal of Performance Analysis in Sport*, 15*(2), 687-703.
https://doi.org/10.1080/24748668.2015.11868824

Dežman, B., Erčulj, F., Lasan, M., & Čoh, M. (2005). *Kondicijska priprava v košarki* [Conditioning for basketball]. Ljubljana, Slovenia: Faculty of Sport, Institute of Sport.

Erčulj, F., Dežman, B., & Vučković, G. (2003). *Differences between playing positions in some motor ability tests of young female basketball players.* In E. Muller, H. Schwameder, G. Zallinger, & V. Fastenbauer (Eds.), Proceedings of 8th Annual Congress of the European College of Sport Science (pp. 292-293). Salzburg, Austria: University of Salzburg, Institute of Sport Science.

Hoffman, J. R., & Maresh, C. M. (2000). *Physiology of basketball*. In W. E. Garret Jr. & D. T. Kirkendall (Eds.), Exercise and sport science (pp. 733-744). Lippincott Williams & Williams.

Hulka, K., & Weisser, R. (2017). *The influence of the number of players on workload during small-sided games among elite futsal players.* Montenegrin Journal of Sports Science and Medicine, *6*(1), 45-48.

Ibáñez, S. J., Sampaio, J., Feu, S., Calvo, A. L., Gómez, M. A., & Ortega, E. (2008). *Basketball game-related statistics that discriminate between teams' season-long success.* European Journal of Sport Science*, 8*(6), 369-372.
https://doi.org/10.1080/17461390802261470

Karpowicz, K. (2006). *Interrelation of selected factors determining the effectiveness of training in young basketball players*. Human Movement*, 7*, 130-146.

Köklü, Y., Alemdaroğlu, U., Koçak, F., Erol, A., & Findikoğlu, G. (2011). *Comparison of chosen physical fitness characteristics of Turkish professional basketball players by division and playing position*. Journal of Human Kinetics*, 30*, 99-106. https://doi.org/10.2478/v10078-011-0077-y

Korkmaz, C., & Karahan, M. (2012). *A comparative study on the physical fitness and performance of male basketball players in different divisions*. Journal of Physical Education and Sport Sciences*, 6*(1), 16-23.

Leonardi, T. J., Paes, R. R., Breder, L., Foster, C., Goncalves, C. E., & Carvalho, H. M. (2018). *Biological maturation, training experience, body size and functional capacity of adolescent female basketball players: A Bayesian analysis*. International Journal of Sports Science & Coaching*, 13*(5), 713-722. https://doi.org/10.1177/1747954118772489

Masanovic B. (2018). *Comparative study of anthropometric measurement and body composition between junior basketball and volleyball players from Serbian national league*. Sport Mont*, 16*(3), 19-24. https://doi.org/10.26773/smj.181004

McInnes, S. E., Carlson, J. S., Jones, C. J., & McKenna, M. J. (1995). *The physiological load imposed on basketball players during competition*. Journal of Sports Sciences*, 13*(5), 387-397. https://doi.org/10.1080/02640419508732254

Meckel, Y., Gottlieb, R., & Eliakim, A. (2009). *Repeated sprint tests in young basketball players at different game stages*. European Journal of Applied Physiology, *107*, 273-279.
https://doi.org/10.1007/s00421-009-1120-8

Ostojic, S. M., Mazic, S., & Dikic, N. (2006). *Profiling in basketball: Physical and physiological characteristics of elite players.* Journal of Strength and Conditioning Research*, 20*(4), 740-744. https://doi.org/10.1519/r-15944.1

Padulo, J., Bragazzi, N. L., Nikolaidis, P. T., Iacono, A. D., Attene, G., Pizzolato, F., Pupo, J. D., Zagatto, A. M., Oggianu, M., & Migliaccio, G. M. (2016). *Repeated sprint ability in young basketball players: Multi-direction vs. one-change of direction (Part 1)*. Frontiers in Physiology*, 7*: 133. https://doi.org/10.3389/fphys.2016.00133

Popovic, S., Akpinar, S., Jaksic, D., Matic, R., & Bkelica, D. (2013). *Comparative study of anthropometric measurement and body composition between elite soccer and basketball players*. International Journal of Morphology*, 31*(2), 461-467.

Ramos, S., Volossovitch, A., Ferreira, A. P., Fragoso, I., & Massuça, L. (2019). *Differences in maturity, morphological and physical attributes between players selected to the primary and secondary teams of a Portuguese Basketball elite academy*. Journal of Sports Sciences, *37*(15), 1681-1689. https://doi.org/10.1080/02640414.2019.1585410

Ramos-Campo, D. J., Martínez Sánchez, F., Esteban García, P., Rubio Arias, J. Á., Bores Cerezal, A., Clemente-Suarez, V. J., & Jiménez Díaz, J. F. (2014). *Body composition features in different playing position of professional team indoor players: Basketball, handball and futsal*. International Journal of Morphology*, 32*(4), 1316-1324. http://dx.doi.org/10.4067/S0717-95022014000400032

Ransone, J. (2016). *Physiologic profile of basketball athletes*. https://www.gssiweb.org/sports-science-exchange/article/physiologic-profile-of-basketball-athletes

Rodriguez-Alonso, M., Fernandez-Garcia, B., Perez-Landaluce, J., & Terrados, N. (2003). *Blood lactate and heart rate during national and international women's basketball.* The Journal of Sports Medicine and Physical Fitness*, 43*(4), 432-436. PMID: 14767402.

Scanlan, A. T., Tucker, P. S., & Dalbo, V. J. (2014). *A comparison of linear speed, closed-skill agility, and open-skill agility qualities between backcourt and frontcourt adult semiprofessional male basketball players.* Journal of Strength and Conditioning Research*, 28*(5), 1319-1327. https://doi.org/10.1519/jsc.0000000000000276

Vaquera, A., Santos, S., Villa, J. G., Morante, J. C., & Garcia-Tormo, V. (2015). *Anthropometric characteristics of Spanish professional basketball players*. Journal of Human Kinetics*, 46*(1), 99-106. https://doi.org/10.1515/hukin-2015-0038

VARIA

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 98-101
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-12

CONSIDERATIONS REGARDING THE IMPORTANCE OF PRACTICING WOMEN'S FOOTBALL AS A FREE-TIME MOTOR ACTIVITY

Bogdan GOZU[1], Gabriela NISTOR[2]*
[1]*University of Bucharest, Department of Physical Education and Sport, 36-46 Bvd. Kogălniceanu, Bucharest,Romania*
[2]*University of Bucharest, Faculty of Biology 91-95 Splaiul Independenței, Bucharest, Romania*
* Corresponding author: gabinistor0111@gmail.com

Abstract. *Background.* Motor activities are actions that involve the movement of the body and the use of the locomotor apparatus in order to fulfill the proposed tasks and objectives. These are important activities for the physical development of the individual and the health of the human body in general.
Lately, more and more emphasis has been placed on devoting free time to activities of relaxation, entertainment, personal development, socializing, to restore the body after the pressure exerted by work tasks or other daily responsibilities. Motor activities can lead to the recovery of the required body, movement being a tool/means of relaxation, revitalization and optimization of physical condition.
For females, involvement in sports activities has been limited by historical and social contexts. Introduced in Romania only three decades ago, women's football represents one of the team sports with multiple benefits, both physically and mentally, a fact for which it can be successfully classified in the category of free-time motor activities.
Purpose. The aim of the paper is to highlight the importance of playing football by women as a leisure activity. Thus, the presentation highlights the physiological and psychological benefits of this sport on the female body. These aspects are discussed through the prism of my personal experience as a player in the Representative Football Team of the University of Bucharest.
Rezults. Playing football, among other things, leads to the improvement of physical and mental resistance, resilience, tolerance and collaborative character, contributes to the hormonal balance of the body and the intensification of metabolic processes. At the same time, through the intense and complex demand on the body, women's football presents benefits on the cardio-respiratory system, reducing the incidence of cardiovascular diseases.
Conclusion. From my experience as a player of women's football, both in my spare time and within the Representative Football Team of the University of Bucharest, we can conclude that this sport fits very well the physical needs of anyone who wants their free time to be used for health, relaxation and socializing.

Keywords: women's football; leisure motor activities, benefits.

Introduction

Football is a physically demanding team sport and recreational activity that requires both strength and resistance, which is why it has often been considered a male-specific sport.

Encountering much skepticism and hostility in several countries, women's football officially debuted in Scotland in 1892 in Glasgow. About 30 years from this event, in 1921, the Football Association of England decided for banning the practice of football in an organized setting by women. However, the Federation's decision could not prevent women from playing football in their free time, as they valued the benefits of this sport as a recreational activity and socializing opportunity.

In recent years, women's football has grown in popularity, becoming popular for both female and male audiences. This significant increase in popularity can be explained by the high degree of involvement of female players, the intense competitiveness, and the course of game brought to the level of art.

Having been practiced by a large number of players, women's football has demonstrated determination, perseverance and talent. However, men's football continues to overshadow the women's game, possible explanations being the cult that has been created around it, the increased aggressiveness level and substantial investments that has been brought over the years.

In Romania, women's football had a slower evolution compared to other European countries, with the first teams being known around 1990. Only from this date, the practice of women's football began to develop more rapidly, becoming more and more more popular among athletes and supporters.

As a physical leisure activity, playing football is currently among the preferences of the general public. Due to the large number of people who choose to play football for recreational and entertainment purposes, this game has attracted the attention of researchers who have studied its short- and long-term effects. It has been proven that playing football brings a series of physical and mental benefits, being recommended for both men and women.

Objectives

This study aimed to present the benefits that women's football, as a leisure activity, can have on the body of the players, influencing both muscle tone and metabolism, as well as mood and mental state. These aspects are discussed in the paper in relation to my personal experience as a player in the Representative Football Team of the University of Bucharest and in relation to the existing studies in the specialized literature, taking into account both the specifics of the football game and the characteristics of the female body. Thus, several bibliographic sources were selected and analyzed in order to identify the possible correlations between the observed effects of sports in general on physical and mental health and those of the practice of football in free time by the female gender.

Purpose

The aim of the paper is to highlight the importance of playing football by women as a leisure activity. Thus, the presentation highlights the physiological and psychological benefits of this sport on the female body. These aspects are discussed through the lens of my personal experience as a player in the Bucharest University Football Representative Team.

As a player of women's football in the University Team and in my spare time, I understood, both from my own experience and from documenting myself, that this sport, regardless of whether it is practiced at the level of performance or at the level of recreational activity, offers a series of benefits on the body, both physical and mental.

The benefits of football on the female body:

1. Physical health benefits

The main physical benefits of playing women's football include improving muscle tone, maintaining an appropriate body weight, strengthening the bone system and increasing the endurance of the cardiovascular system, with considerable effects on the quality of life.

Playing football can lead to improved endurance and muscle tone, as football is a sport that involves rapid transitions from low-speed activities (walking, standing, light jogging) to high-intensity running and sprinting activities. Although during a game the share of low-speed activities is more than 90%, there are indications that the required oxygen intake is increased, while the heart rate can reach up to 170 beats per minute. In these conditions, the cardio-vascular system is

alternately lightly or intensively requested, which leads to the strengthening of the heart muscle and the increase of inspired oxygen content.

Regarding the influence of football on the bone system, a study aimed at evaluating the bone density of active and retired female football players revealed the positive impact and long-term benefits of football practice on bone mineral structure. This may mean a decrease in the cases of osteoporosis and the risk of fractures faced by a number of women at the age of menopause, as it is known that women have a pronounced risk of developing bone disorders due to the hormonal changes during this period, respectively decrease in estrogen levels.

Thus, the physical benefits of practicing women's football in free time have educational and formative values, being summarized below:

a) maintains muscle mass/ provides toning and toning to the body;
b) improves reflexes and increases agility;
c) increases the resistance of the myocardium and the capacity to transport oxygen in the blood;
d) strengthens the bone system in the long term;
e) intensifies metabolic burning and supports weight loss.

2. Mental health benefits

During adolescence, there is an increased incidence of the onset of mental illness, with studies indicating that approximately 14% of adolescents between the ages of 12 and 17 experience a mental illness over the course of a year. Practicing sports can be an effective way of managing the psycho-affective problems they face. At the same time, practicing a sport regularly can increase the body's relaxation level, with direct benefits on cognitive and learning skills.

Specifically, women are more likely than men to develop conditions associated with depression and anxiety. This fact is explained by the tendency of women to let themselves be much more affected by recurring problems, which leads to an increased level of stress. Lack of communication and isolation can contribute to worsening anxiety and depression and ultimately affect a woman's mood or mental health. Women's football is a team sport, which means that during the practice of this sport there is the possibility of communication with other members of the team, and the breaks can be used for socializing and developing friendships. Playing football in your free time is a light activity that combines physical training with moments of relaxation and socializing.

Players thus have the opportunity to share their personal experiences, ask for or give advice and come into contact with different ways of looking at the world. On the other hand, focusing on sports activity lowers stress levels by distancing yourself from daily worries, inducing a feeling of relaxation and euphoria. Reducing the level of stress is also an effect induced by the release of endorphins in the body and with the practice of sports activity, these neurotransmitters being responsible for decreasing mental tension and reducing pain. Cortisol and adrenaline levels also drop drastically, balancing states of anxiety and stress. Thus, in an interview attended by 60 football players, it was proven that the practice of women's football contributes in particular to a better management of difficult situations on a daily basis or at work, to increasing self-confidence and motivation.

In terms of body weight management, women's football contributes favorably to maintaining an appropriate weight. Regular exercise is indicated as a healthy way to reduce the prevalence of obesity, being also correlated with the regulation of health problems such as diabetes, cardiovascular diseases or even certain types of cancer. Although this aspect is mostly correlated with the physical benefits of sports on the body, specialized studies have highlighted the correlation between weight and the perception of one's own person or the level of self-esteem. In general, it was found that the prevalence of obesity in women is higher compared to men, with mechanisms specific to the two genders.

Obesity is mostly associated with eating irregularly or simultaneously with other activities, caloric excess, unhealthy diet and sedentary lifestyle, but also with pregnancy or failure to lose weight after childbirth, hormonal problems or depression. Overweight or obese women have a low level of self-esteem, especially since there is an increasing tendency to criticize the shape or size of a person's body or the so-called "body shaming".

Practicing women's football as a leisure activity can contribute to maintaining an optimal weight both in adolescence and in adulthood, representing a medium-demanding activity that allows the association of physical exercise with socialization. Thus, along with physical toning, the benefits of playing women's football include the development of self-esteem, tolerance and acceptance.

Conclusion

Among other things, football contributes to the improvement of physical and mental capacities, resilience, tolerance and collaborative character, contributes to the hormonal balance of the body and to the intensification of metabolic processes. At the same time, through the intense and complex demand on the body, women's football presents benefits on the cardio-respiratory system, reducing the incidence of cardiovascular diseases, but also a beneficial effect on the bone system.

From my experience as a female football player, both in my free time and as part of the Bucharest University Representative Football Team, I can say that this sport suits very well the physical and emotional needs of people who want to spend their free time for health , relaxation and socializing.

References

Aldhahi MI., Al Khalil,WK., Almutiri, RB., Alyousefi, MM., Alharkan, BS., AnNasban, H. (2022). *Effect of Weight Self-Stigma and Self-Esteem on Aerobic Exercise Capacity in Adult Women with Different Body Compositions*. International Journal of Environmental Research and Public Health. 2022; 19(2):873. https://doi.org/10.3390/ijerph19020873

Andersson, H. (2014). *Training For Performance: Developing Elite Female Football Players*. Women and Sport, Scientific Report Series, Issue 3, 2.

Appleton, P. (2017). *The Psychological and Emotional Benefits of Playing Football on Girls and Women in Europe*. Project Report April, 2017.

Balint, Gh. (2008). *Bazele generale ale fotbalului*. Publisher: PIM, Iaşi, Editor: PIM, ISBN: 978-605-520-005-0.

Cooper, AJ, Gupta, SR., Moustafa, AF., Chao, AM.(2021). *Sex/Gender Differences in Obesity Prevalence, Comorbidities, and Treatment.* Curr Obes Rep. 2021 Dec;10(4):458-466. doi: 10.1007/s13679-021-00453-x.

Duppe, H., Gardsell, P., Johnell, O., Ornstein, E. (1996*). Bone Mineral Density in Female Junior, Senior and Former Football Players*. Osteoporosis International, 6:437-441.

Kruger, J., Yore, MM., Kohl, HW. (2002). *Leisure-time physical activity patterns by weight control status: 1999–2002*.

Liddle, S., K., Frank, P., D., Stewart, A., V. (2016). *Addressing mental health through sport: a review of sporting organizations' websites*. Volume11, Issue2, p. 93-103. https://doi.org/10.1111/eip.12337.

https://www.sisuforlag.se/wp-content/uploads/2018/06/womenandsport-3-2.pdf

https://www.mentalhealth.org.uk/explore-mental-health/a-z-topics/women-and-mental-health

https://www.godigit.com/health-insurance/health-guides/health-benefits-of-sports

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 102-108
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-15

THE UNSTOPPABLE PANTELIMON 2024 TRIATHLON FROM THE PERSPECTIVE OF THE PARTICIPANTS

Cătălin ŞERBAN[1*], Bogdan GOZU[2]
[1]*University of Bucharest, 90, Panduri Street, Sector 5, 050663, Bucharest, Romania*
[2] *University of Bucharest, 90, Panduri Street, Sector 5, 050663, Bucharest, Romania*
* Corresponding author: catalin.serban@unibuc.ro

Abstract. As a result of an increasingly important need to compensate for the harmful effects of the lack of movement determined by daily activities, people are looking for more and more diverse and challenging alternatives in the area of free time motor activities, so that the benefits cover both the physical and the mental sphere as well. By nature and their particularities, triathlon competitions, in general, fit very well into this category, gaining more and more ground compared to other forms of movement, in the options of the participants, precisely because they offer a favorable environment where everyone can test their limits, can compete with other people and establish his own training strategy.Having this important and interesting information at hand, we will be able to better understand the perspective, preferences and reporting of the participants to the particularities of such a competition, all in the context of a deep awareness of the importance of constant involvement in a form of movement.
The main purpose of this research is to create a profile of the participant in the Unstoppable Pantelimon 2024 Triathlon, by applying a questionnaire designed to lead to the identification of the main reasons that were the basis of this option. Moreover, through our scientific approach, we aim to highlight the way in which this competition resonates with the expectations and preparation strategies of the participants, thus leading to a common perspective regarding the benefits of participating in these physical activities.

Keywords: triathlon, perspective, options

Introduction

"The current language considers performance as a result of an activity, such as the completion of a task or action successfully achieved". Performance can be seen as the (individual or collective) result obtained following an assessment (expressed in absolute figures, considering the official scale system or the place in the ranking), (Epuran, Holdevici and Toniţa, 2001).

The interest to reach optimal sports performance in a short time, with high efficiency and minimum biological risks, has led to a huge development of scientific research in sports, but also to an increased reaction for the knowledge transfer and implementation in other areas (Gagea, 2007:7).

Sports performance is defined (according to Dragnea, 1996: 61) as "a bio-psycho-social value achieved in an official competition, as a result of a capacity with multiple determinations and appreciated on the basis of rigorous criteria or scales". It can be a valuable individual or collective result obtained in a sports competition and expressed in absolute figures, considering the official scale system or the place in the ranking. This means both the process and outcome of an action which, in specialized terms, represents craftsmanship, a task accomplished as well as possible, being dependent on the interrelationship of endogenous factors (predispositions, skills) with exogenous (environmental) factors expressed in the quality of training, motor conditions, motility and influence of social factors".

