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STUDY ON THE UNDERSTANDING AND PERCEPTION OF PHYSICAL LITERACY AMONG PHYSICAL EDUCATION AND SPORT TEACHERS IN ROMANIA

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ABSTRACT. Introduction: Physical literacy (PL) is a concept that, in recent years, has earned notoriety within the field of physical education and has become a focus point in schools physical education and sports programs. Physical education lessons represent an ideal setting for fostering and developing physical literacy, and the teacher plays an essential role in its development. The physical education teachers' choices during the lesson influence what students learn and whether the objective of physical literacy is achieved. **Objective:** The purpose of this study was to investigate the understanding and perception of PL among Romanian physical education and sport teachers. **Material and method:** The participants in this study were 169 physical education and sport teachers (42% female and 58% male) from Romania, most of them from the western part of the country (86,39%). This study was conducted using the questionnaire survey method. A questionnaire that assessed the teachers' understanding and perception towards physical literacy was applied. The collected data was analyzed using the IBM SPSS Statistics 20. **Results:** The main results indicate that there is a positive and moderate correlation between the understanding and perception of PL among Romanian physical education and sport teachers ($\rho = .454$, $p < 0.001$). **Conclusions:** It is concluded that the understanding and perception of the concept of PA are positively associated, which highlights the need for teachers to be informed about PA in order to optimize the teaching process.

Keywords: *Physical literacy, teachers, understanding, perception.*

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Introduction

Due to recent social changes, an inactive, sedentary lifestyle is becoming more and more common in society, a phenomenon also found among children (Nelson et al., 2006). In both developed and developing countries, the number of children at risk of obesity has increased significantly (Pop, 2020). According to the World Health Organization (WHO) the prevalence of overweight and obesity among children and adolescents has increased dramatically. A very important factor in preventing overweight and obesity among children and adolescents, as well as in reducing the risk of obesity in adulthood, is physical activity (Hills, Andersen & Byrne, 2011). Regular physical activity brings many physical and mental benefits and is vital for a healthy lifestyle (Tomaczkowski & Klonowska, 2020).

A potential cornerstone for increasing the number of people who engage in physical activity from an early age is represented by physical literacy (Brown, Dudley & Cairney, 2020). This concept is seen as a key element in discussions about how sports, recreation, health, and physical education could help solve problems related to physical inactivity and obesity (Roetert & MacDonald, 2015).

Physical literacy encompasses both the desire to participate in physical activity and to gain meaningful, fulfilling experiences through it. Crucially, it redefines how physical activity is understood and gives importance to the holistic development of an individual's physical potential (Whitehead, 2010). Some authors believe that physical literacy is an essential life skill that ensures participation and active involvement in society (Roetert & Jeffries, 2014), and as such, it should be seen as an integral component of a child's holistic development in the educational environment (Roetert & Couturier MacDonald, 2015).

From an education perspective, the United Nations Educational, Scientific and Cultural Organization policy document states that high-quality school curricula for physical education and sport should target physical literacy (UNESCO, 2015). The relationship between physical literacy and physical education was emphasized by Whitehead (2013) who stated that the former is not an alternative to the latter, that there is no competition between the two, and that the most important aspect is that physical literacy is the goal of physical education, a goal that can be uttered and defended with confidence to reveal the intrinsic value of physical activity.

In school environment, physical education lessons provide a suitable and formalized framework for fostering and increasing physical literacy (Stoddart & Humbert, 2017), and teachers play an important role in its development. The choices physical education teachers make during the lesson determine what students learn and whether the goal of physical literacy is achieved. School plays a significant role in a child's overall development, so it is very important that

physical education teachers understand the phenomenon of physical literacy. Knowledge of physical literacy will enable them to maximise opportunities to engage pupils in a variety of ways, which will lead to their development from this perspective. Physical education and sport teachers also play a key role in promoting understanding and awareness of the importance of the concept of physical literacy among both other teachers and parents. Therefore, it is an absolute must that physical education and sport teachers are aware of the complexity of the concept, given that physical literacy incorporates components from three domains of learning: cognitive, affective and psychomotor (Graham, Holt/Hale & Parker, 2013).

Objective and hypotheses

The objective of this study was to analyze the relationship between the understanding and perception of the concept of physical literacy as well as the differences in terms of gender among physical education and sport teachers in Romania.

In this research the following hypotheses were assumed:

Hypothesis 1: It is assumed that there is a correlation between the understanding and perception of the concept of physical literacy among physical education and sport teachers participating in the study.

Hypothesis 2: It is assumed that, depending on the gender of the subjects, there may be differences in their understanding and perception of the concept of physical literacy.

Material and methods

Participants

A total of 169 physical education and sport teachers (42% female and 58% male) from Romania participated in this study, most of them from the western part of the country (86,39%). All subjects were informed about the study objectives and the procedure and agreed to participate voluntarily in the research.

Procedure

In this study, the questionnaire administered to assess the understanding and perception of physical literacy was adapted from the model proposed by Essiet et al. (2022). The original version of the questionnaire includes 19 items.

In this study, 17 of them were selected, which make up 2 scales – understanding and perception – 10 items for the first scale and 7 for the perception scale, the answers being given on a 5-point Likert scale. Of these, three items are reversed. High scores reflect a higher level of understanding and underscore the perceived importance of the concept. The questionnaire used in this study was translated into Romanian by a specialized translator. The questionnaire was developed using Google Forms, the participants having the opportunity to provide the answers online.

The IBM SPSS Statistics 20 program was used for the statistical processing and analysis of the collected data. To study the internal consistency of the questionnaire, Cronbach's alpha coefficient will be calculated and a simple correlation analysis will be performed to analyze the association between understanding and perception of the concept of physical literacy.

Results

Regarding the participants in the study, most of them (38%) were aged between 25 - 34 years, 34% were aged between 35 - 44 years, 17% were aged between 45 - 54 years, 7% were aged between 21 - 24 years, and the fewest were 55 years old and older (4%).

In terms of the degree programme graduated, 33% of the subjects graduated only a bachelor's degree programme, 64% a master's degree programme and 3% a doctoral degree programme.

Concerning the professional experience in the field of education, 28% of subjects declared that it falls within the range of 1 – 4 years, 27% between 5 – 9 years and 9% have experience of 25 years or more.

Of the subjects included in the study, 16% are classified as beginning teachers, 39% are with a full-time professional degree, 19% have obtained the second teaching degree qualification and 34% have obtained the first teaching degree qualification or the PhD title (Table 1).

Table 1. Demographic data of the study participants

Demographic data		N	%
Gender *(n=169)*	Male	98	58.0
	Female	71	42.0
Age group *(n=169)*	21-24 years	11	6.5
	25-34 years	65	38.5
	35-44 years	58	34.3
	45-54 years	29	17.2
	55 + years	6	3.6

Demographic data		N	%
Educational background *(n=169)*	Bachelor's degree	55	32.5
	Master's degree	109	64.5
	PhD	5	3.0
Experience *(n=169)*	1 - 4 years	48	28.4
	5 - 9 years	45	26.6
	10 - 14 years	16	9.5
	15 - 19 years	25	14.8
	20 - 24 years	23	13.6
	25 +	12	7.1
Teaching degrees obtained *(n=169)*	Beginning teacher	26	15.4
	Full-time professional degree	66	39.1
	Second teaching degree qualification	19	11.2
	First teaching degree qualification/ PhD title	58	34.3

For the questionnaire used, after its translation into Romanian, the Cronbach alpha fidelity coefficient of the 17 items was calculated. The value of .702, with a percentage of 100%, means that the scale has a good internal consistency (Table 2).

Table 2. Internal consistency of the questionnaire

Cases	**N**	**%**	**Cronbach's Alfa**	**No. of items**
Valid	169	100.0	.702	17
Excluded	0	0		
Total	169	100.0		

Regarding the studied sample, at the descriptive level the following values were found for the Understanding and Perception scales (Table 3):

Table 3. Descriptive analysis

Variables	*Mean*	*Std. dev*	*Min. value*	*Max. value*
Understanding	37,17	3,98	26	47
Perception	29,19	3,33	21	35

In order to verify the relationship between the comprehension and perception variables, a scatter plot was first performed (Figure 1), with a scatter coefficient of R^2 = .0192. The dispersion line indicates a positive relationship, meaning that an increased value of understanding of the concept of physical literacy leads to an increased perception of it.