Present in our entire life, physical activity is encountered in some areas of activity, the level of exercise and people's experience contributing substantially to the quality of life of each of us. Science movement introduces us only in areas of in physical activity study without deepening knowledge of each area.

The ways of leisure are influenced by a complex of social and economic factors. From the point of view of the individual, beyond cultural variables, access and appeal to different forms of leisure are determined by income.Ways of leisure imply different costs (transport, equipment, taxes, etc.). most of these active assets being more expensive than passive ones.

The triathlon is a product of post-modern society and because it combines three sports with a long tradition in the Western world (swimming, cycling and running), quickly became a very popular sport.

The most important competitions aline at the starting point thousands of participants, every year professionals trying to find new technical training options in order to exceed their performance.

The first forms of triathlon dating from around 1920, when there were several competitions in France that combined the three disciplines - swimming, running and cycling. At that time the competitions were called "Le trois sports".

These competitions have evolved to modern form of the triathlon which appeared in 1974, the first event of its kind being organized by San Diego Track Club, California. The event brought 46 competitors to start and consisted in 10 km running, 8 km cycling and 500 m swimming. In the next decade, triathlon's popularity continued to grow rapidly and gained worldwide recognition.

In 1989 the International Triathlon Union (ITU) was founded and in the same year it was organized in Avignon - France first World Championship Triathlon. The official distances for triathlon was set at 1.5 km swimming, 40 km cycling and 10 km running - distances taken from the existing competitions in the Olympic program.

Subsequently, triathlon made its Olympic debut at the Summer Olympics in Sydney 2000. Since this time, the triathlon has become a popular discipline with recognized competitions and thousands of participants. Currently there are over 120 national federations affiliated to ITU.

In Romania, the triathlon is a relatively young sport but has become very popular in recent years. The number of practicipants and clubs with triathlon branches has grown tremendously, and if in 2008 there were only two triathlon competitions in Romania and several dozen participants, in 2016 were over 10 such events with hundreds of participants.

"Unstoppable Pantelimon 2024 Triathlon " competition is organized by Unstoppable Sport Culb and aims to promote the triathlon as a leisure activity and sustaining high performance sport among Romanian triathletes.

Picture no. 1. The Unstoppable Club Team

Picture no. 2. Start

Picture no. 3. Swimming

Picture no. 4. Cycling

Picture no. 5. Running

Operational and methodological framework

The assumption from which we started in achieving this research, was that the participants in such competitions, shows a similar profile, in terms of the reasons underlying the participation and also in terms of material resources and their spare time.

*Purpose***:** in conducting our research we aimed to identify the main reasons and options that led the questioned subjects to participate in Unstoppable Pantelimon 2024 Triathlon.

*Objectives***:** theoretical analysis of the speciality literature; analysis of the questionnaire, processing and interpretation of data using graphics.

Materials and Methods

Observation method:

Through its content and many forms of presentation, observation is one of the most appropriate methods to explore the natural environment. As a scientific method of research, it consists in"tracking deliberately, carefully and methodically the aspects of facts, processes, events and the accurate and systematic recording of their various manifestations, as they behave in natural, normal conditions, in order to present them in their essential aspects in an existing situational context" (Niculescu, 2002. Pag. 316).

Questionnaire method:

According to Epuran M., (2005), the questionnaire "represents a logical and psychological writing questions or graphics with stimuli function, relative to the research hypotheses which, administered by operators or self-inquiry, determine a verbal or nonverbal behavior of the subject , to be recorded in writing. "

According to Cosmovici A. (1996), quoted by Tudor V., (2008) "it is a question system developed so as to obtain more accurate data about an individual or a social group."

Questionnaire method applies when considering concordance or discordance, less variability in responses to prospecting character questions, echo, response (feed-back) etc. (Gagea A., 2000).

The purpose of the questionnaire, as a research tool is to measure attitudinal and behavioral characteristics of subjects or to probe them. Analysis of responses is both quantitative and qualitative. Research objectives depend on the assumptions made and the studied problem.

Subjects' responses are evaluated by scales. Questions should be clear, precise and understood by the subjects, unambiguously formulated and not suggesting a particular answer. Based on the information mentioned above, in our research we used the following questionnaire:

QUESTIONNAIRE The options of participants in Triathlon Unstoppable Pantelimon 2024 Triathlon Age category Gender (M/F).....	
1. Job (State system - S / privat system - P).....	privat state
2. What are the main reasons that led you to participate in this competition? a). Compensation intellectual activity through movement b). Health improvement c). Competition and socializing d). Materialmotivation	
3. How many days per week spent on the preparation for this competition?	a) 2 days; b) 3 days; c) more3 days.
4. What kind of venues do you prefer for conducting training?	a) indoor; b) outdoor; c) both.
5. How prefer that preparation?	a) individual; b) in an organized group; c)both.
6. In your training, appeal to the guidance of a specialist?	a) yes; b) not.
7. What is the budget which you allocate for the preparation and participation in the competition (training equipment, sustaining effort, subscriptions, other expenses)?	a) between 2000-4000 RON; b) between 4000-6000 RON; c) more 6000 RON.

Results

Table 1. Age categories

questions	Age categories							Total
	14-15	16-19	20-29	30-39	40-49	50-59	60+	
	14	24	10	40	38	11	1	138
		3	10	36	37	11	1	98
1				4	1			5
2. a	2	7	2	11	6	2		28
b	4	6	2	9	14	6	1	38
c	7	9	4	15	16	3		47
d	1	2	2	5	2	0		11
3. a	2	2	0					4
b	3	5	2	3	1			14
c	9	17	8	37	37	11	1	120
4. a	3	1						4
b	8	21	8	29	31	8	1	106
c	3	2	2	11	7	3		28
5. a	5	3	7	19	20	10		64
b	9	18	3	11	12	1	1	55
c		3	0	10	6			19
6. a	14	22	9	33	35	9	1	123
b		2	1	7	3	2		15
7. a	1	2	0					3
b	4	6	2	1	0			13
c	9	16	8	39	38	11	1	122

Table 2. Age category participants

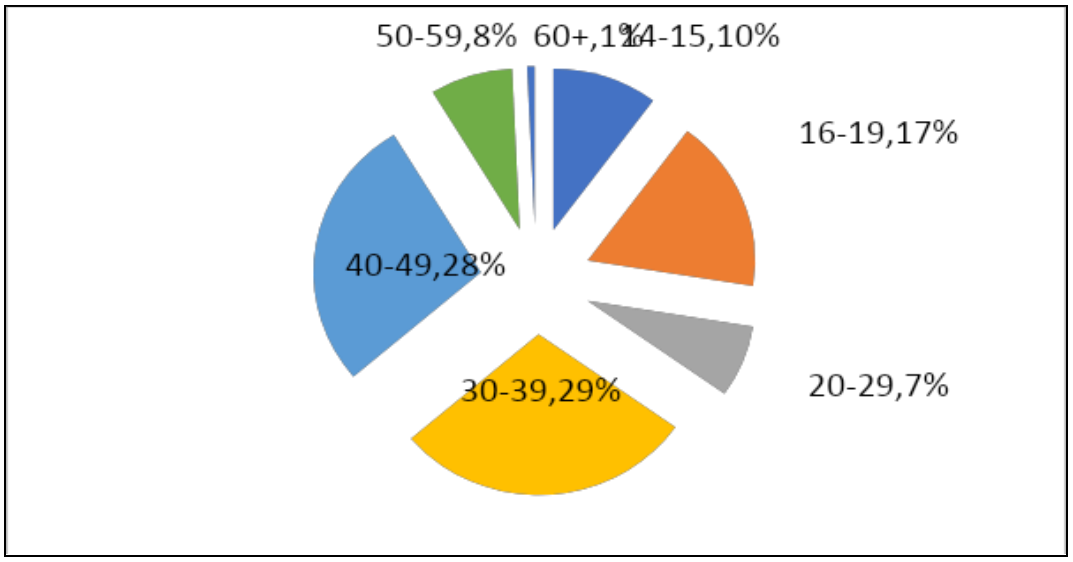


Table 3. Main reason that led to participate in this competition

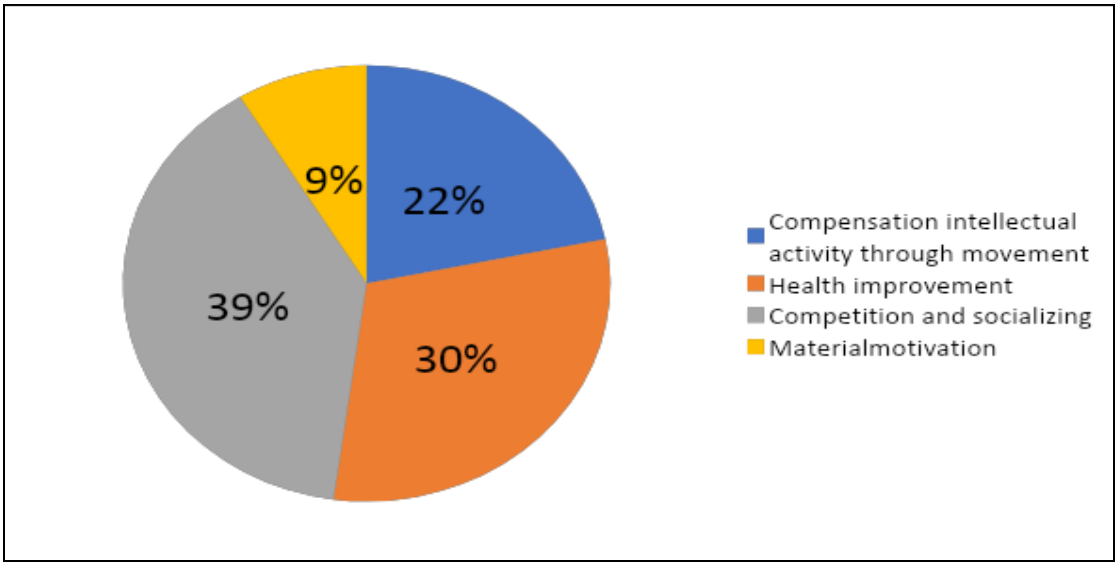
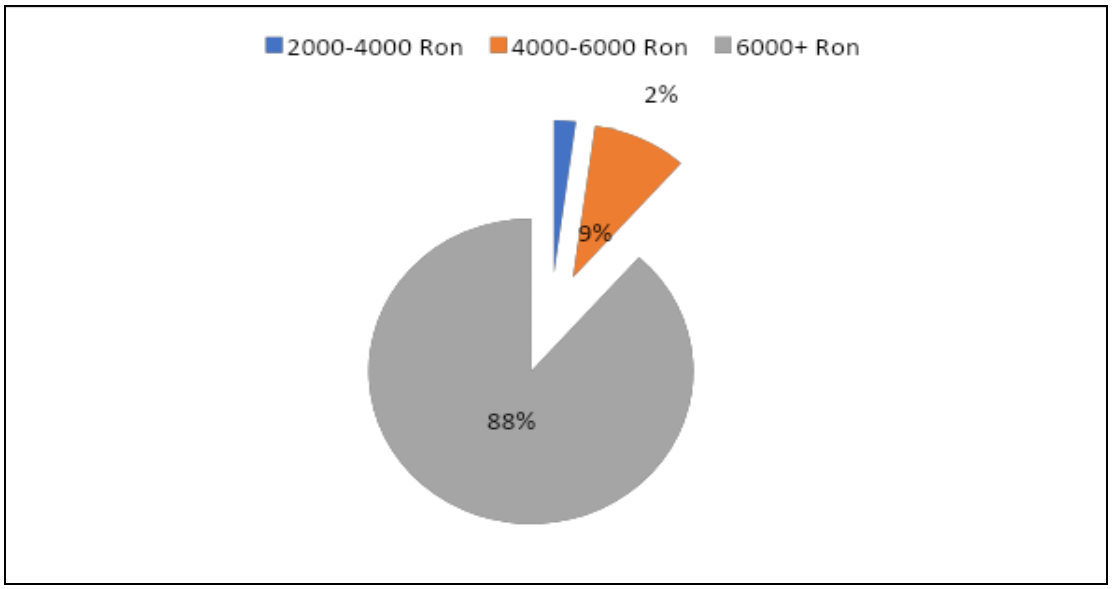


Table 4. The budget which you allocate for the preparation and participation in the competition



Conclusions

Through its numerous educational and formative facets that they present, leisure activities should continue to be a concern to any persons interested in a healthy lifestyle, in agreement with current demands of modern society. If we add to this the benefits of practicing them in a competitive, formal framework, we might have a general idea of the importance and opportunity of this research topic.

The analysis of information obtained from the questionnaire, indicate that subjects participating in the Triathlon Unstoppable Pantelimon 2024 are coming, particularly, from the private sector, as confirmed by main reasons underlying their participation: improving health, the compensation of intellectual activity through movement, competing and socializing.

Regarding the material resources involved, responses indicate that preparing and participating in such a competition involves a financial effort according to previously aspects described by the participants, in most cases exceeding the threshold of 6,000 RON.

Although our scientific approach has led to the achievement of the originally proposed objectives, it meets the partial need for knowledge and understanding of the participants' particularities in such activities, especially through their rapid evolution on national scale.

Therefore, we consider useful and necessary that the topic addressed in this paper to be backed by a number of subsequent research that will provide important vectors directed towards promoting the benefits of regular practice of these forms of movement.

References

Dragnea, A. (1996). *Antrenamentul sportiv*. Editura Didactică şi Pedagogică, Bucureşti.
Epuran, M., Holdevici, I.&Toniţa, F. (2001). *Psihologia sportului de performanţă. Teorie şi practică*. Editura FEST, Bucureşti.
Epuran, M., 2005, *Metodologia cercetării activităţilor corporale*. Editura FEST,Bucureşti, p. 224.
Gagea A. (2000). *Statistică Computerizată în Educaţie Fizică şi Sport*. Editura Ecologică, Bucureşti p. 95.
Gagea, A. (coord.). (2007). *Cercetări interdisciplinare în sportul de performanţă*. Editura Ministerului Internelor şi Reformei Administrative, Bucureşti.
Niculescu, M. (2002). *Metodologia cercetării ştiinţifice în educaţie fizică şi sport*. ANEFS, Bucureşti, p. 316.
Tudor V. (2008), *Măsurare şi evaluare în cultură fizică şi sport*. Editura Moroşan, Bucureşti, p. 37.
http://frtri.ro/istoria-triatlonului/
https://www.facebook.com/unstoppablesportclub

https://www.facebook.com/photo.php?fbid=948796163923855&set=pb.100063804390264.-2207520000&type=3
https://www.facebook.com/photo.php?fbid=941523607984444&set=pb.100063804390264.-2207520000&type=3

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 109-113
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-13

GAME, SET, STYLE: UNVEILING THE FASHION SECRETS OF TENNIS DRESS CODE

George Dan MOISE[1*], Anamaria POPA[2]
[1] *University of Bucharest, Department of Physical Education and Sport, 36-46 Bvd. Kogălniceanu, Bucharest, Romania*
[2] *History University, University of Bucharest, Bucharest, Romania*
* Corresponding author: moisegeorgedan1971@yahoo.com

Abstract. Clothing in the game of tennis is one of the most important elements in the sport, both in terms of the role it plays, and the impact of the historical tradition it holds. Over centuries, both clothing and tennis shoes have undergone massive evolution, transitioning from traditional attire to more practical and technologically advanced designs. This evolution has not only enhanced the players' performance but has also contributed to the financial development of tennis through effective marketing strategies.
Clothing in the game of tennis has always had a set of specific characteristics, often passed down from one generation to another as an unwritten rule. Although it does not have a major role in how a tennis match is influenced, it has a significant financial impact, through the important role of marketing reflected by associating the apparel with important figures in tennis. Throughout history, tennis clothing has evolved, abandoning many of its traditional aspects, opting for a much more practical version of the way they are made in the context of innovation, technology and design (durability, style and sustainability). Despite embracing innovation and modern design principles, certain traditional elements persist, notably exemplified by the strict dress code of prestigious events like Wimbledon.
Similarly, tennis footwear has experienced significant transformations, largely driven by changes in playing surfaces. These advancements aim to optimize players' performance at the professional level and, like clothing, contribute to the financial dynamics of the sport.
Therefore, the present paper aims to illustrate how the evolution of these essential elements of tennis equipment have led to the improvement of the game of tennis, and how the preservation of traditions over time has helped in the rise of the marketing element in tennis.

Key words: tennis clothing, tennis shoes, tradition, marketing, evolution.

Introduction

The evolution of men's and women's tennis apparel has gone through many changes throughout its history, from its inception to its impact on the fashion world. This is evident both in marketing and in the way major sports brands make huge profits from the impact male and female tennis players have on the court when they wear their logos.

Women's Tennis Fashion

In the early days of tennis, women's tennis clothes had to take into account not only the fashion of the time, but also its mentality, depending a lot on the image of the woman in the era. Starting from the 19th century, women were restricted from wearing loose clothing that could help them move around on the tennis court. Initially, the clothes worn by women were very uncomfortable, often accompanied by accessories uncomfortable for a sportswoman, such as corsets or floor-length dresses.

Sources: allure.com

Source: sport.ro

The situation changed once with the famous French player, Suzanne Lenglen, whose name today names one of the most important courts at Roland Garros, the grand slam tournament that is hosted by the French capital. In 1919, Suzanne Lenglen made her Wimbledon debut wearing an extremely revealing outfit: a short-sleeved V-neck dress and a calf-length pleated skirt. A floppy hat covered her short hair. She rolled up her white stockings to her knees because the suspenders would restrict her legs. She was not wearing a corset. She wasn't even wearing a petticoat. This was labelled as indecent by the media, but it was a turning point for women's tennis fashion.

From then until now fashion has changed and turned its attention more towards the comfort and durability side, with an emphasis on the aesthetic side as well. Today's female players are much more interested in the comfort and qualities that a piece of equipment provides, how the ideal piece of equipment can improve their performance on the court. In this era, brand endorsements became a significant influence on the fashion and flair of modern tennis apparel for top players.

Venus and Serena Williams were ones of the key players in changing the fashion landscape by introducing lightweight and durable polyester and nylon materials that remove moisture away from the body. As fabric technology advanced, tennis clothing also began to incorporate sun protection features. The fabrics were made with a combination of weave, colour, high-quality sunscreen ingredients, and sun-bouncing minerals like titanium oxide and zinc oxide infused into the fibres. Sharapova's dress at Roland Garros in 2015 was a popular choice, featuring Dri-FIT technology to keep moisture at bay. The design included a thin T-back, showcasing her nearly bare back and ensuring freedom of movement.

Naturally, these changes had a significant impact on the marketing strategies of equipment manufacturing brands. High-profile athletes endorsing their clothing resulted in major profits for big sports brands, particularly from female players. At the 2017 U.S. Open, Sharapova impressed spectators with a sophisticated black lace Nike dress created by Riccardo Tisci, which featured numerous glittering Swarovski crystals.

However, with these changes came clothing controversies reminiscent of the early days of tennis. An example of this is the incident involving Serena Williams at Roland Garros in 2018, where she wore a black catsuit inspired by Wakanda. Williams claimed that the outfit was designed to help prevent blood clots, a recurring issue for her. Despite her justification, the French tennis federation later banned this type of equipment.