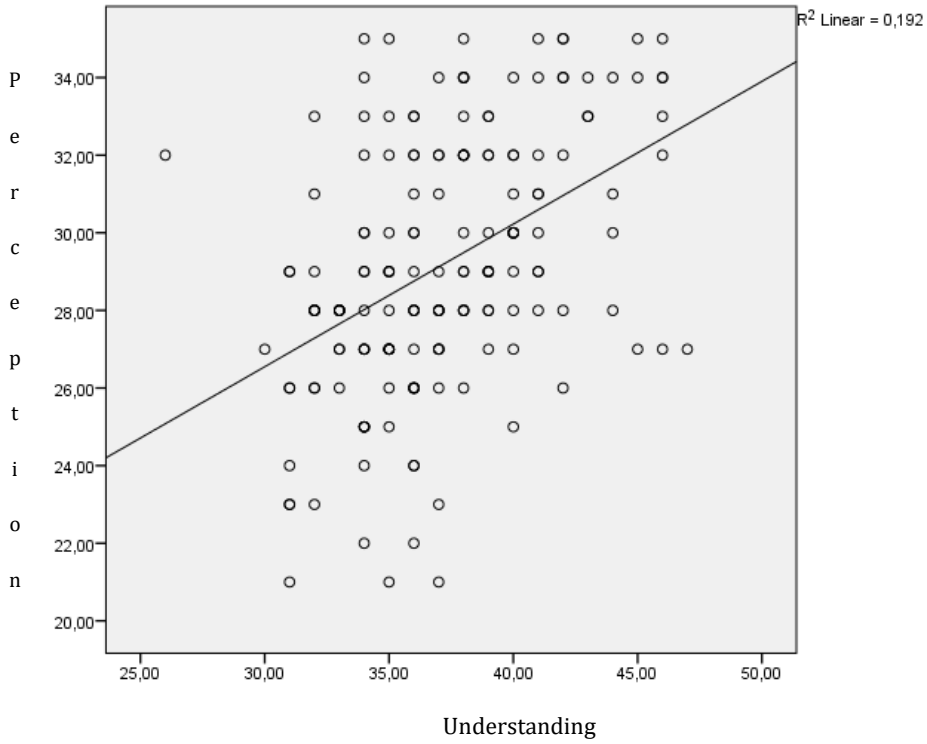

Figure 1. Scatter diagram showing the relationship between the variables of understanding and perception

Testing the associative hypothesis began by checking the shape of the distributions of the two variables. The results of the Kolmogorov-Smirnov's Test for the normality of the distributions are shown in Table 4:

Table 4. Normality test of distributions for comprehension and perception

	Kolmogorov-Smirnov		
Variables	Statistic	df	Sig
Understanding	.095	169	.001
Perception	.106	169	.000

Since none of the distributions met the normality criterion ($p<.05$), the Spearman coefficient was used as a technique for testing the hypothesis.

Calculation of the Spearman correlation coefficient shows a value of ρ = .454 (Table 5), revealing that there is a moderate positive correlation between the two variables.

Table 5. Correlation between understanding and perception variables

		Perception	Understanding
Perception	Spearman's Correlation	1	.454
	Sig. 2-tailed	-	.000
	N	169	169
Understanding	Spearman's Correlation	.454	1
	Sig. 2-tailed	.000	-
	N	169	169

Thus, as understanding scores increase among the physical education and sport teachers, so do the physical literacy perception scores.

Regarding the second hypothesis, concerning possible differences in understanding and perception of the concept of physical literacy according to the gender of the subjects, the Mann Whitney U nonparametric test for independent samples was used as a statistical technique, since the distributions of the two variables for both groups were abnormal (Table 6).

Table 6. Normality test of distributions for comprehension and perception variables

		Kolmogorov-Smirnov		
		Statistic	df	Sig
Male	*Understanding*	.149	98	.000
	Perception	.146	98	.000
Female	*Understanding*	.110	71	.033
	Perception	.144	71	.001

The results of the Mann Whitney U test for the comprehension and perception variables are shown in Table 7. One can notice that for both variables the scores are higher for female subjects. They concluded that for the understanding variable there is no significant difference between the mean scores recorded according to the gender of the subjects ($U = 2883$, $N_1 = 98$, $N_2 = 71$, $p = .057$), but that for the perception variable the difference is significant ($U = 2329$, $N_1 = 98$, $N_2 = 71$, $p = .000$).

Table 7. Mann Whitney U test – Ranks and statistics

Variable	Group	N	Mean Rank	Sum of Ranks	U	Z	Sig.
Understanding	1 Male	98	78,92	7734,00	2883	1.904	.057
	2 Female	71	93,39	6631,00			
Perception	1 Male	98	73,27	7180,00	2329	3.682	.000
	2 Female	71	101,20	7185,00			

Discussion

In this research, we focused our attention on the variables of the degree of understanding and perception of the concept of physical literacy among physical education teachers (N=169), but also on the possible differences according to the gender of the subjects.

There are studies in the literature showing that there are teachers who find it difficult to understand the concept, which highlight the need for teachers to receive support in this regard in order to be able to develop physical literacy through physical education and sports lessons (Robinson, Randall & Barrett, 2018; Stoddart & Humber, 2021).

The results obtained in this study confirm the existence of a statistically significant link between the understanding and perception of the concept of physical literacy. A similar study was conducted by Essiet et al. (2022) involving 122 subjects, mostly male 48,4%. The study sought to identify how teachers understand and perceive the concept of physical literacy and revealed that the majority of teachers included in the research perceive physical literacy as an important and valuable concept; however, it highlights the fact that without proper understanding and knowledge, it would be difficult to implement it. These results could explain what was demonstrated in the present study.

The present study also revealed a statistically significant difference according to gender, with female teachers (42% of the analysed population) having a higher perception of the concept of physical literacy than male teachers (58% of the analysed population). The level of understanding of the concept of physical literacy does not differ between the two genders.

In essence, both categories of subjects have a similar level of understanding but perceive the importance of the concept of physical literacy differently.

Limitations of the study and future recommendations

The results are limited from the point of view of generalization as most subjects are from the same geographical area. Furthermore, the small number of participants is a limit of the present research (N=169). A larger sample could have

provided a clearer, more complex picture of the relationship between the variables studied in the research. At the same time, the use of the questionnaire for data collection excluded the possibility of obtaining details of the answers provided.

Regarding future suggestions for approaching this topic, it should be taken into account that other studies also recommended the use of interviews with the subjects, as an additional method to gather more detailed and accurate information on how they understand and perceive physical literacy.

Conclusions

The objective of the present study was to capture a possible link between the understanding and perception of the concept of physical literacy among physical education and sport teachers in Romania, as well as possible gender differences between the two variables. The obtained data confirmed the associative hypothesis that there is a statistically moderate correlation between understanding and the perceived importance of physical literacy. The correlation between the two is positive, but understanding and perception are dependent in only 19% of study participants.

Moreover, a statistically significant difference was highlighted according to the gender of the subjects at the level of perception of the concept. In terms of understanding, no statistically significant differences were found between participants by gender, although there are differences here too. Thus, although the level of understanding is the same in both groups, the perception of the concept of physical literacy is more pronounced among female physical education and sport teachers.

Taking into account the fact that understanding and perception of physical literacy are corelated, it is concluded that information about the concept and knowledge of aspects of physical literacy can contribute to awareness of its importance. This association may be reflected in the future by the increased attention paid by physical education and sport teachers to all components of physical literacy.

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SPORTS PRACTICE AS THERAPEUTIC METHOD IN PHYSICAL REHABILITATION PROGRAMS FOR CHILDREN WITH SPECIAL EDUCATION NEEDS

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ABSTRACT. Our main concern consists in offering an optimal physical development rehabilitation program for children with special educational needs. The therapeutic programs we approach in special schools is based on the diversity of physiotherapy methods and playful physical activity. To increase pupil's interest in physiotherapy sessions and to make this therapy more pleasant for this children we introduced key elements from regular sport activities in their individual therapeutic intervention programs (e.g. basketball- played at a larger and lower positioned basket, football- played with a lighter ball in a small field, bocce- played with lightweight balls on a smaller field). These programs have been well received, no special needs child was yet to refuse playing any adapted sport for his condition. By introducing regular sports in the physiotherapy programs applied for the children in our school, we succeeded to forward socialization, team-work, improving gross and fine motor skills, developing high receptivity towards sports. In order to bring out the best out of their abilities, each and every child is given the opportunity and encouraged to compete in local sports competitions organized for children with special needs. There are connections between mental and physical wellness. Maintaining physical health can also support mental well-being. In this way, everyone can use athletics as a form of treatment. This review will go into great detail on the therapeutic benefits of sport for kids, including how it can help them individually achieve better physical and emotional results and facilitate social integration. For the diversity of the

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therapeutic program and the healthy development of this children, as well as for the increase of their quality of life, it is necessary to integrate mainstream sports in the curriculum of special schools, as long as they are adapted to the needs of children with disabilities.

Key words: *sports practice, physiotherapy, special education needs, methods*

Sport practice, seen from the perspective of therapeutic applicability, has several dimensions in terms of its impact on people's health by increasing physical, mental and social well-being.

According to Australian Physical Literacy Framework in 2019 (Scott et al., 2021) sports practice can be organized in four areas, each of which consists of key elements contributing to the development of physical culture (Almond & Whitehead, 2012): physical, psychological, social and cognitive (Figure 1). These four elements are interconnected and can be used in a variety of contexts and tasks. When engaging in activities that will support the growth or maintenance of physical literacy, a person will need to be aware of which components are pertinent to their personal development. Australian Physical Literacy Framework consist in the interrelation of **physical elements**, **psychological, social** and **cognitive**. It connects the skills and fitness of a person with the attitudes and the emotion that a person has regarding movement or sports practice that makes him interact with others.

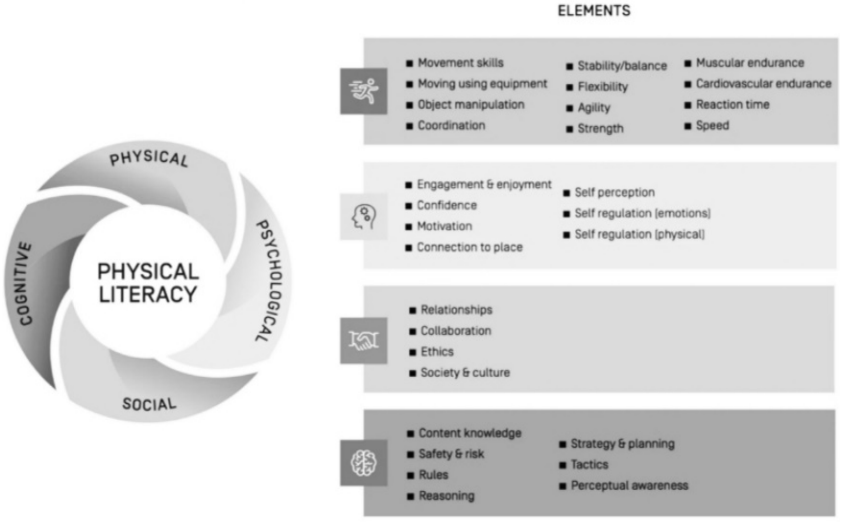

Figure 1. *Australian Physical Literacy Framework*

Physical literacy, according to Almond and Whitehead (2012), is a fundamental and important human skill that can be characterized as an attitude acquired by human individuals and including motivation, confidence, physical skill, knowledge, and understanding that establish intentional physical activity as an integrated part of their lifestyle. Whitehead (2012) uses the following qualities—adaptability, distinctiveness, and applicability—to characterize the basic and significant components of physical education. A physically educated person values and accepts responsibility for maintaining lifelong goal-oriented physical activity; preparation is indicated by the joy of being active, which is at the core of the concept (Shearer et al., 2018).

Sports practice, a social integration method for children with special needs

Through specific methods and means, physical education and sport practice provide an accessible educational environment with a strong formative and educational impact on people with disabilities (Albrecht et al., 2019).

In recent years, physical education and adapted sports have established themselves as sub-systems with specific objectives for different types of disabilities. Adapted motor structures, specific rules, modified material and organizational resources make it easier for these people to express themselves according to their own abilities and capacities. On the other hand, in this way, therapeutic-compensatory and developmental effects are possible, which allow the creation of a new self-image, favorable to social integration (Rapp & Corral-Granados, 2021).

Modern physical education and adapted sport programs promotes inclusive education by including people with and without disabilities in joint activities (Winnick & Porretta, 2016a).

Sport aims to strengthen the body and leads to good physical fitness, providing opportunities for early physical development, improved spatial orientation and safe movement. Sports practice lead to increased fine and gross motor coordination, improved concentration, listening skills, self-esteem and confidence, playfulness, creativity, cooperation and communication skills with others.

Some children with severe learning difficulties have good motor skills, they can work independently. Others may need special assistance while playing sports. (Winnick & Porretta, 2016b; UK Parliament, 2006; Carey et al., 2009)

Sports activities must be different from those practiced by pupils in mainstream schools, so that the pupil with multiple disabilities is able to perform the movements required for the sport he/she wants to practice.

Thus, each pupil must be encouraged to participate to the maximum of his or her ability in physical education classes and to carry out activities as diversified as possible, such as games, gymnastics, dancing and swimming (O'Reilly, 2001).

All sports are based on motor skills and abilities. The difference of sports practice consists in the degree of difficulty that all sports require. For example, Entertainment and Sports Programming Network defined a list of degree of sports practice difficulties - endurance, strength, power, speed, flexibility, nerve, durability, hand-eye coordination and analytic aptitude (Caple, 2012).

The complexity of physiotherapy practice in rehabilitation programs for children with special needs requires a high level of knowledge of the deficiencies and a precise assessment of the progression of students' results (Afxonidis et al., 2022). In this article we will present the importance of using sport-based qualitative techniques in physiotherapy.

Sports practice by children with special needs

The play patterns and skills of children with disabilities are often shown to be lower in development, disorganized, and less diversified than those of their non-disabled colleagues. Fewell & Kaminski, 1988; Harrison & Kielhofner, 1986; Howard, 1996; Linder, 1993; Restall & Magill-Evans, 1994; Bundy, 1989; Desha, Ziviani, & Rodger, 2003). Their capacity to play may be restricted by traits or obstacles related to their impairment (Swinth & Tanta 2008).

Barriers to the development of play behaviours in children with disabilities can occur in several ways: excessive caregiver dependence; physical, psychological or sensory limitations; environmental restrictions; or reduced social interactions (Missiuna & Pollock, 1991; Royeen, 1997). These barriers to engagement in play activities can result in secondary disabilities such as increased dependency, diminished imagination, poor social skills, and lack of motivation (Missiuna & Pollock, 1991).

Learned helper dependence is a secondary developmental disadvantage that can have an impact on a kid with disabilities' social relationships and functioning capabilities. The perception that a person cannot exert control over the events taking place as a result of interactions with the environment is known as acquired helplessness (Gargiulo & O'Sullivan, 1986; Wen, 2020). Motivational, cognitive and emotional deficits occur when children feel they have no control over the performance of their own motor activities. Low self-esteem could develop, which would have a negative impact on how they behave and function. They typically exhibit a lack of assertiveness and an incapacity to react to the activities around them. To prevent secondary impairments brought on by a lack of

play, educational interventions are required in these circumstances to assist children in overcoming components of their physical and environmental disabilities that restrict social inclusion in children's play (Missiuna & Pollock, 1991).

Researches has shown that children with disabilities can be taught movement skills that will be generalized to all movement activities (Goldstein & Cisar, 1992; Lifter et al., 1993; Le Goff, 2004; Rogers, 2000). Such data provide support for instructional programs and goals that address the development of play skills. In this way, including play activities in the curriculum for all students is a realistic and necessary goal of curriculum planning.

In order to increase children's physical activity and the number of rehabilitation activity sessions, it is important to implement an individual physical training program for children with special needs based on therapeutic sports.

Balance skills must be developed during this time period as a foundation for future movement skills and competences in order to support the early development of coordination abilities to support the preparation of children with special needs for the sports rehabilitation phase. The degree of development of balance abilities affects the quality of several special activities.

It has been found that the effectiveness of specially designed exercises for particular sports is influenced by children's training levels and the movement abilities taught in physical education programs for kids with special needs (Akulovich, 2021).

Adapted physical education and physiotherapy consist of a number of sports-related exercises, programs, and activities that have been adapted to be appropriate for those with disabilities. The goals of the disabled children's physiotherapy are based on the fundamental physical education curriculum. Simply taking part in adaptive sports is insufficient; it's also critical to improve the self-efficacy of kids with disabilities, change the way their parents and teachers view the sport, adapt the equipment, and improve the school's physical infrastructure. In this case, social and personal factors, the wrong equipment, and insufficient facilities may make it difficult for a child with special needs to participate in physical education activities (Wang, 2019). Some centers for integrated rehabilitation see sports practice activities and adapted physical education as supplements to physiotherapy rather than as an essential component of the treatments (Standal et al., 2018). Curriculums could encourage social inclusion and autonomy in special education settings (Al-Zoubi, & Bani Abdel Rahman, 2017). Sports participation has a positive effect on the development of the physical, functional, and motor efficacy of every body part because physical sports activities are intended to increase the physical, motor, functional, psychological, social, and mental abilities of children with special education needs (SEN). This must lead to the organization of sporting events for SEN

students. The health of a person's body organs is typically associated with how active they are. The range of physical and sporting activities largely aids individuals in improving their physical fitness and reducing their risk of illness (Sayyd et al., 2020). Sports activities have importance since they are intended to help people develop their talents and are also thought of as a type of clinical and rehabilitative therapy that enables people to integrate into society. Adapted sports and physical activities help SEN children's motor and functional skills since exercise is correlated to heart rate, blood pressure, bioactivity, muscle strength, power, and response time (Abdel-Hussein, 2009). Because the majority of SEN children have disabilities, physical exercises developes them physically, psychologically, and socially; specific physical education programs in schools improve kids' social and motor skills (Shaheen, Al Saadi, & Al-Hadabi, 2019).

In our special school, a school that has an educational program adapted for children with severe motor and physical disabilities, the main concern consists in offering a good physical development for pupils dealing with special needs, in particular motor disabilities, by introducing key elements from regular sports activities in their personalized intervention programs, primarily adapted to their needs.

These programs have been well received by our children, no special needs child was yet to refuse playing the specially adapted sport for his condition. Top favorite activities have been the bocce game, bowling, football and table tennis amongst the oldest.

Sports games are adapted for groups of children following certain criteria: depending on the deficiencies children are differentiated in groups making up the teams for whom have the same kind of need; children who use wheelchairs prefer sports like: bowling, bocce, table, basketball. By age: the little ones prefer sports entertainment, less aggressive: gymnastics, athletics, bowling, and the big ones prefer individual sports with a competitive character - chess and backgammon, or team games: football and basketball. Children who agree each other form the teams for a good flow of the game. Preferences by gender: girls prefer sports like athletics, gymnastics, dance, and boys prefer sports balls: football, tennis, table tennis, bowling and bocce.

Therapeutic effects pursued in the mass sports adapted for children with special needs

In the Rehabilitation programs of gross and fine motor and during physical education classes of pupils with SEN, we are using elements from motor games and sports adapted to each student and groups to diversify motions, stimulate

teamwork, and increase self-esteem, motor rehabilitation for independence and functionality. In preventing accidents we have changed the rules of game play, adapted the play spaces and the necessary materials.

Football and ball games. Football is a broad-spectrum therapy against lifestyle disorders and the most popular sport in the world, providing much more than just amusement (Milanović et al., 2018).