Men's Tennis Fashion

Men's fashion has not always stayed the same over time. From the starting point, men's clothing was as uncomfortable as it was for women, and often included unnecessary design elements. Men often

wore shirts, pants and even ties during tennis matches. Men's fashion didn't make significant advancements until the 1920s when Rene Lacoste introduced his innovative designs.

Source: Wikipedia.org

Source: townandcountrymag.com

Tennis player Rene Lacoste, known as the Alligator, revolutionized men's clothing by inventing a short-sleeved cotton shirt that was far more comfortable than traditional styles. In the early 1930s, short-sleeved shirts were becoming more common and around the same time, a bold new trend emerged. In 1933, Bunny Austin made history as the first male tennis player to compete in a major public event wearing shorts instead of trousers.

In the 1970s, colour was incorporated into men's tennis clothing for the first time in the history of the sport. This change was made in response to complaints from spectators who found it hard to differentiate between players due to the plain colouring. Additionally, headbands gained popularity around this time, with both John McEnroe and Bjorn Borg wearing them during their iconic rivalry. In the 1990s, athletes transitioned from wearing short-shorts to baggier Bermuda style shorts. Some players, including Agassi, began sporting lycra cycling shorts underneath this new trend, which has persisted over the years.

Nowadays, men's tennis attire prioritizes comfort, ease of movement, and freedom of the body. Sponsorship has also become crucial, with brands often outshining the clothing itself or its symbolic value. Although materials have changed, to ensure better evaporation of sweat, but also much greater flexibility, important players such as Novak Djokovic or Roger Federer still opted for the traditional polo style of the shirts. As in the case of women's tennis, men's tennis clothing has also made important advances in marketing, thanks to the association of brands with important names in world of tennis. A notable example is the successful partnership between Rafael Nadal and Nike, which over the years has developed countless clothing designs including the use of Nadal-specific tops.

Men's tennis has not been immune to controversy either, and a notable example was the break between Nike and Roger Federer, respectively the latter's move to the Uniqlo camp. The Swiss player motivated the break between him and the big American brand as a difference of vision on how clothing should look and what it should convey.

Preserving traditions

Perhaps the most notable example of the preservation of the tradition of tennis clothing is in the dress code of the prestigious Wimbledon tournament. With a remarkable history behind it, dating

back to the 19th century, Wimbledon has kept its stamp on how tennis players should dress during the tournament as much as possible. In the beginning, both women and men used to wear white during tennis matches because white easily hid sweat stains and did not attract strong heat like other colors.

Even today, the Wimbledon tournament has in its dress code the tradition of wearing the mandatory white to be able to participate in the event. But this code has also brought dissatisfaction from players such as the American player Andre Agassi. Andre Agassi became well-known for refusing to participate in Wimbledon from 1988 to 1990 due to the tournament's strict all-white dress code, as he preferred colorful attire. However, he changed his mind and competed in 1991, ultimately winning the Grand Slam title the next year while wearing all-white clothing.

Tennis Shoes

Whether they are women's or men's footwear, tennis shoes have had a noticeable evolution over time, designed to help players adapt to both surfaces and playing conditions. Since the late 1800s, tennis shoes have evolved significantly from the early days of the sport. Initially, women were seen playing in heeled boots that went above the ankle, while men wore loafers with spiked soles for better traction. The Open Era that began in 1968 allowed top tennis players to participate in major tournaments and also allowed them to receive sponsorships from sportswear brands, transforming footwear from mere equipment to a form of personal expression and opening up new endorsement possibilities.

Sources: weare1959.com

Source: runrepeat.com

In modern times, tennis players are concerned with the aesthetics and materials of their shoes to ensure optimal comfort for their feet. Additionally, advancements in technology have resulted in a variety of innovative techniques to enhance footwear, such as materials that prioritize abrasion resistance and comfort, along with shoes that feature memory foam heel lining to conform to the shape of the wearer's foot, among other advancements.

Conclusion

Clothing has seen major innovations in design, material selection, breathability, durability, and overall function. Similarly, tennis shoes have also undergone advancements to meet the requirements of different court surfaces and provide maximum comfort to players. Over time, there has been significant evolution in both tennis clothing and tennis shoes, leading to new horizons in technology and advancements, and with these developments, there have also been noticeable changes in the marketing strategies of brands investing in tennis equipment.

References

10 Major Fashion Milestones in Tennis History.
Retrieved from: https://hypebeast.com/2019/9/tennis-fashion-history-us-open-nike-uniqlo
A History of Women's Fashion in Tennis, 2022.
Retrieved from:https://alalastyle.com/blogs/spotlight/a-history-of-tennis
A History: Women's Tennis Fashion.
Retrieved from: https://www.merchantoftnnis.com/blogs/tennis-interest/a-history-womens-tennis-fashion
Anna Purna Kambhampaty, The Surprising–and Sometimes Troubling–History of Tennis Clothes, 2019.
Retrieved from:https://time.com/5667447/tennis-clothes-history/
ASICS Tennis Shoe Technologies. Retrieved from: https://www.tennisexpress.com/info/asics-tennis-shoe-technologies
Gerald Flores, How Tennis Shoes Impacted Pop Culture. Retrieved from: https://www.tennisfame.com/sneakers
History of Men's Tennis Fashions, 2015. Retrieved from: https://www.bethq.com/blog/history-of-mens-tennis-fashions/
Kimberly Chrisman-Campbell, Hemlines and Court Lines: On the Evolution of Women's Tennis Clothes, 2022. Retrieved from: https://lithub.com/hemlines-and-court-lines-on-the-evolution-of-womens-tennis-clothes/
The evolution of fashion in tennis, 2021.
Retrieved from: https://www.slazengerheritage.com/the-evolution-of-fashion-in-tennis/

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 114-119
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-14

TENNIS GEAR

George Dan MOISE[1*], Anamaria POPA[2]
[1]*University of Bucharest, Department of Physical Education and Sport, 36-46 Bvd. Kogălniceanu, Bucharest,Romania*
[2] *History University, University of Bucharest, Bucharest, Romania*
* Corresponding author: moisegeorgedan1971@yahoo.com

Abstract. Tennis equipment is one of the most important aspects of the game of tennis. Often, tennis equipment has a massive impact on how a tennis match plays out, or how the style of play evolves, even if it's less visible. Among the essential components of tennis equipment are the tennis balls and rackets. Complementing these elements is the playing surface, a critical determinant in the game of tennis.
This paper aims to demonstrate the evolution of tennis equipment in the importance of quality tennis history over time and how advanced technology has or has not influenced the style of play and its speed. The discernible evolution of tennis balls, encompassing variations in size and materials, has significantly shaped the sport. Similarly, the modernization of racket design and strings, incorporating diverse materials–synthetic or natural–has ushered in a new era of heightened intensity in tennis, characterized by increased speed and power.
In the same context, another key element is the playing surface, more precisely the four main surfaces, hard (or cement), clay, grass and carpet, which contributed to changing the game of tennis and its speed, stimulated by the importance of the materials used to create, or the way of maintenance of these surfaces.
Finally, in this paper, we will see how tennis modernization had a great impact on the production of tennis balls and the evolution of the way rackets are made, to which is added the composition of materials used in the creation or maintenance of playing surfaces, have led to a marked transformation of the tennis game. It will also elucidate how these changes have often elicited both acclaim and discontent among professional tennis players and, in certain instances, contributed to injuries.

Key words: tennis, tennis balls, rackets, tennis surfaces, evolution.

Introduction

One of the most crucial components of the game of tennis is the equipment. Even though it's less obvious, tennis equipment has a significant influence on how a match unfolds or how the style of play changes. Tennis balls and rackets are two of the most important parts of a tennis set. The playing surface, which is an important factor in tennis, complements these components.

Tennis Balls

Tennis balls are indeed a crucial component of the game. They are small, yellow, and typically covered in a fuzzy felt material with a white, curvilinear shape on the surface. Due to the change in the materials they are made of, balls have had a major impact on the game and its speed. Although tennis balls are very popular, their production process is less well known. The production of tennis balls follows six steps, namely:

1. **Choosing the Rubber:** Firstly, the process of creating tennis balls begins with the mixing of rubber with up to 10 additional substances until the blend is perfect.
2. **The Forming of the Half-Shells:** In the second step, the rubber pellets that cover the rubber are moulded at 155°C and machine-pressed at 160kg/cm^2 into half-spheres with adhesive added to the edges.
3. **The Connection of the Half-Shells:** Thirdly, in the process of manufacturing tennis balls, there is a crucial step known as vulcanisation. Before joining the components, pressurized air is added to form the core. This helps the core to conform to the correct pressure as determined by the ITF(International Tennis Federation).
4. **The Sanding of the Ball:** The next process involves placing the cores in a massive rotating drum that's been lined with sandpaper. This action is taken to rough up the surfaces of the cores. Afterward, the balls are coated with glue, making them ready for the furry covering.
5. **The Covering of the Ball:** Manufacturers use different blends of materials to create individual felt, but it is common for it to be made up of approximately one-third nylon and two-thirds wool. The reason for this is that wool has superior shape retention properties compared to nylon. To create the felt, it is first cut into specific shapes, such as 'dog bones', and then coated with adhesive.
6. **The Final Touches:** In the last step, the balls are passed through a machine to eliminate any air bubbles between the core and the material. They are then quality-controlled for factors such as size, weight, bounce height, and pressure. Finally, they are printed with the manufacturer's logo and packed into pressurized cans for use.

History of Tennis Balls

The tennis ball has undergone several transformations over the years. Initially, it was made of wood, but later on, leather with sawdust became the preferred material. As time went by, wool replaced sawdust as the primary stuffing material, and twine was used to wrap the core. Today, the modern tennis ball that we know is a result of these evolutionary changes.

The production of tennis balls came to a halt in 1941 due to the rubber priorities of World War II. Manufacturers had to find alternative materials to crude rubber to keep the game going. It was then that Wilson came up with "Victory" ball, a synthetic rubber-based ball that was a perfect replacement for traditional tennis balls.

Source: reddit.com

Source:coachweb.com

Tennis Rackets

Tennis rackets are one of the most essential parts of the game. Tennis rackets have seen a vast evolution in both size and shape throughout history. Tennis rackets have also had a notable impact

on the game due to the material change they are made of. The tennis racket is composed of several elements, which have an essential impact on the game, but also on the playing style of each player.

The other elements of the racket largely depend on the preferences of each player, and are related to the size of the racket, its weight, but also its length. The ITF has a number of rules and restrictions regarding the dimensions of tennis rackets that are allowed to be used in regulated matches such as: *to have a total length no greater than 29 inches (73.66cm), to be no wider than 12.5 inches (31.75cm), to have a "hitting surface" (strings) that is no more than 15.5 inches long (39.37c) & 11.5 inches wide (29.21cm)*, (ITF, 2024).

One of the key elements of the racket is its strings. There are several types of strings that have different qualities, mainly due to the materials from which they are produced. One of the most popular types of strings is synthetic gut, which is made of nylon and is ideal for beginners. Another is the multi-filament one, created from hundreds of small fibres joined together, this type of string having an ideal tension during hitting. Other type of string is the natural gut, produced from cow intestines, being used by most of the professional players because of the comfort it offers. Another common type of string is the polyester one. This type of string is much more durable and offers the possibility of shots with a lot of spin and control.

The Evolution of the Racket

The origins of lawn tennis can be traced back to London in 1874 when Major Walter Clopton Wingfield created the first-ever tennis racket. This racket was made of solid wood with a leather grip.

In 1947, tennis rackets took a new turn with the use of laminated wood, a material that made the rackets more flexible. Brands like Slazenger, Dunlop, and Wilson capitalized on this advancement by adding paint and decals to their products, making them more unique and recognizable.

As time passed, tennis brands started incorporating graphite into the manufacturing process of their rackets in the late 1970s and early 1980s. This development led to the creation of more stable and responsive rackets, a significant improvement over the previous metal rackets.

Source: sportstechbiz.com

Currently, most tennis rackets are made of a combination of materials such as carbon fibre or fiberglass, metals like titanium alloys, or ceramics.

Surfaces in Tennis

Tennis surfaces are one of the most essential aspects of the game because of how they influence a match. There are many types of tennis surfaces, but the three important ones used at the professional level are hard (cement), clay and grass. In addition to those already mentioned, there are other types such as acrylic, asphalt, carpet, concrete, artificial clay, hybrid clay, artificial grass, wood, or tiles, etc.

Hard courts consist of various mixtures of concrete and asphalt materials, which are then coated with an acrylic surface layer to provide surface sealing and cushioning. Compared to clay courts, hard courts have less energy absorption, which leads to a higher bounce and faster ball speed. There are different types of hard courts available such as DecoTurf, GreenSet, Laykold, Plexicushion, Rebound Ace, and many more.

Clay tennis courts consist of a top layer of finely crushed aggregate and can be made from materials such as stone, brick, slate or other unbonded materials. Underneath the top layer is usually a thicker layer of the same material, but compacted. Clay courts are considered "slow" due to the ball's lower bounce and speed when it makes contact with the ground, making it more difficult for players to hit shots that cannot be returned.

Grass tennis courts consist of a layer of clay, silt, and sand with a natural lawn on top. You will need a drain pipe to prevent standing water. The ball slides across the grass, making the game faster and chipping more efficient. Flat hitters, tall servers and elite volley players excel on grass.

Source: reddit.com

Impact over tennis players

Ball problems

Due to the constant changes in ball sizes, but also the development of technology has led to the appearance of dissatisfaction on the part of many tennis players. The periodic change of balls led to a lack of consistency and therefore to the increasingly frequent occurrence of injuries. Many professional players have accused major problems due to the constant changes made to the balls, including Daniil Medvedev or Vasek Pospisil.

Racket problems

The most common racket-related injury is a condition called tennis elbow. To minimize the amount of shock and vibration that the arm experiences while playing tennis, it is important to consider the location of ball impacts on the racket head, the stiffness of the racket, and the force applied by the grip.

Surface problems

Playing surfaces can often cause problems for players. Whether it's dirt or grass, these two surfaces are prone to frequent slips that can end in serious injuries. In the case of hardcourts, it has a different impact, but is equally dangerous due to the need for more force when braking on cement, which can lead to knee sprains or tears, ankle sprains, lower back, etc.

Conclusion

Tennis equipment is one of the most essential parts of this sport. Over time it has had a noticeable evolution, both in the case of tennis balls, rackets and playing surfaces. Thanks to advanced technology, these elements have been constructed differently and from new and improved materials that have changed the game of tennis today from the beginning.

However, these improvements also came at the cost of more and more injuries and complaints from professional players. Due to the constant changes in playing equipment, players were equally forced to make changes that often resulted in serious and often career-defining injuries.

References

Alex Mann, The History of Tennis Racquets, 2023. Retrieved from: https://tennisnerd.net/gear/racquets/the-history-of-tennis-racquets/28502

Amanda Mustard, New Balls, Please, 2016. Retrieved from: https://www.nytimes.com/2016/09/04/sports/tennis/wilson-tennis-balls-made.html

Brad McCall, A Brief History of Tennis Balls & Containers, 2016. Retrieved from: https://tenniscollectors.org/a-brief-history-of-tennis-balls-containers/

Ewald M. Hennig, Influence of racket properties on injuries and performance in tennis, 2007. Retrieved from: https://pubmed.ncbi.nlm.nih.gov/17417052/

Grass Court. Retrieved from: https://en.wikipedia.org/wiki/Grass_court

Hardcourt. Retrieved from: https://en.wikipedia.org/wiki/Hardcourt

How are Tennis Balls Made?, 2022. Retrieved from: https://www.discoveryuk.com/how-its-made/how-are-tennis-balls-made/

International Tennis Federation, Ball Manufacture, 2024. Retrieved from: https://www.itftennis.com/media/2167/balls-ball-manufacture.pdf

International Tennis Federation, Balls, 2024. Retrieved from: https://www.itftennis.com/media/2152/equipment-balls.pdf

MasterClass, Explore the 4 Types of Tennis Courts, From Clay to Synthetic, 2021. Retrieved from: https://www.masterclass.com/articles/types-of-tennis-courts

Rocky Lang, The History of Tennis Balls. Retrieved from: https://www.tennisplayer.net/public/notes_on_tour/rocky_lang/the_history_of_tennis_balls/?public=true

Sydney Pitter, Tennis Surfaces Affect Injuries, 2019. Retrieved from: https://c-hit.org/2019/08/12/tennis-surfaces-affect-injuries/

Tennis Court Surfacing: The 11 Tennis Court Surfaces Explained, 2022. Retrieved from: https://www.tenniscourtsupply.com/Tennis-Court-Surfacing-The-11-Tennis-Court-Surfaces-Explained_b_1105.html

Tennis Racket Size Guide. Retrieved from: https://www.networldsports.co.uk/buyers-guides/tennis-racket-size-guide

The Evolution of the Tennis Ball. Retrieved from: https://www.merchantoftennis.com/blogs/tennis-balls/the-evolution-of-the-tennis-ball

Uri Berliner, Tennis balls are causing arm injuries, top players say. Now, a review is underway, 2024. Retrieved from: https://www.npr.org/2024/01/14/1224181737/tennis-balls-arm-injury-players-pro-tennis

What Are Tennis Courts Made Of? (The 11 Surfaces*). Retrieved from: https://mytennishq.com/the-different-types-of-tennis-court-surfaces-explained/*

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 120-127
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-16

EVOLUTION OF THE GAME OF FOOTBALL IN TERMS OF RULES AND FORMATIONS OF PLAY

Sebastian-Iulian VICOL[1*], Silvia TEODORESCU[2], Nicoleta DUMITRU[3]
[1,2] Universitatea Națională de Educație Fizică și Sport, Str. Constantin Noica, Nr. 140, Sector 6, C.P. 060057, București, România
[3] Universitatea din București, Șir. Edgar Quinet, Nr. 5-7, Sector 1, C.P. 010017, București, România
* Corresponding author: tel.: +4054792318
E-mail address: vicolsebastian07@gmail.com

Abstract. The game of football has, throughout its history, provided moments of unparalleled spectacle and popularity, with a global following. From the earliest documented instances of ball games played with the feet, without clearly defined rules, to the most sophisticated styles of play observed in modern times, the evolution of football has been a continuous process. The development of football has been influenced by the contributions of renowned coaches and players who have introduced innovative techniques, such as "tiki-taka" and the "Galacticos." These innovations have shaped the evolution of the sport in response to the demands of the modern era. A number of renowned coaches, including Helenio Herrera, Sir Alex Ferguson, Rinus Michels, Enzo Bearzot, Johan Cruyff, Pep Guardiola and others, have employed creativity to devise innovative systems of play and principles to enhance the abilities of their players, with the objective of achieving victories. The objective of this study was to analyse the literature on the subject and illustrate the game systems that were employed in the earliest official matches and how they evolved in response to changes in the regulations. Over time, international governing bodies have issued regulations that have compelled coaches to be creative and identify optimal strategies for their teams to achieve victory and perform at their best. Each system of play has been described in chronological order, with the aim of establishing a correlation between the rules of play and the systems employed at the time. The field of football is undergoing continuous development, with technology playing an increasingly significant role in the conduct of matches. Software and statistical data are being used by referees and coaches to inform decision-making, thereby reducing the time required for decision-making.