Scientists have concluded that football training is an intense and diverse training method that includes endurance, aerobic high-intensity interval training, and strength training for participants of all ages and ability levels (Oja et al., 2015; Milanovi et al., 2015). Football can therefore be described as an all-in-one sort of training having good and simultaneous effects on cardiovascular, metabolic, and musculoskeletal fitness for the whole population (Krustrup et al., 2010; Krustrup, Helge & Hansen, 2018).

In order to be applied as a therapeutic method for our SEN pupils, game rules are changed the way of progress is simplified. Football is practiced on a much smaller field and played with a lighter ball.

Standing balance is educated and by passing and stopping the ball. Education of coordination by the kick of ball, by hitting lateral and front of ball and driving the ball through pole trailers or by passing between obstacles.

Spatial orientation – developing this capacity is made by applying the simplified scheme of defense and attack tactics (long pass, stopping, hitting, and displacement between pole trailers), pass in two exchanging places, and pass with left – right leg and pass in three with shift.

Basketball. Repeated motions in basketball might cause musculoskeletal abnormalities.

It's not always the case that playing basketball will especially overload some energy systems or actions and promote strength, vertical leap height, and fitness adaptability.

When creating a therapeutic program that uses basketball as a therapeutic tool, it is important to consider the fitness elements that are utilized. Then, it is necessary to evaluate each player's fitness in the following areas: speed endurance since basketball involves sporadic, high-intensity running and direction change (Ben Abdelkrim, 2007; McInnes et al., 1995; Strumbelj et al., 2014); speed and agility (Conte et al., 2015). Basketball speed and agility drills should emphasize maximum sprint attempts over maximum distances, strength and power, core strength, and injury prevention (Hoffman et al., 1996). (Puente et al., 2016; Hertel et al., 2007). These factors contribute to the prevalence of ligament injuries and knee deformities. There is evidence to support the requirement for an

efficient preseason injury prevention training program (Kofotolis & Kellis, 2007). Basketball knee and ankle injuries can be avoided with the help of a competent program that trains dynamic core stability, proper single- and double-leg landing mechanics, and good muscular force and capacity.

If played at a larger and lower positioned basket, grasping and shoulder joint mobility is developed through catching and throwing in two shifting place, huge and shift. The development of coordination in walking and ocular-motor is educated by throwing the ball on the basketball hoop from different positions with one or two hands. Balance development is made by throwing the ball from an inclined or unstable surface.

Bowling and bocce are played with lightweight balls made from different materials to increase the possibility of easy playing for these children. It develops spatial orientation, accuracy and coordination.

Table tennis, tennis, badminton are played with balloons or sponge balls without a net; table tennis game is done with appropriate modifications of the rules of children with SEN. This sports improve range of movement in joints of the arms, rehabilitation spine alignment, the development of spatial orientation, speed of reaction and reflexes, coordination and skill development, capacity development of effort development of volition qualities: attention, concentration, developing team spirit, fellowship, friendship and fun.

Basic Gymnastics develops of correct posture and body alignment and balance, improves motor skills: strength, speed, strength, skill and aesthetic sense: exercises with various portable devices, developes general mobility: flexibility, extension, rotation, running, rolling, climbing.

Dancing improves motor skills aesthetic sense. Learning and applying dance steps in made on background music (step added, changed, jump, cross, simple jumping on one foot and two).

Athletics- for the rehabilitation of our children we use basic exercises and some elements from school of walking and running. It educates gross motor skills: variety of walking and jumping, alternatives of running, catching and throwing.

In **chess and backgammon** are used larger pieces or pawns to be handled with greater ease. Are being educated fine motor skills - grasping and coordination are deficient for spastic children. Attention and spatial orientation are stimulated within delimited action spaces.

Conclusions

By introducing regular sports in the programs we undertake with our children we succeeded to forward socialization, team-work, improving gross and fine motor skills, developing high receptivity towards sports. In order to bring out the best out of their abilities, each and every child is given the opportunity and encouraged to compete in local sports competitions organized for children with special needs. We believe in the harmonious up growth of each and every child and stride to better the quality of their lives by introducing these adapted sports in the special school's curriculum.

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STUDY ON GENDER AND AGE DIFFERENCE AND THE DEVELOPMENT OF SPACE-TEMPORAL SKILLS IN STUDENTS AGED 8-11 YEARS

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ABSTRACT. Introduction: Understanding the mechanisms leading to the development of spatial and temporal skills is a topic of current interest, especially since they can predict academic performance. **Objectives**: The objective of this study was to improve space orientation skills with the help of specific exercises. **Material and methods**: 148 children aged between 8.1 and 11.9 years participated in this study (M= 9.70; SD= 0.79). They were subjected to 2 tests that measure spatial orientation skills (the Piaget Head Test and the Bender Santucci Test). The samples were applied both in the pre-test and post-test period. The participants in the experimental group, underwent a specific program for a period of 12 weeks. The participants in the control group did not benefit from any manipulation of this variable. **Results**: The results showed that there is a statistically significant difference between the control group and the experimental group as recorded by the Piaget Head post-test results (M-W=2166.0, p=0.02). Moreover, differences were also recorded in the age categories, for both samples. Children aged between 10.6-11.9 years registered significantly higher scores, compared to the others (p.008/p.013). There were also differences between the gender categories, but they were not significant. **Conclusions**: In conclusion, the intervention program had the expected effect.

***Keywords**: space-temporal orientation, intervention, gender, age*

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Introduction

Psychomotricity promotes the integral development of the person (Briceño-Pérez, 2021). It is made up of 3 dimensions that influence each other: motor, psychic and emotional (Bustillos-Martínez, 2022). In a child's life, psychomotor components play a very important role, contributing not only to physical development, but also to cognitive, social, and affective development (Arufe-Giráldez et al., 2021). Psychomotor activities relate one's body to others, objects, space, and time (Acosta Bravo, 2021). In addition to the components that influence the stage of psychomotor development, the learning of the concept of space and time plays an essential role in cognitive development (Díaz-Segura, 2022; Herrera, 2021), and has been an important area of research in educational psychology for nearly 100 years (Rittle-Johnson et al., 2019). Spatial skills are the ability to mentally manipulate shapes, objects, and dimensions, visualize the location of objects and their paths, and remember them. (Herbst et al., 2022; Nazareth et al., 2019). Although it is an essential cognitive skill, some authors believe it is limited and can only be partially improved through education (Yang et al., 2020; Rimfeld et al., 2017). According to Boggio and Omori (2017), they mentioned that in the everyday and educational environment, children face possible situations related to orientation and localization. The study of time and space concepts at children is currently a trending topic for researchers (Oqueso-Huanaco, 2019). This is a point of interest that has been growing in the scientific environment over time, numerous studies identifying its importance due to the link with mathematics (Atit et. al, 2021; Casey & Ganley, 2021; Reyes-Flores, 2022). To the same extent, it has been demonstrated that the child's ability to orient him/herself in a surrounding environment influences writing and reading, because the same spatial thinking processes intervenes in the two activities (Garcia, 2022; Salazar-Armijosm, 2022; Wang, Hu & Zhang, 2021). A positive aspect is that spatial skills are malleable and can be developed in people of all ages through a variety of approaches (Hawes, Gilligan & Mix, 2022).

Objectives and hypotheses

This study is part of a larger research, which directs its direction to the link between academic performance and orientation ability. The main objective is the development of space-temporal orientation ability in primary school students, through specific exercises in the physical education and sports lesson.

1. It is assumed that the total scores on the Piaget Head spatial orientation test, but also on the Bender Santucci test, in the post-test period, are significantly different for the two groups, as a result of the intervention applied to the experimental group.

2. There are statistically significant differences in spatial orientation tests according to age groups (8.1-10.5 years and 10.6-11.9 years). Children aged 10.6-11.9 will score higher on spatial orientation.
3. There is a statistically significant difference between boys and girls, in terms of scores on the Piaget Head spatial orientation test, but also on the Bender Santucci test.

Materials and Methods

Study participants

148 students participated in this study, aged between 8.1 and 11.9 years (M=9.70; SD=0.79), of which 70 were male and 78 were female. Inclusion of participants in the study was done by using convenience sampling. The number of children in each group was equal (N=74).

Research Tools

The students were given two tests that determine the ability of spatial orientation, before and after the actual intervention, both pre-test and post-test.

The Piaget Head Test for determining spatial orientation highlights the perception of space, each age being assigned a series of items that the child is asked to perform (3, 5 or 6).

The Bender-Santucci perceptual-motor test of spatial configuration targets the perceptual-motor function of spatial configuration, thus allowing an evaluation of the level of perceptual-motor organization and structuring of space. The testing was done individually. The necessary materials were represented by five models that the child must copy as faithfully as possible on a sheet of paper.

Research procedure

In order to start the study, an agreement was signed between Secondary School no. 24 from Timişoara, Faculty of Physical Education and Sports from Timişoara and Timiş School Inspectorate. The inclusion of children in the research was carried out after obtaining the consent of the parents or legal guardians. Both tests were applied under the guidance of a specialized psychologist.

Statistical analysis

The results of this research were obtained and processed using the IBM SPSS Statistics 20 program. The Mann-Whitney U test and the t-student test for independent samples were used to identify differences between groups, but also for age categories.

The Intervention

The space-temporal orientation intervention applied to the children in the experimental group was done at the physical education and sports lessons, over a period of 12 weeks. The first category, the space motor perceptual structure, included certain types of tools, done through different exercises and movement games, which included bodily references, notions of size, recognition and operation with spatial notions, but also the estimation of some distances. The second category, the education of perceptual-motor structures of time, included exercises for the education of order, sequence, duration and intervals.

Results

Hypothesis 1

To verify the first proposed hypothesis, the Mann-Whitney U test was used at a level of statistical significance $p < 0.05$.

Thus, there was a statistically significant difference between the control group and the experimental group regarding the Piaget Head Test after the intervention (M-W=2166.0, p=0.02). The experimental group registered higher scores on the Piaget Head Test (82, 23 vs. 66.77). The results can be seen in table 1:

Table 1. Mann-Whitney U Test Results (P. H.)

Independent-Samples	**Mann-Whitney U Test Summary**
Total N	148
Mann-Whitney U	2166.000
Wilcoxon W	4941.000
Test Statistic	2166.000
Standard Error	260.124
Standardized Test Statistic	-2.199
Asymptotic Sig. (2-sided test)	.028

The difference between the control group and the experimental group at the level of the Bender-Santucci Test after the intervention was not recorded (M-W=2347.50, p=0.13), as can be verified in table 2.

Table 2. Mann-Whitney U Test Results (B. S.)

Independent-Samples	**Mann-Whitney U Test Summary**
Total N	148
Mann-Whitney U	2347.500
Wilcoxon W	5122.500
Test Statistic	2347.500
Standard Error	260.382
Standardized Test Statistic	-1.500
Asymptotic Sig. (2-sided test)	.134

Hypothesis 2

There were statistically significant differences in the Piaget-Head post-test according to the age groups (8.1-10.5 years and 10.6-11.9 years), meaning that those aged between 10.6-11 ,9 years old (m=21.57; ds=5.80) registered higher scores for spatial orientation in the post-test than the 8.1-10.5-year-old age group (m=18.89; ds=5.29), according to t=2.710; df=88.32; p.008; d-Cohen=.48. These values that can be seen in the following table:

Table 3. The t-test for the Piaget Head exercise

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Piaget Head-after	Equal variances assumed	1.531	.218	-2.796	146	.006	-2.67244	.95572	-4.56126	-.78361
	Equal variances not assumed			-2.710	88.324	.008	-2.67244	.98607	-4.63194	-.71294

Group Statistics

	Age	N	Mean	Std. Deviation	Std. Error Mean
Piaget Head-after	8.1-10.5 y	99	18.8990	5.29824	.53249
	10.6- 11.9 y	49	21.5714	5.80948	.82993

There were statistically significant differences in the Bender-Santucci test according to age groups (8.1-10.5 years and 10.6-11.9 years). Children aged between 10.6-11.9 years (m=16.32; ds=6.52) registered higher scores for spatial orientation in the post-test than the age group 8.1-10.5 years (m=13.54; ds=6.40), according to t=2.536; df=94.28; p.013; d-Cohen=.43. These values can be seen in the following table:

Table 4. The t-test for the Bender Santucci exercise

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Bender Santucci-after	Equal variances assumed	.079	.779	-2.551	146	.012	-2.87199	1.12563	-5.09661	-.64736
	Equal variances not assumed			-2.536	94,288	.013	-2.87199	1.13238	-5.12026	-.62371

Group Statistics

	Age	N	Mean	Std. Deviation	Std. Error Mean
Bender Santucci-after	8.1-10.5	99	13.4545	6.40675	.64390
	10.6-11.9	49	16.3265	6.52044	.93149

Hypothesis 3

The gender differences according to the results of the scores obtained in the spatial orientation tests, were not statistically significant at the level of the Piaget-Head Test (M-W=2457.0; p=0.29). The Bender-Santucci Test also did not register statistically significant difference between the two groups (M-W=2685.50, p=0.86). These results can be confirmed in tables 5 and 6:

Table 5. Gender Difference in the Bender Santucci Exercise

Test Statistics[a]	
	Bender Santucci
Mann-Whitney U	2685.500
Wilcoxon W	5766.500
Z	-.171
Asymp. Sig. (2-tailed)	.864
a. Grouping Variable: Gen	

Table 6. Gender Difference in the Piaget-Head Exercise

Test Statistics[a]	
	Piaget Head
Mann-Whitney U	2457.000
Wilcoxon W	4942.000
Z	-1.051
Asymp. Sig. (2-tailed)	.293
a. Grouping Variable: Gen	

Discussion

In this study, students in the experimental group scored significantly higher in one of the two space orientation tests, compared to the control group. Contrary to this, a research claims that, compared to teenagers, children between the ages of 10-12 are not as competent in orienting themselves in space, showing a delay in completing the task (Murias, 2019). This shows that although most children of this age develop many of the cognitive skills necessary for successful spatial orientation (Bullens et al., 2010; Negen & Nardini, 2015), increased neural activity in brain areas associated with visual-spatial processing is evident (Liu et. al, 2011). This finding supports the fact that children improve and refine their visual and spatial abilities as they grow older. In addition, another relatively recent study (Costa et al., 2015) confirms that body fat percentage and physical activity level seem to be related to children's cognitive function, an aspect that has also been reported by others (Li et al., 2008; Yu, 2010), as well as to academic performance (Shore et al., 2008),

implying that the outcome of the first two hypotheses of the study could be influenced by these aspects. However, the results of the present study are consistent with previous studies that investigated the effects of a psychomotor program on preschool children's gross motor skills, including spatial orientation (Alesi et al., 2014; Hestbaek et al., 2017).

The context of the results of hypothes 3 lead in contradictory directions compared to other studies that demonstrated that while boys and girls do not differ in terms of general intelligence levels, there were gender differences for more specific cognitive abilities such as the ability of space-temporal orientation (Reilly, Neumann and Andrews, 2017). The results wer particularly favorable for the male gender (Voyer, 2017). Thus, a study focused on mental rotation found a significant gender difference: a small advantage of the male gender in mental rotation performance (Contreras, Rubio & Pena, 2007). While a gender-favoring effect in adults' mental rotation performance is a topic more often found in studies, the respective gender effect in children's performance did not appear in any of the literature (Lauer, Yhang & Lourenco, 2019). Few studies focused on age categories under 10-12 years. However Fernández-Méndez et. al. (2018), was of interest after an experimental study that specified that an intervention that improves spatial ability, in children under the age of 10, could lead to the possibility of maintaining an equality between genders, as differences could only appear in adulthood. Consequently, a number of biological and environmental factors could be involved in explaining gender differences. Of course, more thorough research is needed, as these factors are unlikely to influence spatial orientation ability in children under the age of 10.

Conclusions

The intervention program through specific exercises had the expected effect, so that the differences between the experimental and control groups were highlighted in one of the space-temporal orientation tests. Regarding the second test, there were differences, but not significant. Furthermore, within this program, no gender differences were revealed in any of the tests. This was in contradiction with certain studies mentioned in "Discussions". Thus, after looking for some justifications, I assumed that a determining factor could have been represented by early age, a variable that was found in very few studies with samples under 10 years of age.

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THE RELATION BETWEEN PHYSICAL EDUCATION CURRICULUM TIME ALLOCATION AND OBESITY IN 6-10 YEARS OLD CHILDREN: A CROSS SECTIONAL STUDY

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ABSTRACT. Introduction: Overweight and obesity are major problems in our society, because it's prevalence "among children and adolescents aged 5-19 has risen dramatically from just 4% in 1975 to just over 18% in 2016. The rise has occurred similarly among both boys and girls: in 2016 18% of girls and 19% of boys were overweight. While just under 1% of children and adolescents aged 5-19 were obese in 1975, more 124 million children and adolescents (6% of girls and 8% of boys) were obese in 2016" (WHO, 2021). **Objectives:** The aim of our research is to examine the relationship between the time allocated to physical education at school and overweight/obesity in 6-10 year old children on a global and continental level. **Methods:** Our study is a cross-sectional, population-based descriptive study. We used the data from the World-wide Survey of School Physical Education report published by UNESCO in 2013. We used BMI for the age group 6-10 years from the database published by the Global Burden of Disease Collaborative Network. The GDP data for the countries was taken from the database of the United Nations Economic Commissions for Europe. **Results:** In our study, we analyze data from 145 countries on six continents. The average time devoted to physical education in these countries is 95.6±35.0 minutes per week. The minimum is 30 minutes and the maximum is 225 minutes.

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The 90 minutes occurs with the highest frequency, 26 times. The median also shows the 90-minute value. Examining the results by continent, it is revealed that significantly more time is devoted to school physical education in Europe than in Africa (p=0.020) and Asia (p=0.022), but there is no significant difference between the average of the other three continents and Europe. A Spearman's rank-order correlation was run to assess the relationship between GDP and physical education time allocation. One hundred forty states were included in the analysis. There was a weak positive statistically significant correlation between GDP and physical education time allocation, $r_s(128) = .298$, $p < .001$. **Conclusions:** The amount of time devoted to physical education at school shows a wide variation from state to state. The time allocated to physical education at school is 95.6 minutes on average. Europe and Australia/Oceania are the two continents where the most time (about 110 minutes) is devoted to physical education per week. We did not find a relationship between the time devoted to physical education at school and the frequency of obesity or overweight.