Keywords: history of football, formations of play, rules.

Introduction

Football, or "the king sport," as it is known, is the spectacle that brings millions of people to the stadiums and screens. Every technical execution, every goal scored, and the whole atmosphere that characterizes a football match arouses the spectator's curiosity, pleasure, and adrenaline, bringing him to the most beautiful feelings and emotions. The game of football has developed with society and has deep roots in the culture of historical peoples. The sport has become renowned for its numerous dynamic actions, which facilitate rapid ball turnover. (Dolci, 2018) The game has evolved with the introduction of new rules that simultaneously enhance its spectacle, while also instilling discipline, rigour and responsibility.

The tactics employed in the game are structured according to the laws of the game, as well as the specific attributes of both the home and away teams. A multitude of strategists devised diverse formations of play, integrating both their practical experience and theoretical knowledge in order to achieve success.

In order to ascertain concrete data on the evolution of playing systems and the rules of the game of football, a comprehensive literature review was conducted. In order to achieve this objective, a search was conducted on Google Scholar, SPORTDiscus and Web of Science using the keywords "history of the game of football", "systems of play used in football" and "evolution of the rules in football". The articles that provided the most conclusive information on the subject of the research were selected.

The objective of this study was to examine the evolution of game systems and determine whether they have been adapted in accordance with the regulations. In addition, the impact of the regulations that have been introduced over time on the game of football will be analysed.

Results

FOOTBALL IN MEDIEVAL TIMES

The issues presented from this period concern the country where football has its origins and where it has experienced its greatest expansion – England.

The medieval period, also known as the "*mafia football*" period (Mal, 2021), is characterised by a variety of ball games with no limit on the number of players and almost no rules.

During this period, the sole unambiguous rule governing ball sports was that opponents were not to be killed. (Broeke, 2014). Given the considerable disorder that had ensued, as early as 1314, the Mayor of London was compelled to issue a proclamation banning football in the city. (Klotz, 2016)

The King, Edward IV, continued to oppose the ever-expanding game. In 1477, he enacted legislation that prohibited the playing of illicit games, including dice, knife, football, and other games. (Vasilev, 2009) Additionally, in Manchester, football was prohibited in 1608.

In the Middle Ages, football was perceived as a brutal sport, a perception that does not align with the modern game. In the present era, the concept of fair play and equal opportunities is actively promoted, and any act of violence, whether physical or verbal, is met with appropriate disciplinary action.

ENGLAND, THE BIRTHPLACE OF MODERN FOOTBALL

The game of football, which was played in the British Isles from the 8th to the 19th century, had a wide range of local and regional variations. These eventually led to the creation of modern games such as rugby. (FIFA, 2020)

From the 1850s onwards, factory workers utilised their leisure time after work and at weekends to engage in football-related activities. These teams were organised by various institutions, including trade unions, educational establishments and religious organisations. The dimensions and weight of the football were first standardised in 1863. (Gerhardt, 2019)

In 1863, the development of football reached a pinnacle. Affiliated members of eleven London clubs and colleges visited the Freemason Tavern. This event is regarded as the genesis of association football. A number of factors were taken into account, including the manner in which the ball was propelled, the actions of opponents who kicked the shin or tripped the player. (Witzig, 2006)

On 8 December 1863, football was distinguished from rugby, and over the following eight years, 50 clubs affiliated with the Football Association (FA).

In 1866, the initial 90 minutes of the match between London and Sheffield were played. The popularity of school football increased significantly during the 19th century, particularly at renowned public schools. The game lacked a standardised format, resulting in relatively straightforward rules. In the nineteenth century, football became an integral component of the school curriculum.

The influence of Britain and the subsequent global dissemination of football were rapid and extensive. Subsequently, in the period following 1880, a number of countries established football associations. Consequently, the International Federation of Football Associations (FIFA) was established in Paris in May 1904. At that time, the total number of FIFA members (countries) was seven, but by 1930 this had increased to 41. Between 1937 and 1938, FIFA President Stanley Rous established the modern laws of the game. Over the subsequent two decades, football's continued success attracted new followers from across the globe, with the Association of Men's National

Football Teams reporting that there are now 211 members from every corner of the world. (FIFA, 2020).

This paper presents a historical overview of the game systems (created with SoccerTutor.com Tactics Manager) that have been used for the past 200 years.

1. System of play with 10 attacking players and one goalkeeper (Fig. 1.) - the first system of play used between 1810-1860.
2. Eight-player forward system (1-1-1-8) or T-system (Fig. 2.) - this system of play was first played by the England team in the 1870-1871 England-Scotland meetings. For the first time in history players were allocated to positions (one defender, one midfielder and eight forwards).
3. The 1-1-2-7 system (Fig. 3.) – this system of play was also used by the England and Scotland teams between 1870-1871, involving one defensive player, two midfielders and seven forwards.
4. The 6-forward system or Scottish formula - 1-2-2-6 (Fig. 4.). This system was used for the first time by the Scottish team in 1872 in the England-Scotland match, as the systems used until then had not brought the desired results.
5. The pyramid game system or the 1-2-3-5 triangle (Fig. 5.). It is in fact the tactical system of play: the WM-orthodox, which the English team Nottingham Forest first used in 1883. The main tactical feature of this system is that the tactical positioning of the players equates to 5 players in defence and 5 players in attack, a similar positioning in the tactical development of contemporary football.
6. The M 1-2-3-2-3 double game system (Fig. 6.). It is the predecessor of the famous tactical system of play - WM and was first used in 1925. The main tactical feature of this system is that the positioning of the players on the pitch allows for a much more optimal coverage of the playing space, which contributes to the optimisation of playing relationships in the form of triads.
7. Game system WM 1-3-2-5 (Fig. 7.). This is the tactical system of play that has revolutionised performance football from a tactical point of view. It was created by Herbert Chapman and the team that first used it was Arsenal London – England (1930).

In the microhistory of game systems by Allen Wade, the following requirements for the WM system are mentioned:

- *creating a diagonal defence, whose strong point is the central midfielder (the stopper);*
- *organise a strong defence, capable of initiating rapid offensive action;*
- *the use of a dispatcher to control the construction of offensive actions;*
- *the presence of fast, strong and incisive forwards in the team: the wingers and the centre forward*. (Wade, 2013)

In view of the above, we can say that in the WM system improvement action, the focus was not on improving the players' technical-tactical actions, but on developing their physical qualities.

8. WM system of play – the 1-3-2-2-3 magic box (Fig. 8.). First introduced in the 1930s, this system of play is actually a variant of the classic WM system, which has undergone some modifications due to the refinement of the tactical positioning of the players. Specifically, the midfielders are positioned in such a way that they form a penalty box, which is how this tactical system got its name. The main tactical feature of this system is that the formation of these squares strengthens the midfield area - the area where the game is built.
9. System of play – wall, wall or concrete 1-1-3-2-2-2 (Fig. 9). This tactical system of play (1942) is the creation of the great coach Helenio Herrera. It was first used by the French team Stade Francaise and represents the beginning of defensive tactics in football.
10. Italian Catenaccio 1-1-4-2-3 system of play (Fig. 10.). In 1960, Internationale Milano coach Helenio Herrera came up with an important change at World level, asking one of the

midfielders to position himself behind the fullback line, playing as a libero (to double the fullbacks and play anticipation).

11. The 1-4-4-2 system of play (Fig. 11.). It is a system that originated in 1960 and was used by the England coach Sir Ramsey. In this system, players could execute pressing more effectively to make it difficult for opponents. It was a system that excelled at 'catching the opponent offside'.
12. 1-4-3-3 system (Fig. 12.). It is an attacking system that is still practised and has been applied by coach Rinus Michels since 1965 at Ajax Amsterdam.
13. The 1-1-3-4-2 system (Fig. 13.) is a system first used in 1977 by Italy's coach *Enzo Berzot.* Italy participated successfully in the 1978 and 1982 World Championsships, playing an open and spectacular game.
14. The 1-4-2-3-1 system (Fig. 14.) is a system used a lot in football today. The system involves two defensive midfielders with the role of closing down the space in the center very tightly in order to recover balls and increase the efficiency of the buid-up.
15. The 1-5-3-2 system (Fig. 15.). This system was used and promoted at the 1990 World Cup, played in Italy by West Germany. The numerical superiority in the defensive phase and the use of two central strikers are the strengths of this system.
16. 1-3-4-3 system (Fig. 16.). It is a system that was also widely used in Romania in the 2000s and is one of the mos spectacular and offensive systems of play.

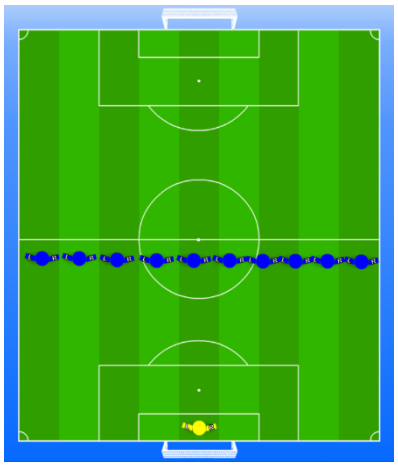


Figure 1. System 1-10

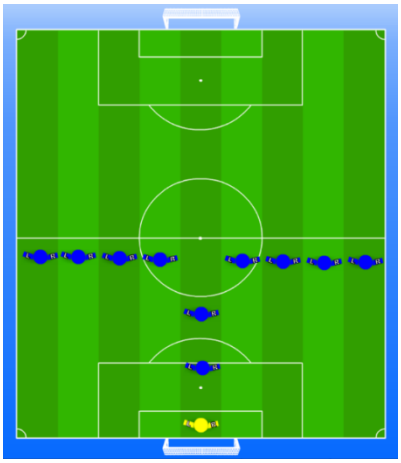


Figure 2. T System

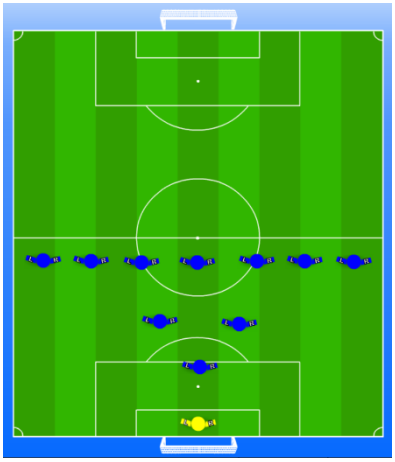


Figure 3. 1-1-2-7 System

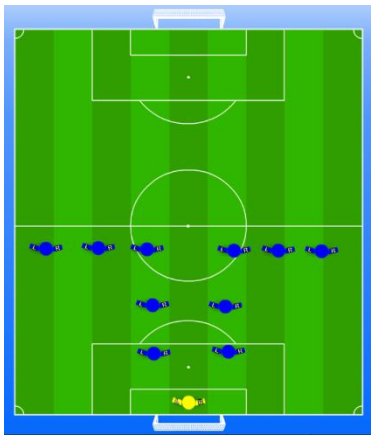


Figure 4. Scottish Formula

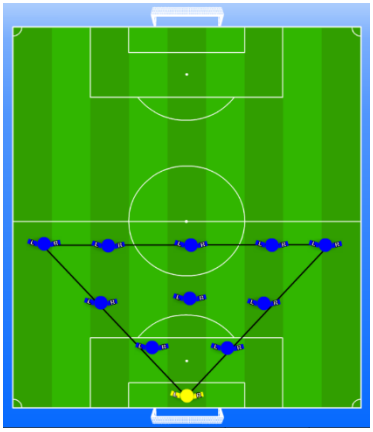


Figure 5. Pyramid

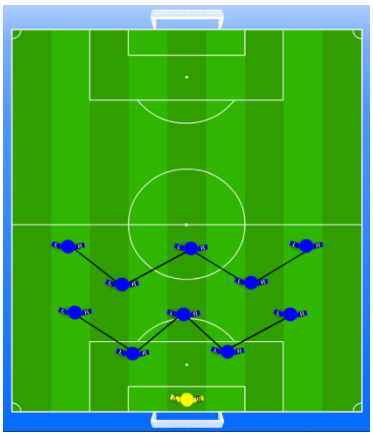


Figure 6. Double M system

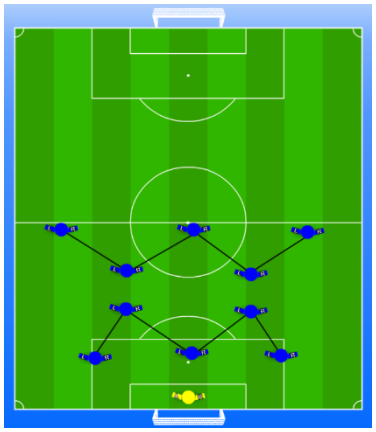


Figure 7. WM System

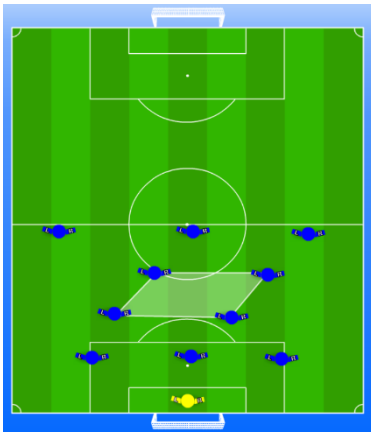


Figure 8. The Magic box

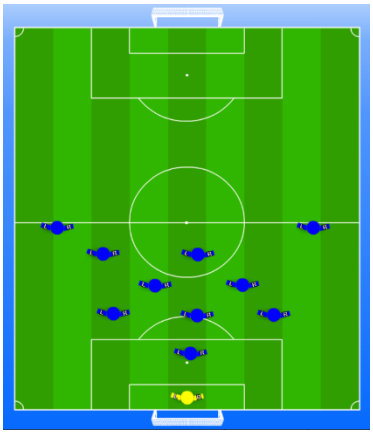


Figure 9. The 1-3-2-2-2 System

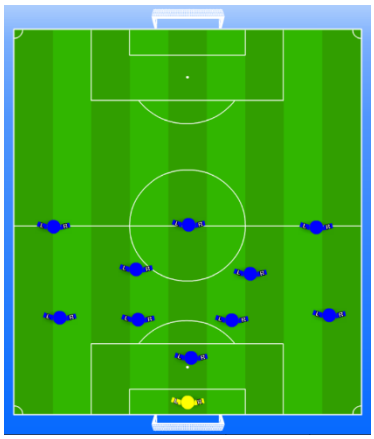


Figure 10. Italian Catenaccio

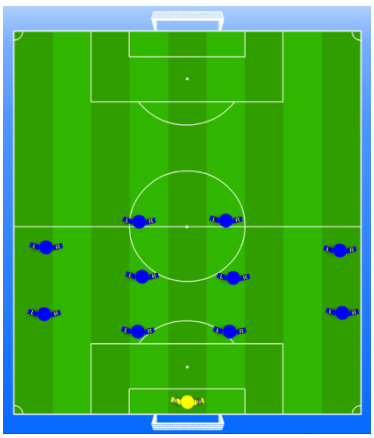


Figure 11. 1-4-4-2 System

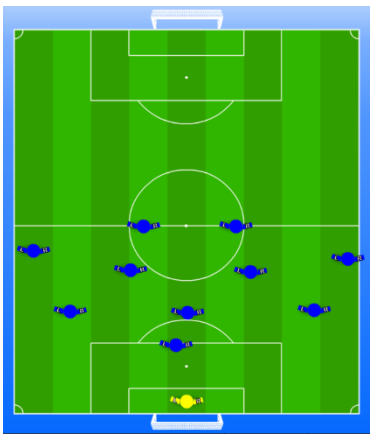


Figure 12. 1-4-3-3 System

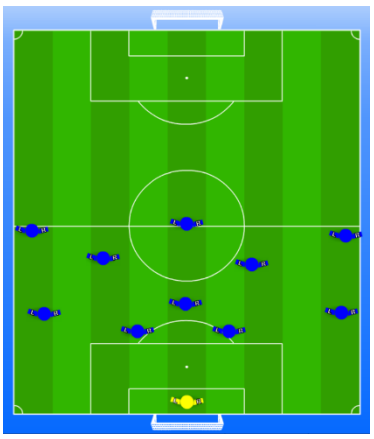


Figure 13. 1-1-3-4-2 System

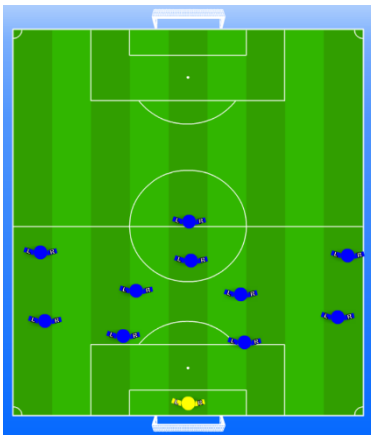


Figure 14. 1-4-2-3-1 System

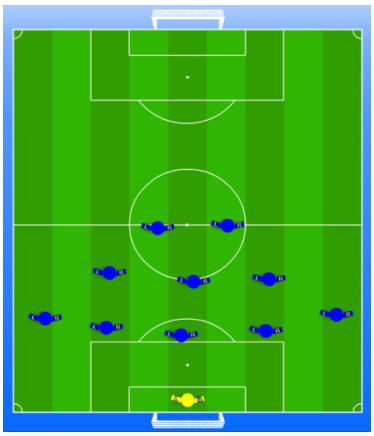


Figure 15. 1-5-3-2 System

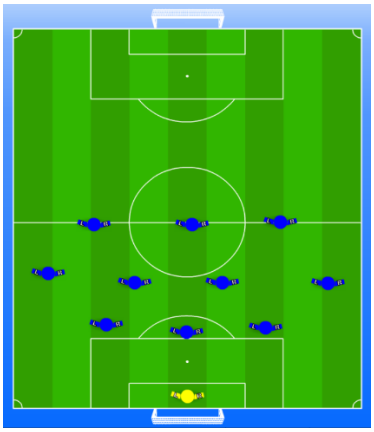


Figure 16. 1-3-4-3 Sys

Table 1. Evolution of rules and systems of play in football

Relationship between the rules and the game system			
Year	Regulation	Year/Years	Game system
1300	A variety of ball games with no limit on the number of players and almost no rules.		
1314	The Mayor of London has seen fit to issue a proclamation banning football in the city		
1608	Football has been banned in Manchester		
1810	Teams of workers are formed	**1810–1860**	1-10
1856	Offside rule – 3 defenders in front of the attacker		
1863	The length (137.16 m) and width of the land (91.44 m) have been determined. (Jia, 2017)	**1860–1872**	1-1-1-8 1-3-7 1-2-2-6 1-1-2-7
1866	There was no standard form of the game, the rules were very simple		
1869	The goal kick (goal out) has been introduced.		
1870	First international game England - Scotland (1-1)		
1872	The corner kick has been introduced.		
1875	The crossbar has been introduced.	**1872–1883**	1-2-2-6
1878	The referee blew the whistle for the first time for a foul. Since then, the whistle has become the referee's "main tool".		
1891	The penalty kick has been introduced. At the same time, nets were installed at the football gates.	**1883–1925**	1-2-3-5
1925	Offside rule – 2 defenders in front of the attacker	**1925–1942**	1-2-3-2-3 1-3-2-5 1-3-2-2-3 1-1-3-2-2
1958	The rule that players can be replaced has been introduced	**1942–1960**	1-3-2-3-2
1970	The first cards (yellow and red) were awarded at the World Cup in Mexico.	**1960–1990**	1-4-2-4 1-4-2-3 1-4-4-2 1-4-3-3 1-1-3-4-2
1990	Offside rule – the attacker is not offside if he is in line with the penultimate opponent		

1992	The rule has been introduced that the goalkeeper cannot catch the ball passed by a teammate.	**1990–1998**	1-1-4-3-2 1-4-4-2 1-3-5-2
1993	The rule has been introduced that a player may be given a yellow card if he 'stalls'.		
1998	The referee may award a red card to penalise gross fouls (intended to endanger the bodily integrity of the contestants).		
2003	FIFA is issuing strict rules on offside to encourage offensive play.	**2003 to present**	1-4-3-3 1-4-2-3-1 1-4-1-4-1 1-3-4-3 1-5-3-2 1-4-3-2-1 1-4-1-4-1
2006	The referee may give a red card to a player for simulation of a foul.		
2014	Goal-line technology has been introduced to help referees determine whether the ball has crossed the goal line.		
2016	Video Assistant Refree (VAR) technology has been introduced.		