Keywords: *obesity, overweight, physical education, time allocation.*

Introduction

Regardless of whether physical exercise is done at school, in an organized setting or in unorganized circumstances outside of school, it has an effect on both our physical and mental state (Andermo, et al., 2020). As professionals, we are used to highlighting and mentioning the positive effects, but we must be aware that, in some cases, the participants can also have a negative effect (Elbe, Lyhne, Madsen, & Krustrup, 2019). A detailed analysis reveals that School-related physical activity interventions may reduce anxiety, increase resilience, improve well-being and increase positive mental health in children and adolescents (Andermo, et al., 2020). According to the Physical Activity Guidelines Advisory Committee (2018), "regular physical activity can help children and adolescents improve cardiorespiratory fitness, build strong bones and muscles, control weight, reduce symptoms of anxiety and depression, and reduce the risk of developing health conditions such as: heart disease, cancer, type 2 diabetes, high blood preasure, osteoporosis and obesity." Bailey et al. (2009) in a review study divide the impact of school physical education and sports activities on school-aged children into four categories: physical benefits, social benefits, affective benefits and cognitive benefits, presenting numerous studies examining each area.

In 2010, the CDC elaborated a comprehensive study entitled Association Between School-Based Physical Activity, Including Physical Education, and Academic Performance, the summary of which shows that "the results suggest that physical activity is either positively related to academic performance (50.5% of the associations summarized) or that there is not a demonstrated relationship between physical activity and academic performance (48% of the associations summarized). In addition, increasing time during the school day for physical activity does not appear to take away from academic performance" (p. 28). These results are supported by other review studies (Rasberry, et al., 2011).

From a world-wide survey of school physical education by the UNESCO it is revealed that "there is an average 97 minutes weekly (range of 25–270 minutes); in the secondary school phase, there is an average of 99 minutes weekly (range of 25–240 minutes)" (p. 25). More time is spent on school physical education in North America (107-125 minutes), Europe (109-105 minutes) and Oceania (111-100 minutes).

Overweight and obesity are major problems in our society, because it's prevalence "among children and adolescents aged 5-19 has risen dramatically from just 4% in 1975 to just over 18% in 2016. The rise has occurred similarly among both boys and girls: in 2016 18% of girls and 19% of boys were overweight. While just under 1% of children and adolescents aged 5-19 were obese in 1975, more 124 million children and adolescents (6% of girls and 8% of boys) were obese in 2016" (WHO, 2021). "Global age-standardised prevalence of obesity increased from 0.7% (0.4–1.2) in 1975 to 5.6% (4.8–6.5) in 2016 in girls, and from 0.9% (0·5–1·3) in 1975 to 7.8% (6.7–9.1) in 2016 in boys; the prevalence of moderate and severe underweight decreased from 9.2% (6.0–12.9) in 1975 to 8.4% (6.8–10.1) in 2016 in girls and from 14.8% (10.4–19.5) in 1975 to 12.4% (10.3–14.5) in 2016 in boys. Prevalence of moderate and severe underweight was highest in India, at 22.7% (16.7–29.6) among girls and 30.7% (23.5–38.0) among boys" (NCD Risk Factor Collaboration, 2017, p. 2627).

Objectives

The aim of our study is to examine the relationship between the time allocated to physical education at school and overweight/obesity on a global and continental level.

Methods

Our study is a cross-sectional, population-based descriptive study. In the statistical analysis, we used data from UNESCO's World-wide Survey of School Physical Education published in 2013. From this, we obtained data on

the time allocated to school physical education for nearly 150 countries. We used BMI for the age group 6-10 years from the database published by the Global Burden of Disease Collaborative Network (2017). The GDP data for the countries was taken from the database of the United Nations Economic Commissions for Europe.

Results

In our study, we present data from 145 countries on six continents. The average time devoted to physical education in these countries is 95.6±35.0 minutes per week. The minimum is 30 minutes and the maximum is 225 minutes.

Table 1. Time allocation for physical education by continents

Continent	Number of countries [N]	Time allocation for P.E. [min]	Minimum value [min]	Maximum value [min]
Africa	40	87.0±37.4	30 (Algeria)	225 (Ethiopia)
Asia	32	85.8±28.6	35 (Pakistan)	180 (Bangladesh)
Australia	5	111.4±49.8	60 (Samoa)	185 (Papua New Guinea)
Europe	43	110.9±33.1	50 (Cyprus)	220 (France)
North America	15	93.6±32.1	40 (Belize)	183 (Cuba)
South America	9	90.2±29.3	35 (Paraguay)	135 (Chile)
Total	144	95.6±35.0		

The 90 minutes occurs with the highest frequency, 26 times. The median also shows the 90-minute value. Examining the results by continent, it turns out that significantly more time is spent on school physical education in Europe than in Africa (p=0.020) and Asia (p=0.022), but there is no significant difference between the average of the other three continents (Australia, North and South America) and Europe.

A Spearman's rank-order correlation was run to assess the relationship between GDP and physical education time allocation. One hundred forty states were included in the analysis. There was a weak positive statistically significant correlation between GDP and physical education time allocation, $r_s(128) = .298$, $p < .001$.

Examining the relationship between GDP and physical education time allocation by continent, the significant correlation remains only in the case of Asian countries, $\tau_b = .255$, $p = .048$.

Over the last 40 years, data on overweight and obesity show a strong increasing trend, regardless of whether it is children or adults (Ng M, 2014). As

the first Figure shows, there are large differences in both obesity and overweight indicators even within European countries. While only 6-7% of children are obese in the Republic of Moldova and Switzerland, it reaches 20% in Italy and Greece.

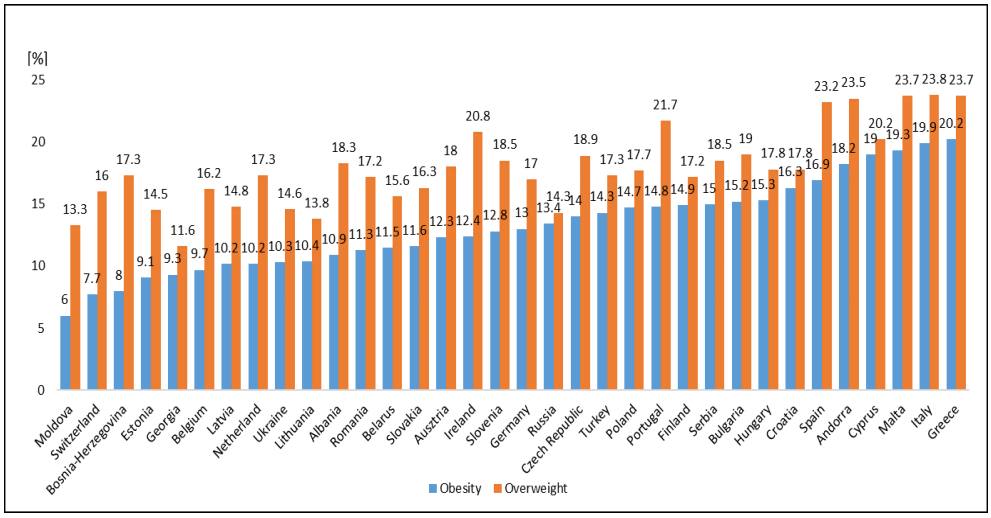

Figure 1. *Prevalence of overweight and obesity in children in 38 European countries*

At the global level r_s (141) = .141, p = .095, as in Europe r_s (40) = .110, p = .501, we did not find an association between the time devoted to physical education at school and the indicators of obesity or overweight. The connection was not found for any continent. Spearman's rank correlation shows a negligible relationship between the time devoted to physical education and the frequency of overweight/ obesity in the case of boys, r_s (141) = .175, p = .038. In European countries, 27.86±5.81% of the examined sample is overweight and 10.65±3.00% obese on average, while in Africa this proportion is 13.64±7.31% and 4.57±4.33%, respectively. Based on these data, the independent sample t test establishes a significant difference, t(78)= 8.842, p =0.000. It is worth noting that while in Europe the overweight indicators are closely followed by the obesity indicators in each country (for example, in the case of Italy, 23.8% are overweight and 19.9% are obese, which means a difference of 3.9%), while in the case of African countries it is up to 3-4 times the proportion of obese compared to overweight is lower. Taking Tunisia as an example, the rate of overweight children is 24.5%, while that of obese children is 8.8%. This trend can be observed in almost all African countries, regardless of population size. In Asia, a large deviation can be observed in the data of the 32 countries included in the analysis. At one extreme, we find countries where the frequency of overweight and obesity

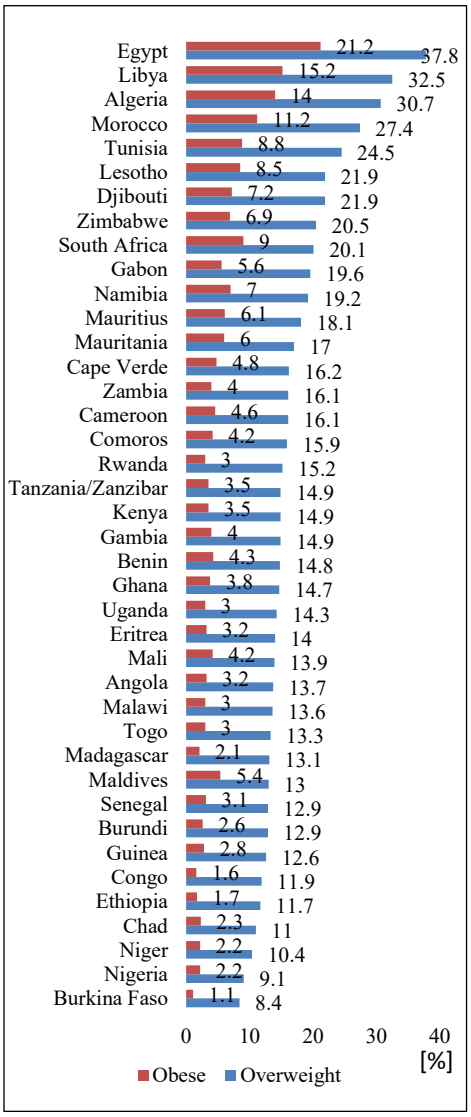

Figure 2. *Prevalence of overweight and obesity in children in Africa*

barely reaches 8-10 percent, while at the other extreme, the frequency of these children is 62-63 percent. It is not surprising that in the case of countries with a higher GDP (for example: Kuwait, Qatar, United Arab Emirates, Bahrain) we find a higher frequency of overweight and obesity. When examined at the global level, we can measure a strong correlation between the GDP of the countries and the frequency of overweight/obesity, $r_s(138) = .727$, $p = .000$. If examined by continent, the strongest correlation was measured in Asia $r_s(31) = .852$, $p = .000$, and the weakest in Europe $r_s(39) = .415$, $p = .009$. We find a significant difference between boys and girls on a global level, 8.67±5.37 percent of girls can be classified as obese, and 10.51±6.83% of boys, $t(280)=2.515$, $p=0.012$. Regarding overweight, we found no significant difference between the two sexes, 23.38±13.01% for boys and 22.83±10.36% for girls, $t(286)=0.398$, $p=0.691$. Analyzing the data by continent, we can reveal some interesting facts. In Europe, there are significantly more overweight and obese boys than girls $t(84)=2.906$, $p=0.005$. However, Europe is the only continent where we find significant differences between the two sexes in both categories. In North America, both boys and girls have high rates of overwseight and obesity. About 32% are overweight and about 14% are obese.

In South America and Asia, we find a difference between boys and girls, but this is not statistically significant. Africa is the only continent where the reverse trend prevails. Significantly more girls are overweight $t(78) = - 3.786$, $p = 0.000$ than boys (16.86±6.31% - 10.42±8.71%), likewise more girls are obese

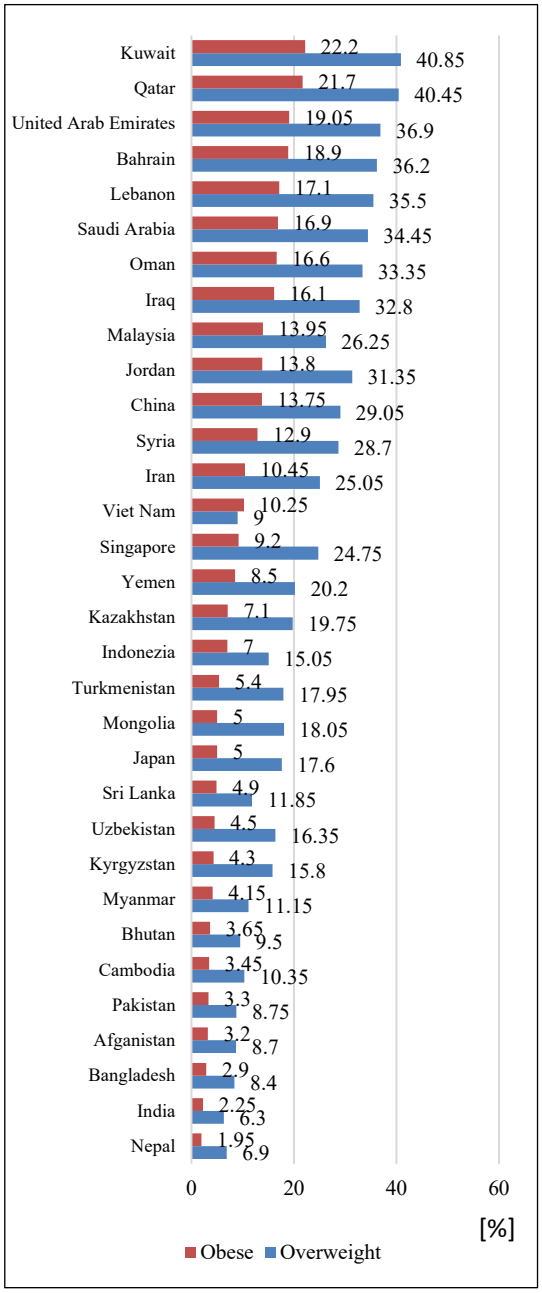

Figure 3. *Prevalence of overweight and obesity in Asia*

than boys, however the difference observed here is not statistically significant, t(78) = -1.511, p=0.135.

Discussion

For many decades, the complications of smoking were the leading cause of death (Banks, et al., 2015; Kuibao, et al., 2016). Today, it is considered that this is no longer true and most of the complications are due to obesity (Abdelaal, le Roux, & Docherty, 2017). Overweight and obesity are physical conditions that are caused by many factors. The two most common reasons would be bad eating habits and lack of exercise, but there are many other reasons that contribute to a greater or lesser extent. Hormonal disorders, sleeping habits, working conditions, mental state, etc (Hruby, et al., 2016). Just changing the time allocated to physical education at school will not necessarily significantly reduce the proportion of children struggling with overweight or obesity. Although the beneficial effect of regular physical exercise on health is indisputable, in order to reach an optimal level, regarding body weight, fitness level and well-being, in many cases it is not only a result of the time allocated for physical exercise, but also a specific lifestyle change, which may include our nutrition, rest and recreation habits (Reiner, Niermann, Jekauc, & Woll, 2013; Warburton, Nicol, & Bredin, 2006). Our analyzes also show that there is no connection

between the time devoted to physical education and the frequency of overweight/obesity.

Globally, the time devoted to physical education has decreased significantly in the last two decades. While around 2000 the average in Primary school was 116 minutes and in Secondary School 146 minutes, in 2007 it was 100 and 102 minutes respectively, and around 2013 it was 97 and 99 minutes respectively (UNESCO, 2013). These data fall far short of the recommendations derived from specific experimental research (150 minutes per week/at least 30 minutes per day). Africa and Asia are the two continents where the least amount of time is provided for physical education, on average barely exceeding 85 minutes per week. And most are allocated to physical education in Australia/Oceania and Europe.

It has long been known that people struggling with overweight and obesity are more common in more economically developed countries (Talukdar, Seenivasan, Cameron, & Sacks, 2020). This was also confirmed by our calculations, for all six continents.

In general, more boys are overweight and obese than girls. The exception to this is Africa, where the trend is reversed at the continental level (Adeboye, Bermano, & Rolland, 2012).

Conclusion

The average time devoted to physical education in the examined countries is 95.6±35.0 minutes per week. The minimum is 30 minutes and the maximum is 225 minutes. 90 minutes occurs with the greatest frequency. Significantly less time is devoted to physical education in schools in Asia and Africa than in the other four continents. A weak positive relationship can be discovered at the global level between the economic development of countries and the time devoted to physical education.

If we examine this relationship at the continental level, only Asia has a significant relationship between the two variables. The frequency of overweight and obesity shows large differences at the continental level. We come across cases where the combined frequency of the two categories barely reaches 10% (Nepal, India, Nigeria), but within the same continent this indicator can be as high as 60% (Egypt, Kuwait, Qatar). In the case of African and Asian countries, the frequency of overweight is mostly between 10-20% (with a few exceptions), while the frequency of obesity is roughly three times less than that of overweight. In the other continents, the gap between the prevalence of overweight and obesity is much smaller. In general, it can be stated that the frequency of overweight and obese children is significantly higher in economically developed countries than in less developed countries. This trend can be observed on all continents.

Limits of the study

The data used in the statistical analysis come from a reliable database, however, these are estimated values and not representative measurements across countries. The average values obtained for the continents may be distorted by the values of countries with large or small populations, since the data were not weighted depending on the number of the country's population.

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FROM YAMABUSHI TO MODERN PSHYCHOLOGICAL TRAINING IN THE MARTIAL ARTS

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ABSTRACT. Yamabushi were forest spirits who lived in the regions of Japan. They did not lead their lives in urban agglomerations, and appeared around monasteries or on mountain paths. They mostly posed no danger to humans, intervening in the lives of martial arts masters, providing them with secret fighting techniques. They had a more psychological training role, which led to exceptional results for the history of martial arts. After the fall of the samurai class and the secular development of Japanese society, these spirits of the forests will be replaced by psychologists, who will try to bring superior performance to the work of martial arts athletes. Using hypnosis, manipulations of the human psyche, but also of the masses, methods of eliminating emotions, up to their annihilation, many countries resorted to high-level psychologists, whose aim was to train an athlete from the point of view psychologically, incapable of being tributary to emotions. With all the methods used, some even taken from the field of military psychology, the athletes' results were not superior to the majority. Not all athletes managed to overcome all their obstacles, some, instead, failed completely, their lives were changed forever, being unable to adapt to the society in which they live. The studies below represent a series of research in the field of psychology of martial arts, with updated data at the time of writing the article.