While in the early years (1810–1860) the game was chaotic, there were no clear rules on the size of the pitch, there were no referees and the game was very different from the modern game, in 1856 a first rule was introduced to regulate the position of a player in offside. For a player to be able to receive and play the ball he had to have at least 3 defenders between him and the goal. The system of play practiced at that time where we are presented with teams of 11 vs 11, presents a 1-10, especially on the offensive phase, and this rule was implemented so that teams were more carefully organized on the defensive phase.

When the dimensions of the pitch, the execution of the corner and the kick were clearly established (1860–1872) and after some years of practice, the system of play adapted slightly, positioning one player in goal, one in defence and the other 8 forward. With these rules, the coaches tried to provide a certain degree of security by always positioning a player who had purely defensive duties.

Until 1875 the gate had no crossbar, and in that year a horizontal bar was introduced at a height of 2.44. In 1878 the first referee's whistle was blown, indicating a deviation from the rules. The foul would change the system of the game, leading coaches to position 2 players in defence and midfield and only 6 in attack. This adaptation of the playing system was intended to avoid counter-attacks and also to remove the danger from the fixed phases caused by possible fouls.

The penalty kick was introduced in 1891, and coaches were determined to drop another player, using the 1-2-3-5 system to support defensive players. Players were tasked with doubling up on each other, so five players had defensive duties.

A revolutionary rule that changed the conception of the game at that time is the adaptation of offsaid to only 2 defenders who must be placed between the attacker and the ball. Immediately after the application of the last amendment, coaches were creative and from 1925 onwards three new systems of play emerged (1-2-3-2-3; 1-3-2-5; 1-3-2-23). As a consequence, the number of goals in matches doubled and the game became more organised but at the same time more spectacular.

Until the 1960s, the systems of play already listed were used, and then more and more teams were set up, which were involved in both domestic and international competitions (European Champions Cup). During these years, the rules were not significantly changed, strengthening the specific skills of the game of football, as well as a good physical training of the players, which led them to get into sporting shape and be selected for the national teams in order to participate in the European and World Championships. In 1970 the first cards (yellow and red) were awarded at the World Cup in Mexico and since then two other systems of play (1-4-2-4 and 1-4-2-3) have been used. Modern football tactics originated from these two systems, which revolutionised the game at the time by placing four players in defence, thus placing a strong emphasis on both defensive and offensive phases of play.

The offside rule was changed in 1990, and since then new systems of play (1-4-3-2; 1-4-4-2; 1-3-5-2) have been consolidated. This rule was particularly important and led coaches to change their tactical thinking because it favoured the attack more, the game no longer had so many static moments and deep passes were often used.

In 2003, FIFA issued strict rules on offside because it wanted to encourage more offense. In this sense, even if a player did not touch the ball, but blocked the field of vision of the goalkeeper or a defender, he was considered in an offside position. As the rules were refined, other systems of play were used by coaches of the time. Since then, systems such as 1-4-3-3; 4-2-3-1; 3-4-3 are still used today.

The game is increasingly dynamic, the players are able to perform remarkable actions, putting their thorough training to good use, and the game is very thoroughly tacticized. The advent of VAR makes the players more precise in their offside exits, as well as in the organisation of the defensive compartment, because every inch more or less is analysed and claimed by the team that deserves it.

Conclusions

Throughout history, football has been characterised by its positive development. It has always adapted to problematic situations and tried to come up with a better way of playing the game. The rules, training and performances of the athletes have been constantly on an upward slope, thus managing to achieve impressive Figs in the current period.

The relationship between the rules that emerged along the way and the formations used is an important one. The systems of play used by the coaches were supposed to surprise the opponent, to showcase their team's athletes, but all within the limits of the rules.

Playing systems have evolved constantly, the great coaches of the current period are still looking for the most efficient ways to play their own football philosophy. No one system is established as the most effective and it always has to be adapted to suit the specifics of one's own team and those of the opponent.

References

Apolozan, D. N. et al. (2019). *Handbook of football culture*. Muscat: Tana Publishing House

Broeke, L. (2014, 11 22) *Game of Medieval 'Mob Football' makes a comeback*. Retrieved from The Daily Telegraph: https://www.dailytelegraph.com.au/news/nsw/game-of-medieval-mob-football-makes-a-comeback/news-story/3abf9a0a41cc6173d99db25504e8c61f

David, E. (2008) *Epikoinos: The ball game Episkuros and Iliad* 12.421-23. *Classical Philology*, 103(4), 414-423.

Dolci, F. N. (2018, 10 23). *Movement. Economy in Soccer: Current data and limitations*. *SPORTS*, p. 124

Dragnea, A. (2006) *Physical education and sport - Theory and didactics.* Bucharest: FEST

History of Football-Britain, the home of Football. Retrieved from FIFA.com: https://www.fifa.com/about-fifa/who-we-are/the-game/britain-home-of-football.html

FIFA.com. (2020, 1 27) *History of Football-The Origins*. Retrieved from FIFA.Com: http://www.fifa.com/about-fifa/who-we-are/the-game/index.html

Gerhardt. (2019, 6 26). *Soccer History: More than 2000 Years of Football*. Retrieved from Soccer-Traing-Info: https://soccer-training-info.com/history_of_soccer/

Jia, Y. (2017) Influence of Rules Change on Football. *Advances in Social Science, Education and Humanities Research, Volume 159*, 30-32

Klotz, L. (2016). *Sustainability Through Soccer.* Oakland: University of California Press.

Mal, B. (2021). Comprehensive Soccer. *E-ISSN 2461-1271 Vol. 7, No.1, June 2021*, 28

Vasilev, S. (2009, 2 10). *History of medieval football – part 1*. Retrieved from Bleacherreport: https://bleacherreport.com/articles/122315-history-of-football-medieval-football-part-1

Wade, A. (2013) *Systems of Play.* USA: Reedswain

Witzig, R. (2006). *The Global Art of Soccer.* London: CusiBoy Publishin.

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 128-131
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-17

FROM COLOSSEUM TO WEMBLEY: ECHOES OF ANCIENT THOUGHTS ON THE IMPORTANCE OF SPORTS IN MODERN FOOTBALL

Atanasie-Teofil DUMITRACHE[1*], Bogdan GOZU[2]
[1]*University of Bucharest, Faculty of History, Bvd. Elisabeta, 4, Bucharest, Romania*
[2]*University of Bucharest, Department of Physical Education and Sport, 36-46 Bvd. Kogălniceanu, Bucharest, Romania*
*Corresponding author: dumitracheatanasieteofil@gmail.com

Abstract. *Background*. The remarkable popularity of sports competitions is not just a feature of the contemporary times. By studying the past, no matter how distant, it can be observed that sport has always been an integral part of human life, and played an essential role in shaping social, cultural and political landscapes. Today, football has emerged as one of the most popular sport, being played, watched and analyzed every single day worldwide, and has a similar impact on society as the gladiatorial combats had in Antiquity.
Objectives. The main goals of this essay are to explore the connections between ancient writings about sports competitions and the implications that football has on contemporary life, and to highlight the similarities between the both cases.
Method. Regarding the method, there were selected three ancient authors, Aristotle, Juvenal and Suetonius and then there were analyzed some of their writings and beliefs about sports and physical activity that can be linked with football. These authors have been chosen because they were citizens of international and influential powers, they had different professions and they were deeply interested in the nature of sports and its impact on individuals and societies.
Results. The study reveals several important similarities between ancient thoughts on sports competitions and the modern relevance of football. Aristotle's philosophical works focus on the physical and moral benefits of sports, Juvenal's satirical writings highlight the social impact of athletic competitions and Suetonius's historical descriptions shed light on the political significance of sports in ancient times. All those ideas can be linked with modern football, considering the health benefits associated with this sport, its social impact and its relation with the politics fields.
Conclusion. This essay demonstrates that ancient ideas about sports continue to resonate today in modern football. Many of the ancient sports aspects are still relevant in the contemporary era. Through this study, can be encouraged the further reflection on the massive significance of sports in human culture.

Keywords: history, society, culture, sports, football.

Introduction

The massive popularity of sports competitions is not just a feature of the contemporary era. Through studying the past, no matter how distant, it can be observed that sport has always been an essential reality of human life. In the time of Antiquity, the Greeks had their Olympic Games, which were their most important sports competitions, held in honor of Zeus every four years at Olympia. Those games had religious, social and diplomatic importance and they were such a vivid reality of Greek culture that ancient historians used their dates to create a new chronological system. The ancient Greeks thought that sports competitions were an essential part of a complete education. They

valued physical exercise and athletic competition as highly as intellectual pursuits. This kind of attention to sports could also be observed in the Roman world. As an imperial power, Rome spread its values throughout all the provinces it conquered. Millions of people became Romans by adopting the lifestyle of the inhabitants of the Eternal City. Over time, being a Roman came to mean living like a Roman, which included a special attitude towards sports competitions. Every Roman city had circuses and amphitheaters in addition to temples, basilicas, baths and aqueducts. These even dominated the urban landscape because they were not just simple centers of entertainment, but also symbols of Roman power and prestige, with a massive propaganda role.

The ancient Greeks and Romans philosophers, historians, poets or physicians were deeply interested in the nature of sport and its impact on individuals and societies. From Aristotle's emphasis on developing virtues through practice to Suetonius's descriptions of gladiatorial combat, these thinkers explored the many dimensions of sports competitions which are still a global phenomenon, with a strong social, cultural or political impact.

In the past, gladiator games were widely practiced and loved by the people. Today, football has become the world's most popular sport, with millions of people playing, watching, and analyzing the game every single day. Considering the widespread attention that people all over the world give to football, the implications that this sport has in various fields can be observed, such as in international relations and diplomacy, education, the promotion of national stereotypes or political ideas.

Objectives

This essay will draw connections between the writings of the ancients about sports competitions and the implications that football has on modern societies. Ancient authors such as Aristotle, Juvenal and Suetonius explained the profound meanings of sports in their communities, and their mentalities, opinions and experiences can be useful in understanding the dynamic, complex and global phenomenon called football.

The ancient method of analyzing the implications of sports on communities can be adopted today in the case of football. Each of the three authors mentioned earlier will be a case study in this text, and their representative writings about sports will be connected to modern football.

Methods and Results

Aristotle had some interesting ideas about sports that can be linked with modern football. Aristotle wrote about the fact that sports competitions were essential for developing virtues such as perseverance, courage or teamwork. He believed that an individual could complete its education and personal development through excellence in sports. The Greek philosopher argues in his *Nicomachean Ethics*, that virtues are not innate qualities, but rather are developed through repeated action and habituation. He said: *becoming just requires doing just actions first, and becoming temperate, temperate actions*[1]. He suggested that virtues are not just something that humans possess, but something that they do. Football provides a special opportunity for individuals to develop virtues through repeated action. The players must constantly practice their skills through repetition which means they are perseverant. Furthermore, football requires individuals to have courage by taking risks such as injuries or pushing themselves to the limit. This sport demands an impressive level of both physical skill and mental toughness. Both players and fans are usually motivated by the desire to win and the pursuit of excellence, because the competition is at the center of this sport.

Aristotle believed that sports can have important social benefits by promoting qualities such as cooperation, friendship, and a sense of shared purpose among athletes and the public, philosophy that can easily be linked with modern football because it has a massive social component, with players coordinating the strategies with their teammates and fans coming together to support their favorite teams. Around football is created an entire community. This sport has an important social role also by promoting values such as fair play and respect even beyond the playing field. With the

[1] Aristotle, *Nicomachean Ethics*, Cambridge University Press, New York, 2000, p. 27.

virtues explained before, both players and fans develop in football terms but they also become better persons. The writings of Aristotle on virtue ethics and their intersection with modern football provides an interesting perspective on the potential for sports competitions to contribute to the development of positive character traits. By promoting virtues such as perseverance, courage or teamwork, football has a remarkable role in shaping the moral character of individuals and society as a whole.

Football has also an important role in International Development and Diplomacy and this can be linked with the ethical works of Aristotle, in which he pointed on the importance of social relationships and cooperation for the development of virtues such as justice and generosity. He said: *no one would choose to live without friends, even if he had all the other goods*[2]. In other words, the wider the interaction in a certain field is, the greater the chance for everyone to evolve is and this idea can be applied to the international role of football. Through football international organizations or competitions there are promoted positive values including respect and peace on a global scale. For example, Fédération Internationale de Football Association (FIFA), relies on cooperation, friendship and social relationships among its member associations to promote sportsmanship, fair play and global football development. Another example is the international tournament called the World Cup which improves relations between nations and promotes diplomacy. In order to achieve positive outcomes worldwide, working together towards common goals is essential.

Football is an efficient way for many people to obtain pleasure. Aristotle's ideas emphasize the relevance of pleasure and play in human existence. He believed that pleasure and play are essential components of a good life and should be pursued in moderation. Today, football is a sport that can bring happiness for every person, regardless of age, ethnicity, social position or wealth. Additionally, football serves as a method of play, which is a fundamental aspect for a good life, according to Aristotle. The play allows individuals to develop strategies and skills, to form social connections with other people and to simply express themselves in a creative way. Football has the potential to contribute to the overall well-being of individuals and communities. In the XXth century, Johan Huizinga also wrote about the importance of play, emphasizing that it is not just a cultural phenomenon, but is deeply ingrained in human behavior and biology[3]. The play is an essential and natural part of human life.

The Romans had a similar attitude towards the importance of sports competitions in people's life. For them, sports was essential for everyone to achieve both physical and mental health, as the poet Juvenal wrote: *mens sana in corpore sano*[4]. In the context of modern football, the quote highlights the relevance of training not only the body but also the mind. The players should be capable of maintaining their concentration, controlling their emotions and making quick decisions under pressure. In the field, they must have both mental toughness and physical strength. In addition to this fact, it is also important to notice that sports are not only about winning or losing but they are about personal improvement as well.

Juvenal did not write only about the positive facts of sports. He was famous for his satirical works in which he often criticized the excesses of Roman society. The ancient poet wrote about the obsession of the Romans with sports competitions in his days, arguing that the achievement of physical excellence was often accompanied by immorality. He believed that the excessive love of sports makes people more interested in these pursuits than in their civic duties. Just as the circuses in Rome, football has become a real force in modern societies, with millions of people playing or following it. Like the gladiators combats in Rome, football matches are usually accompanied by a large amount of spectacle, hype or public attention and eventually this fact can distract people from more important problems.

Juvenal also criticized the social hierarchy of Rome which was based mostly on wealth. The poet denounced the greed, corruption and decadence of the Roman wealthy classes, and he highlighted the contrast between their extravagant lifestyles and the suffering and poverty experienced by the lower classes. Professional football can be seen as an example of social and economic inequality as well. The most successful teams and players have huge amounts of money

[2] *Ibidem*, p. 143.
[3] Johan Huizinga, *Homo Ludens. A Study of the Play-Element in Culture*, Routledge & Kegan Paul, London, 1980, p. 1.
[4] Juvenal, *Thirteen satires of Juvenal*, vol. I, Cambridge University Press, New York, 2010, p. 52.

and power while leaving others behind. There are usually significant differences in wealth or power between the highest-paid managers, players or executives and those who are involved in lower-paying roles, such as security personnel, support staff or groundskeepers. This kind of gasps can be also observed in the comparison between different clubs as well. Just as Juvenal pointed out in his days, the wealthy and powerful structures always have advantages over those in lower social classes and this is a fact that exist even within the sport field.

Suetonius described the lives of the first twelve Roman emperors but those writings were not simple biographies but reflected the entire Roman society, recalling many activities that characterized it. He also wrote about the importance of sports and games in the Roman life. When he described the life of Augustus, he pointed out that the Emperor was very involved in the organization of the games and was attentive to every detail. For example, while attending the games, Augustus was never occupied with other business, such as reading or replying to letters or reports, because of his enthusiasm for sports competitions and his pleasure in watching them. A remarkable fact is that he encouraged the athletes and gave them rewards and prizes from his own funds. He used to reward *all the participants according to their merits*[5]. Suetonius highlighted the role of the emperor in promoting and participating in the sports activities. Augustus himself said: *Three times in my own name I gave a show of gladiators, and five times in the name of my sons or grandsons*[6] and during those shows there fought about ten thousand men.

These facts can be linked to the modern-day role of political leaders and celebrities in promoting and participating in football. The involvement of the historical leaders in athletic activities reflected their political and social ambitions, a fact that has remained valid until today. Sports have always been used to promote social cohesion and cultural values. Football can bring together people from different cultures and backgrounds, fostering a sense of shared identity and community and it is important the political support for its development.

Conclusion

By examining the ancient wisdom on sports and how it relates to modern football, we will gain a deeper understanding of the enduring value and significance of sports in human society. All of those ancient perspectives analyzed in this text demonstrate that sports competitions have been an essential aspect of human life for millennia and it is no coincidence that the symbol of the Rome itself was and remains the Colosseum, while today, across the globe, stadiums like Wembley or Camp Nou are some of the most important, imposing and visited constructions of the cities.

References

Aristotle, *Nicomachean Ethics*, Cambridge University Press, New York, 2000.
Augustus, *Res Gestae Divi Augusti*, in "Velleius Paterculus: Compendium of Roman History. Res Gestae Divi Augusti", Harvard University Press, Cambridge, 1961.
Huizinga Johan, *Homo Ludens. A Study of the Play-Element in Culture*, Routledge & Kegan Paul, London, 1980.
Juvenal, *Thirteen satires of Juvenal*, vol. I, Cambridge University Press, New York, 2010.
Suetonius, *Lives of the Caesars*, Oxford University Press, Oxford, 2008.

[5] Suetonius, *Lives of the Caesars*, Oxford University Press, Oxford, 2008, p. 68.
[6] Augustus, *Res Gestae Divi Augusti* , in "Velleius Paterculus: Compendium of Roman History and Res Gestae Divi Augusti", Harvard University Press, Cambridge, 1961, p. 381.

UNIVERSITY ARENA – Journal of Physical Education, Sport and Health, vol. 7, issue 4, 2024, p. 132-145
ISSN 2602-0440, ISSN-L 2602-0440
DOI: https: //doi.org/10.62229/UaVii_4_24-18

OPTIMIZING THE PHYSICAL DEVELOPMENT OF ADULTS BY USING EMS FITNESS TECHNOLOGY IN LEISURE TIME MOTOR ACTIVITIES

Miruna Elena TRIFAN[1] *, Vladi IONESCU[2], Alina-Mihaela STOICA[3]
[1,3] *Department of Physical Education and Sports, University of Bucharest, Romania*
[2] *National University of Physical Education and Sport, 060057, Bucharest, Romania*
* Corresponding author: trifanmiruna96@gmail.com

Abstract. EMS Fitness is an electrical muscle stimulation, a full-body training method that offers the combination of strength training and cardio training through a machine that uses electrical impulses to stimulate muscle contraction.
The aim of the study was to follow the effects of electrostimulation training on body composition, weight loss and muscle strength increase. Ten people, women and men, aged between 25 and 50, were studied. We want to demonstrate the hypothesis that the use of the EMS Fitness technique over a period of 90 days will lead to a decrease in body weight, optimisation of body mass index and increase in muscle strength. Participants in the exercise group performed 12 weeks of high-intensity training using specific EMS equipment in an Xbody. The objective of the experiment was to identify whether the use of EMS technology contributed to changes in body mass, skeletal muscle mass, body fat and visceral fat.
All exercise sessions were constantly supervised; in addition, exercise intensity, volume and frequency were recorded in training logs. A body composition scale was used for testing, which provides accurate body analysis using BIA technology. The training scheme was used for 12 weeks, changing the dosage and intensity for each subject, with the first signs of weight loss appearing after the first week.
Methods used in the research: experimental method, graph-tabel method, observation method, bibliographic study method.
Our results support the hypothesis, as the use of the EMS Fitness technique over a period of 90 days led to decreased body mass, optimized body mass index and increased muscle strength.
In conclusion, I believe that people in Romania should have a wider openness in practicing physical exercise in their free time in order to develop a healthy generation and decrease the possibility of reaching the stage of obesity and stopping diseases, and a good help in achieving this goal is presented by training using EMS Fitness technology.

Keywords: EMS Fitness, leisure time, xbody, weight loss, health.

Introduction

In the 21st century, we are in a society that is constantly changing, and stress, the passage of time much faster, intellectual demands exist in the life of every man, so the formation of the individual from the moral, physical, aesthetic, psychological points of view, must develop in harmony with the requirements of society. EMS Fitness Tenology includes several equipment, of which only one Just Fit Prp-EMS was used in this work. If we take into account that the Xbody equipment is closely related to the world of sports, both worldwide and in Romania, we can see that the material equipment of EMS Fitness technology will condition the practice of leisure and performance sports in the future.

EMS trainingis one of the most effective forms of exercise (Zatsiorsky 2006), EMS fitness technology offers a wide range of services to sport for all and performance sport, which will open up Romanian society to the benefits of practicing this sport. The interests of society as a whole, as well as the personal interests of each individual, are driven by promoting motor activities to stimulate muscle power through fitness exercises.

Through this scientific work we aimed, by highlighting the effectiveness of the means of actuation, to demonstrate that EMS fitness technology can combat obesity, the effects of sedentarism, increase interest in leisure time exercise.

The topicality of this topic stems from the need to create a healthy lifestyle in which movement and participation in electrical muscle stimulation training plays a special role. At the same time, our experience in conducting and organising EMS Fitness training can help us to identify the importance of training and participation.

Research findings through have shown that EMS training has significant effects on body composition using a small volume of exercise (Kemmler et al., 2009).

Electromyostimulation (EMS Fitness) is a common and established method to increase muscle strength and performance. Systematic analyses have documented the beneficial influence of locally applied EMS on neuromuscular system parameters. Other studies have revealed positive effects on jumping and sprinting ability. The reasons for improvements using EMS are a higher number of motor units recruited during EMS exercise compared to voluntary dynamic contractions alone (Junger et al., 2020). In addition, activation of fast moving fibres at relatively low force levels also plays a relevant role. Most studies have used the maximum pain threshold (maximum tolerated amperage) to adjust the pulse intensity (amperage). However, a high level of muscle tension due to EMS limits the range of dynamic movements. Therefore, in dynamic exercise modes with overlapping EMS, the pulse intensity should be adjusted to ensure sufficient movement 70% of the maximum pain threshold is considered practical and might be more promising, as the subjective feeling of increase remains comfortable, thus the pulse intensity can be selected and modified individually (Holzer et al., 2021). The device has a technology with a protocol that can be programmed at low intensity/low amplitude level (Wolfgang et al., 2013).

In recent years, specialized literature has testified to the importance of carefully and concisely directed physical exercise for improving life, preventing injuries, recovering from various ailments and not least for health (Bota. A. 2011). Obesity has nowadays become one of the main health problems worldwide. This disorder can also appear in the early stages of life, such as childhood and/or adolescence. It is considered a major risk factor for the development of other diseases responsible for high morbidity and mortality in adulthood. Nowadays, it is considered a multifactorial disease in which environmental, genetic, neuro-psychological and endocrine factors are involved (Lobstein et al., 2004). Living in a "society of abundance" , together with a large supply of high-calorie nutrients, changes in lifestyle, people's sedentary lifestyle coexisting with eating habits lacking knowledge of the nutritional characteristics of food, is the axis on which the development of overweight and then obesity is based (De Onis et al., 2010).

Workouts using EMS Fitness have been shown to be successful in improving physical performance (Filipovic et al., 2012).

Motor skills play a crucial role in all phases of life. People of all ages perform fundamental motor skills such as walking and running, exercise, or specific skills such as shooting hoops or driving a car. Measurement of motor skills is one of the fundamental aspects of measuring human performance (Hadel et al., 2004). It is well known that ageing is accompanied by sensorimotor impairments as well as cognitive and perceptual functioning. Older adults need to practise and learn new known motor skills, i.e. as part of a new task training, recreational activities or rehabilitation (Shumway-Cook et al., 2000).

Methodology

Participants and testing procedures

Participants in the EMS exercise group performed 12 weeks of high-intensity training, or EMS, in a well-equipped local Xbody gym. All exercise sessions were constantly supervised; in addition, exercise intensity, volume and frequency were recorded in exercise logs. All participants were asked to maintain their regular medication, dietary habits, physical activity and exercise outside the study protocol throughout the study course.

Subjects performed the guided and supervised low-intensity, resistance protocols. In short, this EMS equipment allows simultaneous activation of muscles in 16 regions (e.g. upper legs, upper arms, glutes, abdomen, chest, lower back and upper back) at different dedicated intensities.

Overall, the exercise protocol of our study closely copied the typical setting of commercial WB-EMS sessions with their low load and short duration strategy. An electric current was applied with a frequency of 90 Hz at the maximum tolerance limit of the subject. The exercise protocol lasted 20 minutes and combined dynamic exercises were performed for all muscle groups performed with and without additional weights. Squat movements with a 90 to 180° knee joint flexion movement were performed during all exercises. Thus, the exercises were divided into 2 large sets with a 3-minute break in between, with an intensity between 50% and 80%. Exercises were customized for each subject, modifying stimulus volume, intensity and frequency. A rest day was given between the compulsory training sessions, with training on Mondays, Wednesdays and Fridays. To measure the effects of EMS training, subjects undergo a 12-week intervention training program. The results of this study were measured by initial, intermediate and final test results.

Samples used for evaluation

A body composition scale was used for testing, which provides accurate body analysis using BIA (Bioelectrical Impedance Analysis) technology based on 8 sensors to ensure accurate determination. This scale has the following functions:

- Measurement of total body meal;
- Measurement of the percentage of adipose tissue – using BIA (Bioelectrical Impedance Analysis) technology the percentage of adipose tissue can be calculated;
- Measurement of skeletal muscle mass;
- Measurement of Body Mass Index (BMI) – the indicator measures total body fat in relation to height and weight.

	Monday	Wednesday	Friday	Intensity
Introductory Part	-20 seconds running with knees up on the spot -10 x kneeling with TRX -10 x kneeling on one (left) leg with TRX -10 x kneeling on one leg (right) with TRX	-20 seconds running with knees up on the spot -10 x kneeling with TRX -10 x kneeling on one (left) leg with TRX -10 x kneeling on one leg (right) with TRX	-20 seconds running with knees up on the spot -10 x kneeling with TRX -10 x kneeling on one (left) leg with TRX -10 x kneeling on one leg (right) with TRX	50%
Fundamental Part	-15 x knees with 2 kg weights in each hand -10 x side-step left lunge followed by kick -10 x lateral lunge step - right followed by kick -10 x forward and backward step-split on the same left leg -10 x forward and backward lunge on same leg-right -2 x 20 stepper crunches -Pause 3 minutes -10 x oblique knee raise up-right -10 x oblique knee raise up-left -15 x triceps x 2 kg on each arm -20 x step lunge with jump -10 x biceps x 4 kg	-30 seconds jumping jacks -30 seconds palms on the ground running with knees to chest -15 x step bent diagonally back-right -15 x step bent diagonally back-left -2 x 20 crunches on stepper -Pause 3 minutes -30 seconds jumping jacks with skipping -10 x 5kg biceps - right -10 x 5kg biceps- left -20 x back extensions -2 x 20 oblique crunches on stepper	-10 x 5 kg front/back lunge with right foot -10 x 5 kg front/back lunge with left foot -20 x alternating side step knee bends with elastic band -15 x knee bends with jump -10 x push-ups -10 x biceps + side step- left -10 x biceps + side step- right -3 x 15 seconds plank -Pause 3 minutes -20 x knees with touching the top of the lift -15 x 6 kg triceps -10 x military plank -10 x side step lunge + right kick -10 x lateral lunge step + left kick	70%
Concluding part	-2 x 30 seconds plenk	-2 x 20 seconds running with knees up on the spot	-2 x 20 stepper crunches	80%

Figure 1. Physical training program

Results and discussions

Table 1. Results of the 10 subjects over 12 weeks

Characteristics	Week 1	Week 6	Week 12
I.R: Weight	92.5	87.7	82
Body Fat	44.5	39.6	30.2
Visceral Fat	12	8	6
Skeletal Muscle	25.2	27.4	38.4
T.S: Weight	81.4	77.2	69.3
Body Fat	31.2	30.2	28.1
Visceral Fat	10	7	5
Skeletal Muscle	32	32.5	33.1
B.A: Weight	70.5	68.2	65.1
Body Fat	26.8	25.3	24.1
Visceral Fat	10	7	6
Skeletal Muscle	34.3	35.6	36.2
T.M: Weight	93.7	86	83.9
Body Fat	31.9	30.1	27.9
Visceral Fat	14	9	7
Skeletal Muscle	32.5	32.7	33.4
D.A: Weight	110.1	108.1	96.3
Body Fat	40.9	36.5	33.1
Visceral Fat	9	9	7
Skeletal Muscle	26.9	30	34.2
S.E: Weight	82.9	78.4	77.3
Body Fat	43.8	38.3	29.9
Visceral Fat	9	6	7
Skeletal Muscle	24.5	26.2	33
V.G: Weight	78.8	72.2	67.7
Body Fat	25.3	23.1	20.2
Visceral Fat	12	8	6
Skeletal Muscle	37.8	39.1	39.5
A.A: Weight	88.7	81.3	75.8
Body Fat	40.5	36.2	33.1
Visceral Fat	18	12	9
Skeletal Muscle	23.7	24.4	26.1
A.A: Weight	81	75.2	65
Body Fat	38.5	33.2	28.1
Visceral Fat	12	8	5
Skeletal Muscle	26.9	27.9	25.1
O.G: Weight	134	123	114
Body Fat	39.5	36.33	33.67
Visceral Fat	11	8	7
Skeletal Muscle	29.2	29.7	30

Each participant was tested at the same time of day (± 1 hour). All follow-up tests were performed after a weekend of rest. The tests were performed in one day within 60 minutes. During the 90 days, all participants had a healthier diet of their own, carbonated beverages, sodas, sweets, bread were eliminated and fruit was introduced daily. Thus, following the analyses it can be seen in figure (1,2,3,4,5,6,7,8,9,10) that both their weight loss and the indices analyzed were done gradually, achieving remarkable results.

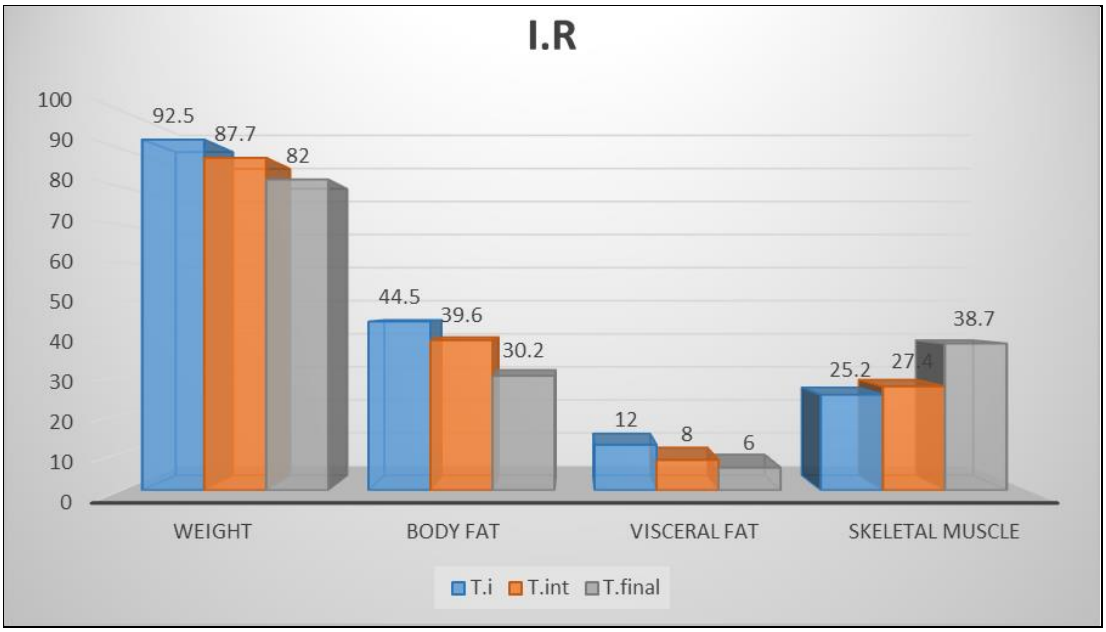


Figure 1. Evolution of I.R. subject indices

Figure 1 analyzes subject I.R is male, 1.61m tall. At the start of testing he presented with a BMI of 35.49, obesity grade I. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50–90 Hz. The training outcome showed a percentage decrease of 11.35%, falling into the first class with a BMI of 31.63.

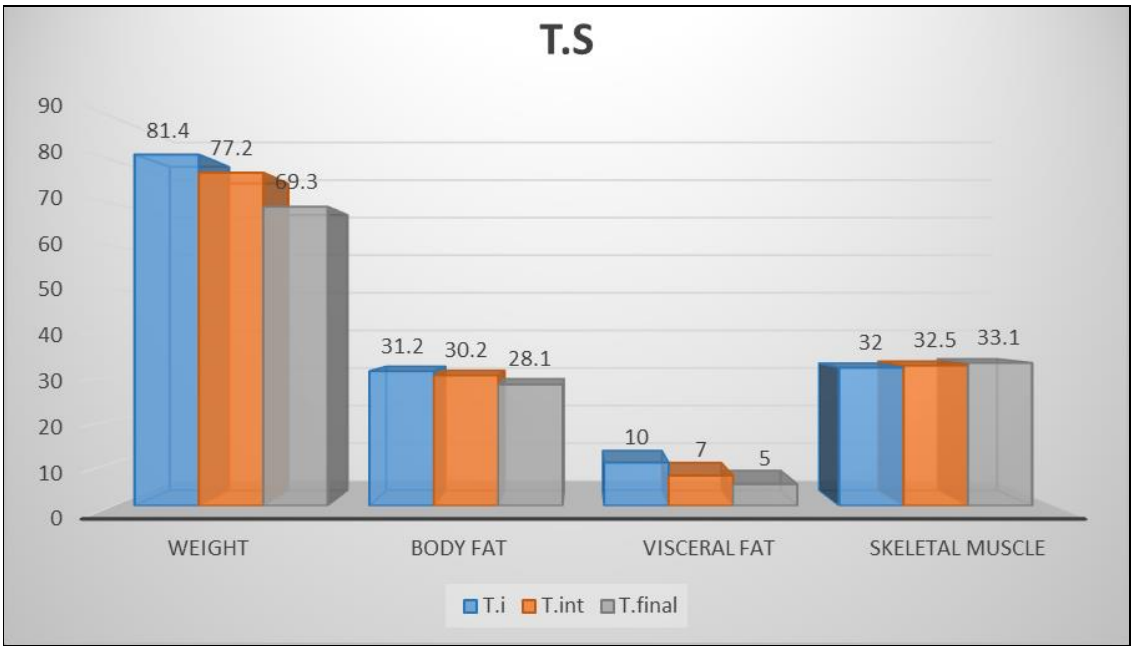


Figure 2. Evolution of T.S. subject indices

Figure 2 analyzes subject T.S is female, with a height of 1.65m. At the beginning of the test being overweight, she presented with a BMI of 29.75. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50–90 Hz. The result of the training showed a percentage decrease of 14.87%, being at the beginning of the overweight classification with a BMI of 25.34.

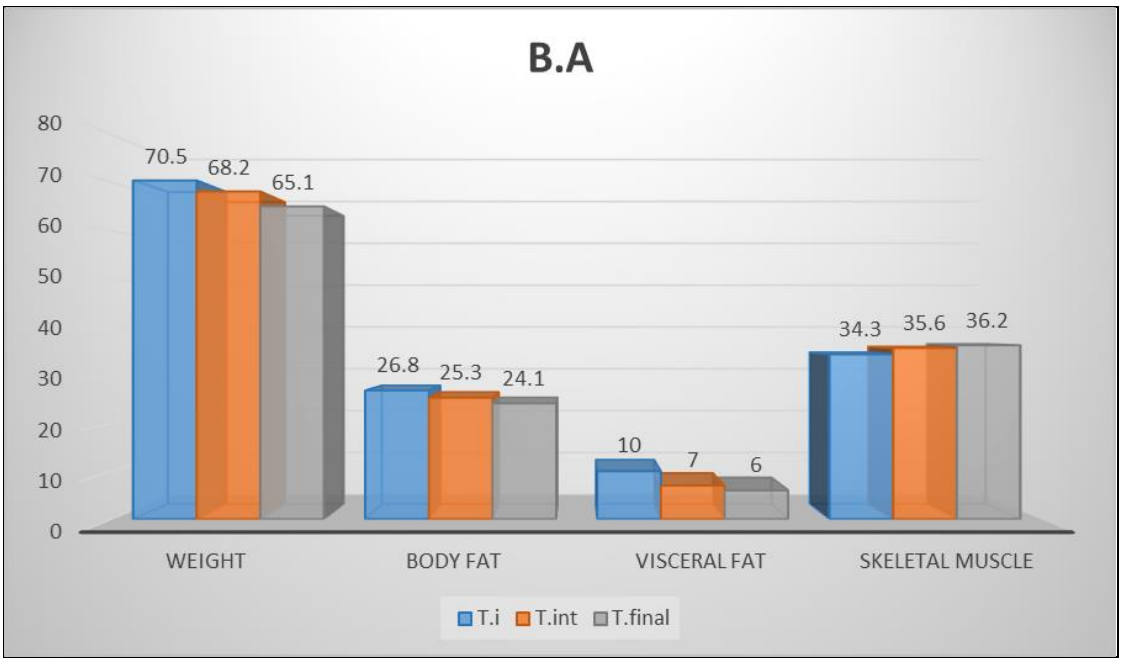


Figure 3. Evolution of B.A. subject indices

Figure 3 analyzes subject B.A is female, 1.70m tall. At the start of testing she has a normal weight, no risk of disease with a BMI of 24.22. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50–90 Hz. The result of the training showed a percentage decrease of 7.66%, maintaining normal weight with a BMI of 22.46.

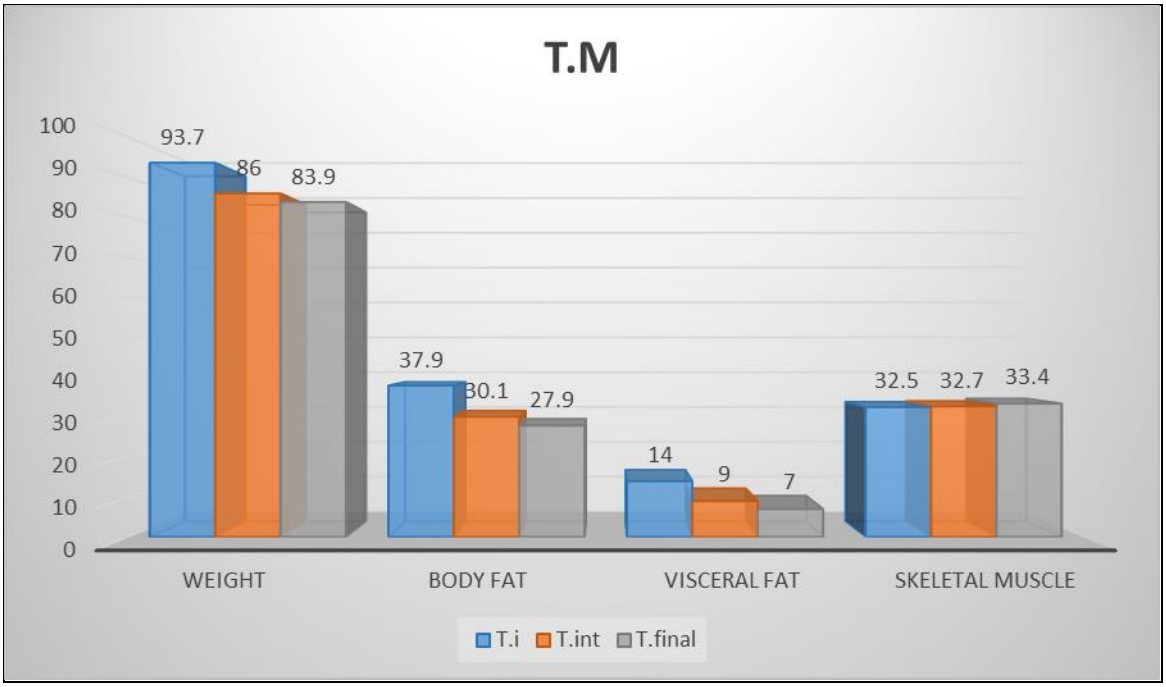


Figure 4. Evolution of T.M. subject indices

Figure 4 analyzes subject T.M is male, 1.75m tall. At the beginning of the test being overweight, he presented with a BMI of 30.37. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50-90 Hz. The result of the training showed a percentage decrease of 10.27%, being at the beginning of the overweight classification with a BMI of 27.10.

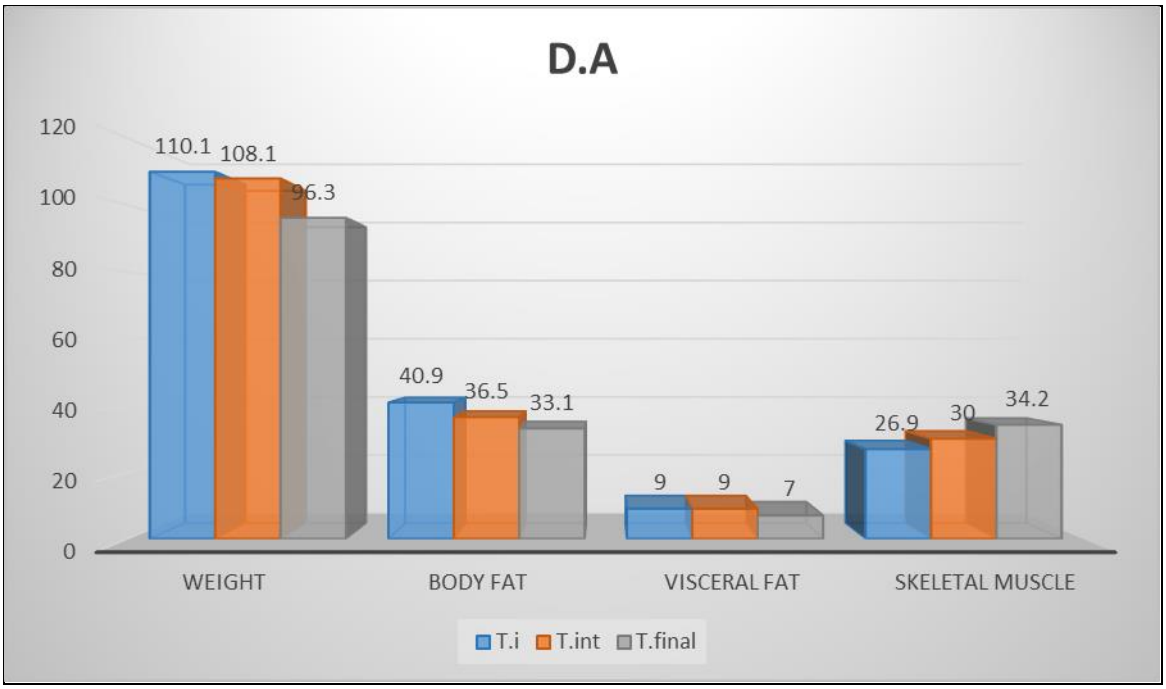


Figure 5. Evolution of D.A. subject indices

Figure 5 analyzes subject D.A is male, with a height of 1.83m. At the beginning of the testing he was in obesity class I with a BMI of 32.85.During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50-90 Hz. The result of the training showed a percentage decrease of 12.54%, which led to a drop in the ranking, being in the overweight category with a BMI of 28.67.

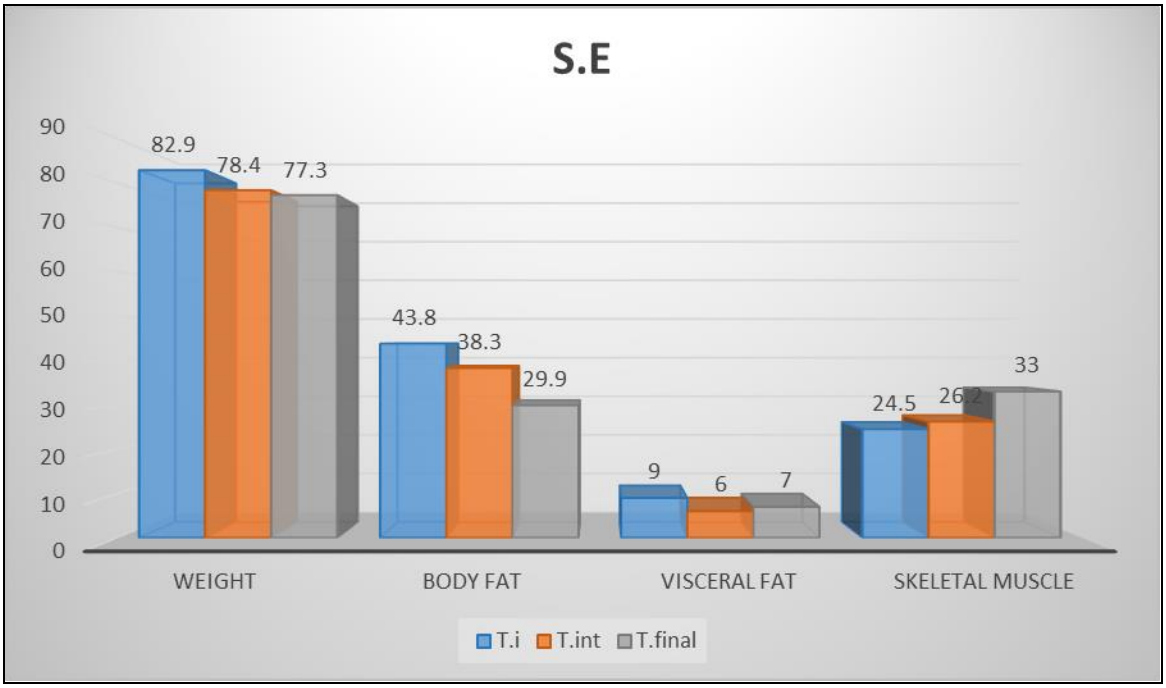


Figure 6. Evolution of S.E. subject indices

Figure 6 analyzes subject S.E is female, with a height of 1.68m. At the beginning of the test being overweight, she presented with a BMI of 29.05. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50–90 Hz. The result of the training showed a percentage decrease of 6.76%, with a BMI of 27.28.

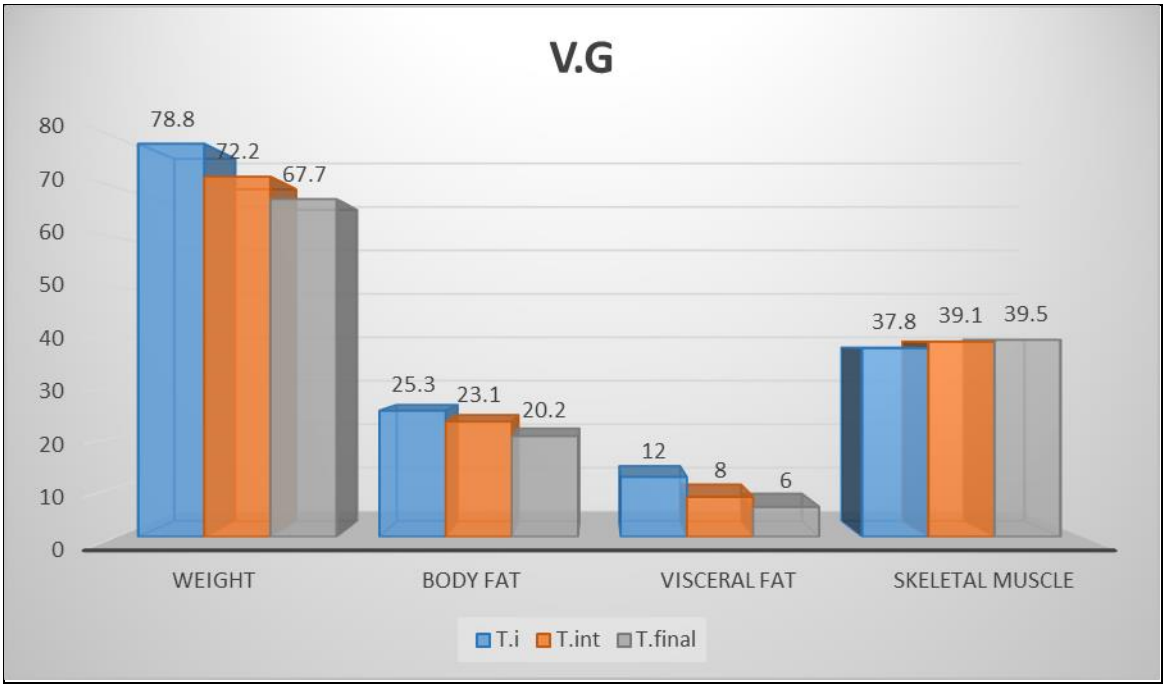


Figure 7. Evolution of V.G. subject indices

Figure 7 analyzes subject V.G is female, with a height of 1.57m. At the beginning of the testing she was in obesity class I with a BMI of 31.64 .During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50–90 Hz. The result of the training showed a percentage decrease of 14.09%, being at the beginning of the overweight classification with a BMI of 27.18.

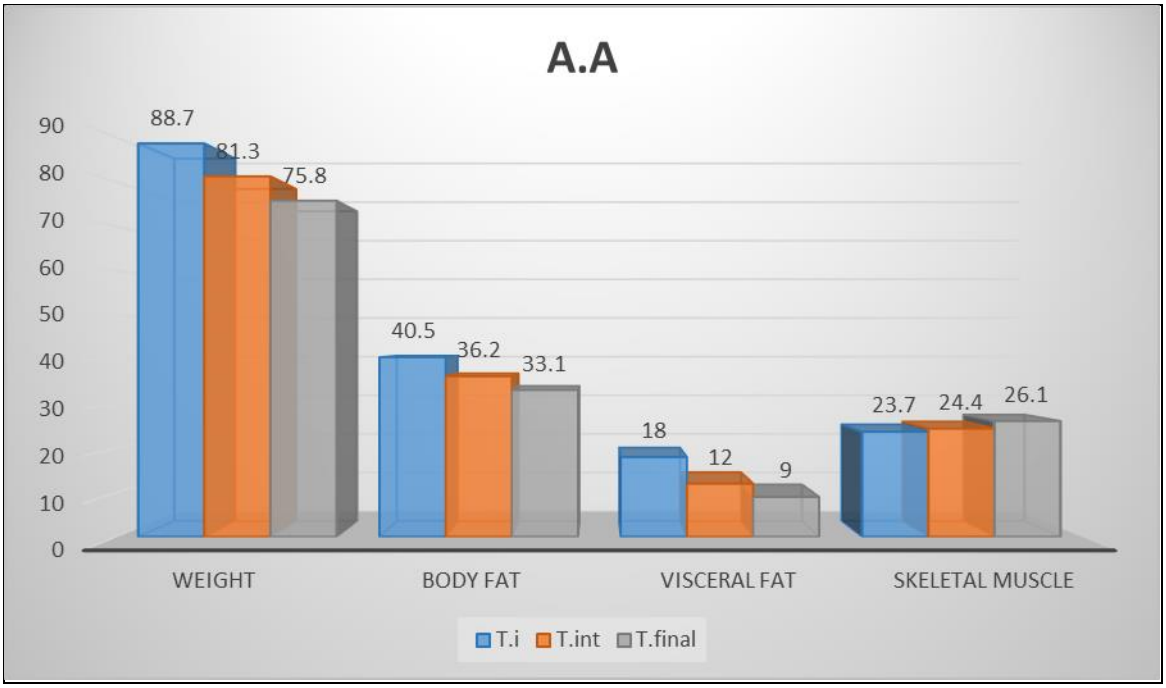


Figure 8. Evolution of A.A. subject indices

Figure 8 analyzes subject A.A is female, with a height of 1.57m. At the beginning of the test she was in the class of obesity class II , BMI 35.70. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50-90 Hz. The result of the training showed a percentage decrease of 14.55%, a significant decrease going down to the beginning of the overweight classification with a BMI of 30.43.

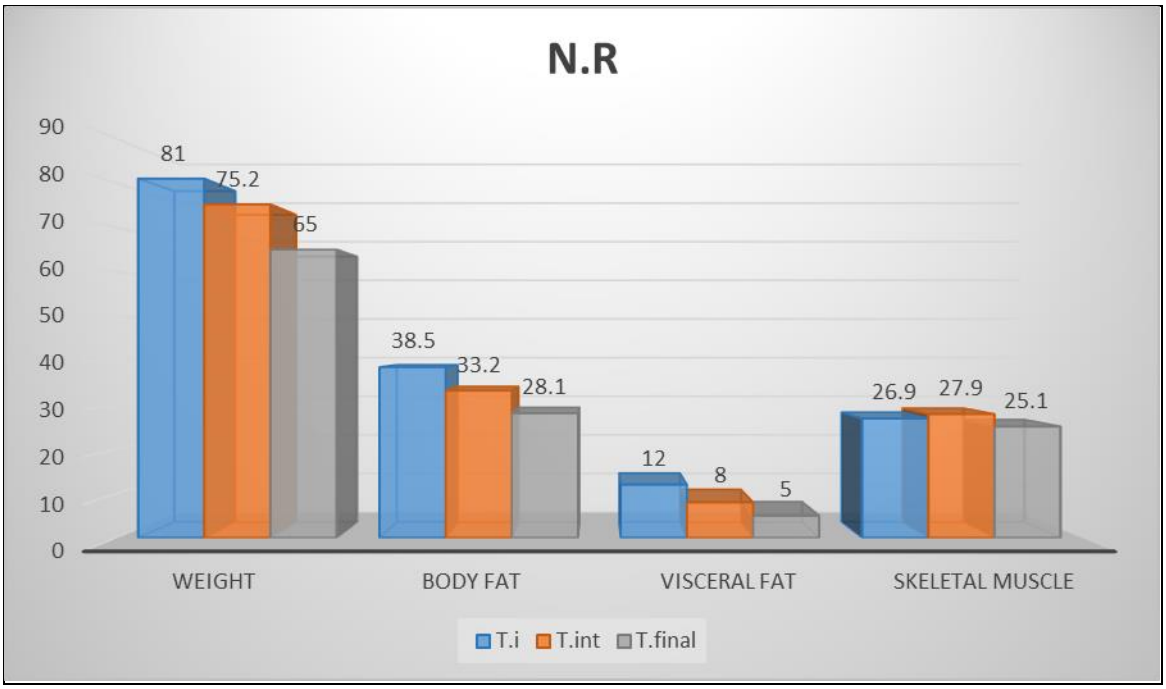


Figure 9. Evolution of N.R. subject indices

Figure 9 analyzes subject N.R is female, with a height of 1.62m. La is in obesity class I with a BMI of 30.82. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50-90 Hz. The training outcome showed the largest percentage decrease in the study, 19.76%, reaching a normal weight and BMI of 24.77.

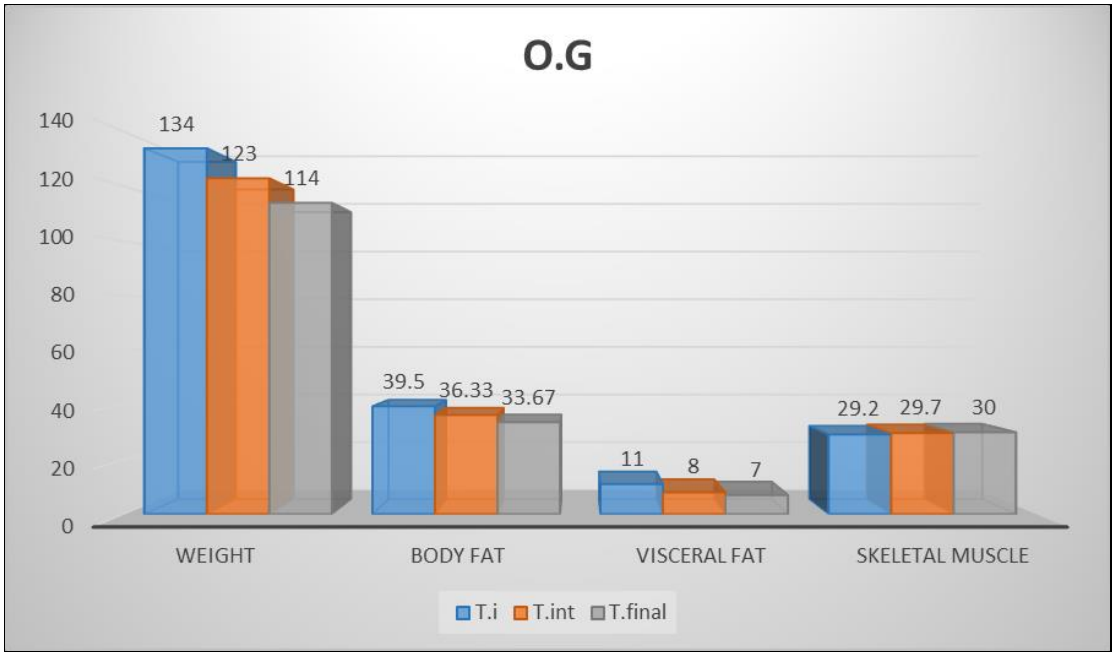


Figure 10. Evolution of O.G. subject indices

Figure 10 analyzes subject O.G is female, with a height of 1.84m. At the beginning of the testing she was at the bottom of the obesity grade II classification, with a BMI of 39.5. During the 90 days, the subject performed the proposed training scheme, initially using a frequency between 5 and 25 Hz of the EMS apart. Subsequently, the volume and intensity of training increased and the stimulus frequency was increased to 50–90 Hz. The result of the training showed a percentage decrease of 14.93%, reaching the obese class I with a BMI of 33.67.

Results

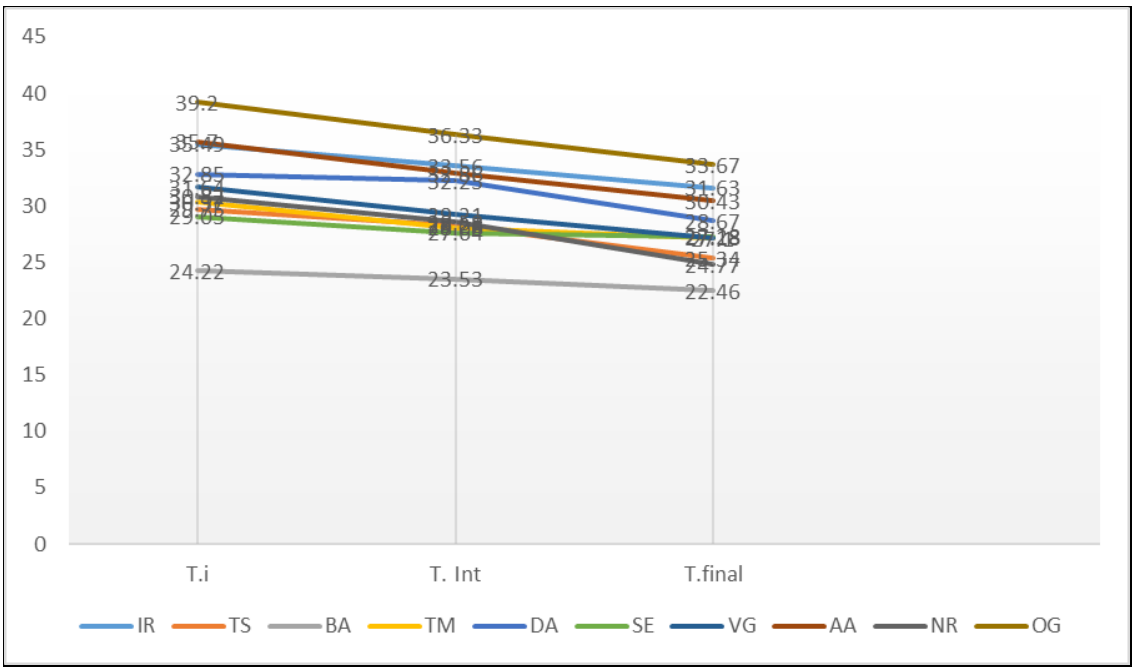


Figure 11. Evolution of body mass index

According to the research conducted, we have shown in Fig.11 that the efforts made in training using EMS Fitness technology, have codus to improve the body mass index (BMI).

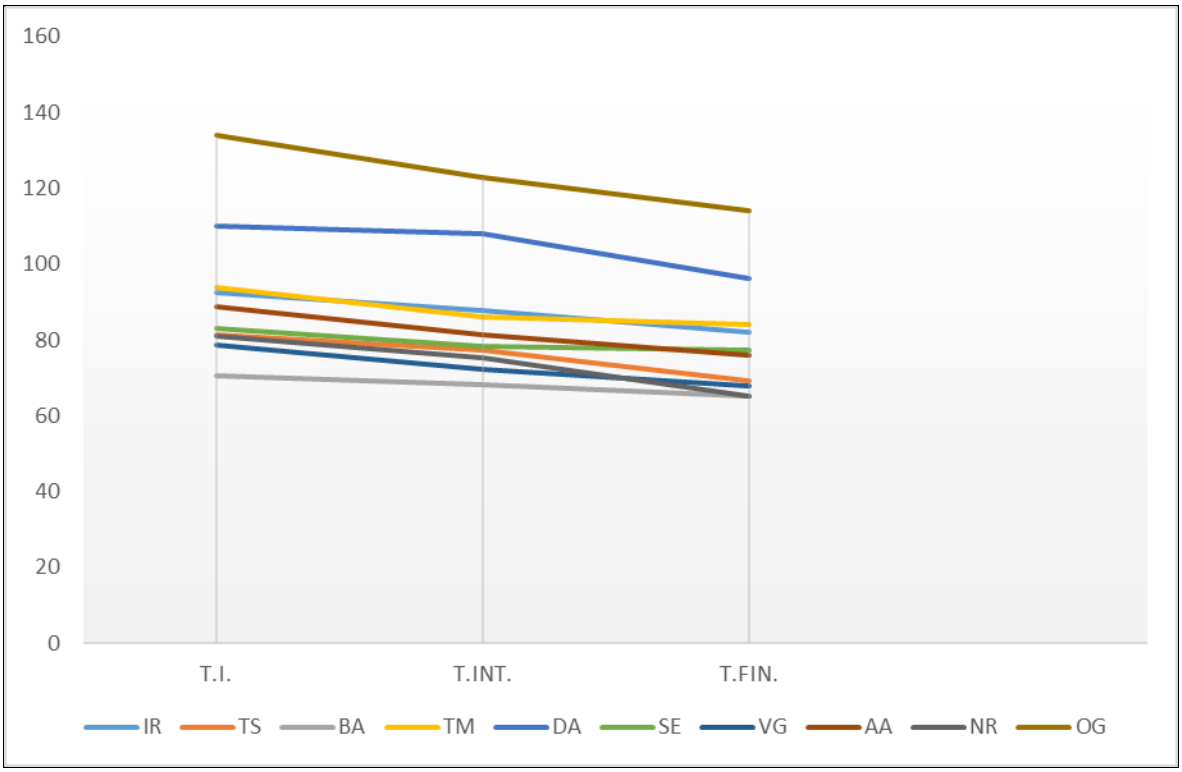


Figure 12. Evolution of the chondrom weight of the three tests

Figure 12. demonstrates that the applied program led to a decrease in body mass of each subject as shown by the three measurements.

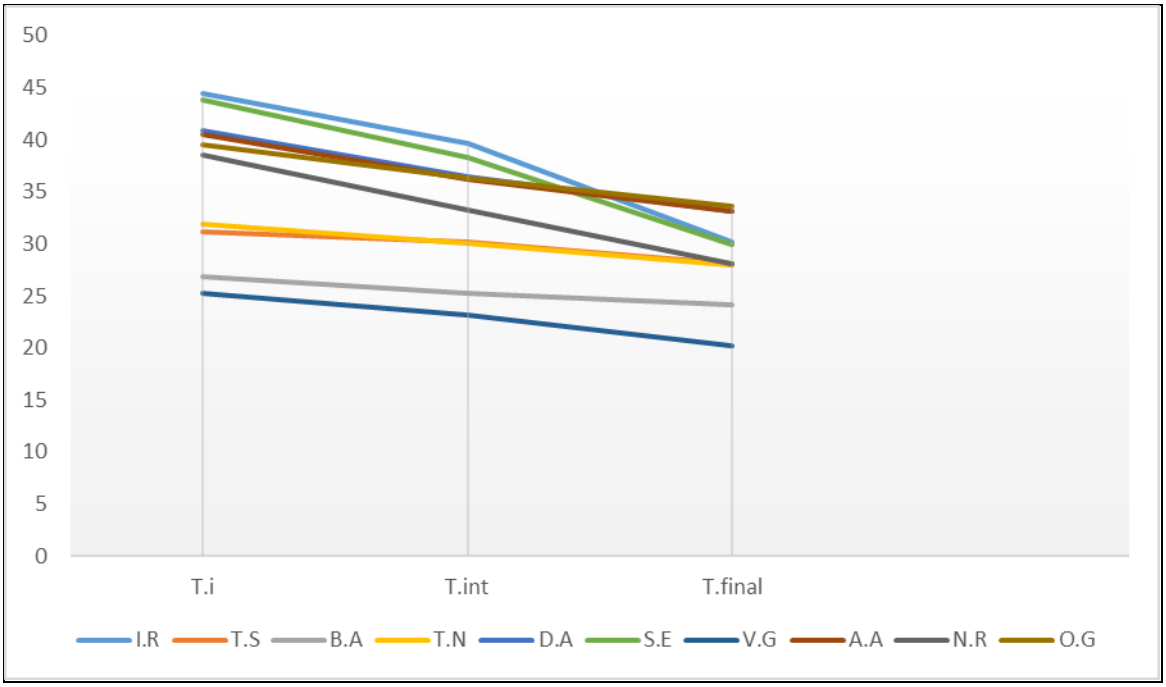


Figure 13. Evolution of body fat decrease during the three tests

Figure 13. demonstrates that following the program carried out by the subjects it is observed that the body fat decreased in each of them.

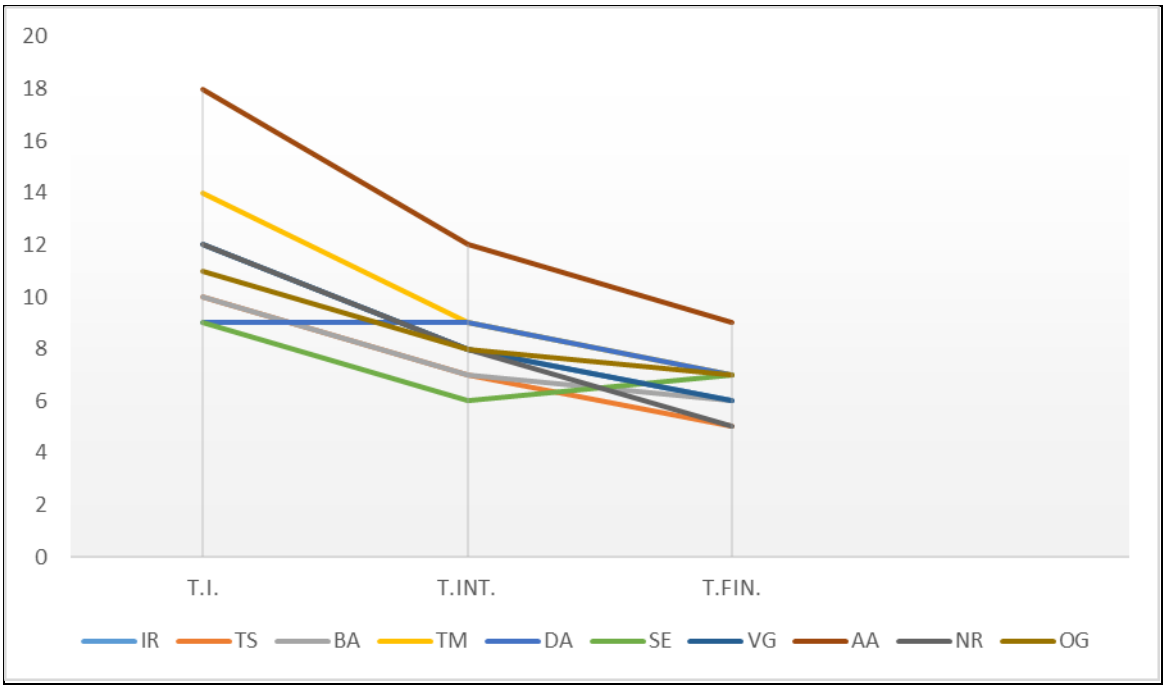


Fig.14. Evolution following the three visceral fat tests

According to Fig.14. it appears that for 9 out of 10 subjects visceral fat decreased. In the case of subject S.E, visceral fat decreased initially by 3 percent and then increased by one percent.

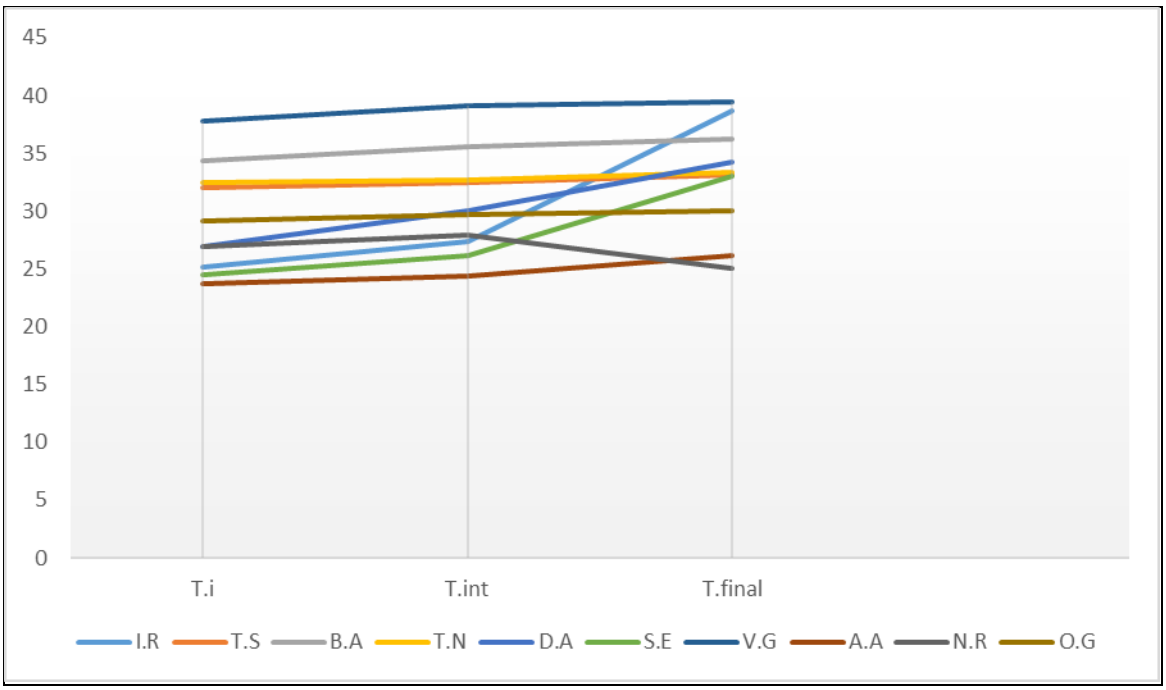


Figure 14. Evolution of skeletal muscles during the three tests

Regarding skeletal muscles, Fig.15. shows an increase in 9 out of 10 subjects. For subject N.R. the skeletal musculature showed a decrease compared to the intermediate test.

Conclusions

The objective of the experiment was to identify using EMS technology whether training contributed to changes in body mass, skeletal muscle mass, body fat and visceral fat. Based on this study, all results obtained are significant for all variables. These findings are beneficial for all human beings seeking a healthy lifestyle in their leisure time.

Our results support the hypothesis, as the use of EMS Fitness technique over a period of 90 days led to decreased body mass, optimized body mass index and increased muscle strength.

In conclusion, I believe that people in Romania should have a wider openness in practicing physical exercise in their free time in order to develop a healthy generation and decrease the possibility of reaching the stage of obesity and stopping diseases, and a good help in achieving this goal is presented by training using EMS Fitness technology.

References

A. Bota, 2011, *Activități motrice de timp liber*, Editura Discobolul, București, p. 48.

A. Shumway-Cook, M. Woollacott, 2000, *Attentional demands and postural control: the effect of sensory context*, J Gerontol A Med Sci 55A: M10 – M16.

Bax, L.; Staes, F.; Verhagen, A. Does Neuromuscular Electrical Stimulation Strengthen the Quadriceps Femoris? Sports Med. 2005, 35, 191–212;

Filipovic, A.; Kleinöder, H.; Dörmann, U.; Mester, J. Electromyostimulation–A Systematic Review of the Effects of Different Electromyostimulation Methods on Selected Strength Parameters in Trained and Elite Athletes. J. Strength Cond. Res. 2012, 26, 2600–2614.

H.J.A. Hedel, V. Dietz, 2004, *The influence of age on learning a locomotor task*, Clin Neurophysiol 115: 2134-2143.

Holzer, R., Schulte-Körne, B., Seidler, J., Predel, H., & Brinkmann, C. (2021). Effects of acute resistance exercise with and without whole-body electromyostimulation and endurance exercise on the postprandial glucose regulation in patients with type 2 diabetes mellitus: A randomized crossover study. *Nutrients, 13*(12), 4322. doi:https://doi.org/10.3390/nu13124322.

JUNGER, JÁN; JUNGER, ANDREA; OSTROWSKI, PAWEL, Body composition of trainees undergoing EMS training with respect to their nutrition, Journal of Physical Education & Sport . Jan2020, Vol. 20 Issue 1, p. 97-101. 5p.

K. Wolfgang, B. Michael, E. Klaus, S. Simon, 2013, Impact of whole-body electromyostimulation on body composition in elderly women at risk for sarcopenia: the Training and ElectroStimulation Trial (TEST-III), Published online Aug 16. doi: 10.1007/s11357-013-9575-2, PMCID: PMC3889893, p. 12.

Kemmler W, Birlauf A, Von Stengel S. [online]. Norimberg: Univerzita Elangen. 2009. [cit.2018-05-03]. Available at: https://www.miha-bodytec.com/sk/studie-k-nizkofrekvencnej-elektrostimulacii-celehotela/.

Kemmler, W.; Weissenfels, A.; Willert, S.; Shojaa, M.; Von Stengel, S.; Filipovic, A.; Kleinöder, H.; Berger, J.; Fröhlich, M. Efficacy and Safety of Low Frequency Whole-Body.

Electromyostimulation (WB-EMS) to Improve Health-Related Outcomes in Non-athletic Adults. A Systematic Review. Front. Physiol. 2018, 9, 573.

M. De Onis, M. Blössner, M. Borghi, 2010, *Global prevalence and trends of overweight and obesity among preschool children*. Am J Clin Nutr., 92, p. 6.

Paillard, T. Combined Application of Neuromuscular Electrical Stimulation and Voluntary Muscular Contractions. Sports Med. 2008, 38, 161–177.

T. Lobstein, L. Baur, R. Uauy, 2004, *Obesity in children and young people: a crisis in public health*. Obes Rev., p. 25.

Zatsiorsky K. Science and Practice of Strength Training. Human Kinetic. 2006. ISBN 978-0736-281.

Tiparul s-a realizat
la Tipografia Editurii Universităţii din Bucureşti