Keywords*: Yamabushi; judo, martial arts, ninjutsu; hypnose; manipulation of the masses; handling the individual; the Autogenic Training Schutz, ronnin.*

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Introduction

Throughout the history of Japanese martial arts, but also in other regions of the Far East, there have been numerous practitioners of martial arts. The most famous remain the samurai, and in China, the fighters from the Shaolin Monastery. We do not know exactly what the samurai training methods were, since they were transmitted in code, in the form of Kata (Barbos, 2014), but we have numerous writings that relate the meeting of samurai, but also of ronnin (former samurai left without masters), with various strange creatures, half-man-half-bird or animal, whom the people called forest spirits (*Yamabushi*).

Although repulsive at first glance, with asymmetrical features, and even fear-inspiring, the Yamabushi were forest spirits that did not harm humans, but could, in certain situations, become a real danger to any human being. Yamabushi appeared at key moments in a martial arts practitioner's life, when the fighter wanted a real change in life, but the path to follow was unclear. Once present, they became the fighter's mentors and psychologists, giving him guidance and true psychological assistance, and never failed in their training, no matter how difficult that fighter was. With their help, a series of martial arts were born, some transforming into peaceful forms, in which the opponent is only immobilized, and not killed.

After martial arts are banned in Japan, starting from the 19th century, fighters become fewer and fewer, so are accounts of encounters with forest spirits. The Western world, based on strictly scientific knowledge, brings the art of war to sports forms, eliminating any military form of combat, but also any trace of mysticism and religion, and the first forms of entertainment are born.

Since any conflict, even a simulated one, involves mental stress, sports psychologists intervened, becoming memories of Yamabushi, taking over the role in the psychological preparation of the fighting athlete. Results for psychologists are expected after more than a hundred years of scientific studies related to the psychology of the human being. No psychologist has been able to take on the role of a Yamabushi, and the results are quite modest, even if they have used some of the most modern research methods.

Motivation of the study

The study started from the research of numerous documents related to the performances of samurai warriors, and which brought to light the fact that these fighters had a separate psychology from the mass population. Beyond physical performance, which can be shown to be related to genetic inheritance and the body's ability to adapt to numerous changes, what amazes the world of

science is the mental capacity to achieve exceptional performance. Their power to withstand extremely high stress situations, to the mental resistance to bear fights and long-term harassment, without having benefited from a science of psychology or some psychologist.

The studies conducted, some already published, tried to explain what exactly made Yamabushi superior to a reputed psychologist specializing in military psychology. Why did a samurai, after training with a forest spirit, and being subjected to numerous war conflicts, not suffer from post-war traumatic syndrome? What was actually at the basis of the samurai's performance, and why does the sports or military psychologist fail to detect it?

How the sports psychologist actually modified the athlete's behavior, along with the coach, to the point where the athlete became a form of manipulation under the strict control of the professional sports industry.

Theoretical framework

Who were the Yamabushi?

Yamabushi, were at first popularly known as yamahoshi, an isolated group of mythological beings who lived in the less traveled forests, or forests around monasteries in the mountains of Japan. These were actually human, and less mythological, beings who chose the "way of training and testing" or "the way to spiritual power through discipline" (*shugendō* a philosophical system with roots as far back as the Kōya Hijiri monks of the 8th and 9th centuries (*Picken, 1994*). The father of this religious movement was *En no Gyōja*, believed to have lived between 634-700/7, and who founded the Shugendō religion, a syncretism of Taoism, Shintoism, esoteric Buddhism (Shingon Mikkyō and Tendai sects) and shamanism traditional japanese (Blacker, 1999).

To understand the role of these characters, who will be considered mythology over time, the doctrine of this Shugendō religion must be understood, a doctrine taken over and assimilated by all members of the community.

According to this doctrine, (and we also find these ideas in other peoples outside the space of Asia), there are several worlds that coexist simultaneously with the world in which man lives. Even though they are separate, worlds outside our space repeatedly intervene in this earthly life. Those from the parallel world send their representatives to earth in the form of gods, and the most important are the Tantric Buddhist goddess Fudō Myōō, along with Dainichi Nyorai, by worshiping and observing the rituals required by the Buddhist Tantric goddess, man can obtain powers and performances out of common, which no ordinary man can achieve (Hitoshi, 2001).

These gods create their sacred places in the mountains, where believers practice rituals called "*mountain practices*" (*nyūbu shugyō*).

The ritual of practices in the monastery

The martial arts practitioner seeking enlightenment had to turn to the advice and practice of a Shinto priest, the Tao, and in the case of our study, a *kenja*, *kenza*, and *shugenja*, practitioners of the Shugendō religion. The fighter had to choose the period in which he wanted to be initiated at the monastery, and most of the time, he chose the spring period, the winter, being the most difficult period for such a ritual. He presented himself with a letter of recommendation, which he received from other masters who practiced in the Shugendō sect, and in its absence they brought offerings (*kuyōhō*) in honor of deities, flowers and recited various mantras (Hitoshi, 2001).

After the period of accommodation, the fighter was initiated into the esoteric part of the cult, called *shōkanjō*, and then followed the initiation into *genjutsu*, the mystical art of fighting and obtaining miraculous powers (walking on extremely sharp objects, passing through fire, or even resistance to boiling in oil, etc.) (Hitoshi, 1989). This practice would fascinate the entire world outside the Asian space to this day. The performance of these fighters exceeds anything known about the science of the human body. These performances will never be found in sports practices.

No fighter left the monastery without being initiated into the art of incantations (*kaji*), which would later be introduced into the Ninjutsu arts as a mandatory form of study, and ninjutsu schools would also introduce the learning of *fuju*, *majinai* methods from here, used for healing after injuries.

Yamabushi become mythological characters after many of the uninitiated come into contact with their special qualities. Uninitiated in the art of this religion, laymen have created hundreds of legends, presenting the half-man-half-bird, who haunts the forests, and sometimes initiates samurai or ronnin in the art of secret combat. They would be known as *sendatsu*, or spiritual mountain guides, and in other regions, *tengu*, whose deeds would become legends to this day.

All these initiations were aimed at achieving the highest performance, calling on psychological practice, which influences the application of combat techniques, but also survival in combat situations.

The emergence of modern psychology in the martial arts

The Japanese feudal system is abolished in the 19th century, a process that lasts almost 150 years. The warrior class was outlawed. What remains of Japanese combat systems are beginning to be abandoned, but on the other

hand, efforts are being made to preserve them. The only way this could be done was by transforming it into a sporting form, as would happen with the systems of *kenjutsu*, which would become *kendo* (Ozawa, 1997).

Over time, the competition becomes such a powerful financial form that it turns into a profitable industry that will change the lives of millions of athletes. In order to continuously perform, the human body is exploited to the maximum, using the most bizarre psychological methods in preparation. Many of them will be transferred, upon abandoning the sports career, in the manipulation of the groups of which the athlete will be a part.

Hypnosis

The term hypnosis appears only in 1820, when Étienne Félix d'Henin de Cuvillers, takes the term from the Greek language (hypnos = sleep), and defines it as a state of nervous sleep. Starting from 1857, this practice is embraced in the circles of European high society, along with spiritualism and other occult practices, so that later, it expands throughout the social space, and of course, also in the world of sports psychology (Hartman, 2000).

Among the first countries to use hypnosis to enhance sports performance was Russia, which, beginning in 1956, employed 11 psychologists specializing in hypnotic techniques to train the Russian Olympic team for the Melbourne Olympics. The result was that the Russian team got the most medals. The methods used by these hypnotists were not only limited to improving sports performance, but also to changing their behavior (Paccagnella, 2004*)*.

Martial arts, which have become sports, resorted, in addition to hypnosis, to manipulations by trainers, with the aim of transforming the athlete into a being capable of fighting without any emotion, any human empathy. Japan has been accused in both judo and 22 other sports of using abusive training methods, which include beatings with the kendo stick, using the sword (Katana), holding children's heads under water to simulate drowning. The Association of Parents of Judo Accident Victims in Japan sued clubs and training centers because between 1983 and 2012, at least 110 died during training (Japan, 2011).

Manipulation and anguish is another method used to induce athletes to continue their sporting activity. These interventions, with the aim of strengthening the self, actually transform the athlete's behavior into a selfish one, and not infrequently, when they reach leadership positions, the athlete uses numerous methods of influence, through emotional blackmail of subordinates, only to maintain its leadership status.

The technique of autogenic training developed by Schultz (Nelson, 1998) is day present in all martial arts training. The athlete is taught that he is able to modify his own behavior through proper concentration. In many situations, psychologists advise athletes to endlessly suggest to themselves the idea that

they are so perfect and special that after hundreds of sessions, both their thinking and behavior change. Over the years, they are unable to adapt in a democratic society, becoming dictatorial leaders, convinced that they are the most important personalities of the time, misunderstood by those around them.

In many situations, martial artists do not respond immediately to hypnosis programs or Schultz autogenic training. This is a normal subconscious reaction, and the coach and therapist begin to intervene through methods much more difficult for the athlete to control, called projection (Rosenthal, 2017).

Following the methods of sports training for a martial arts competition, the athlete who has reached the competitive evaluation phase actually highlights the physical training, because his emotional reactions get out of control, and his displays of anger and aggression towards those around are hard to control (Reynes, 2004).

Discussions and conclusions

The performances achieved by yamabushi practitioners can never be achieved by any martial arts athlete as long as he does not practice the methods existing within this sect or other Asian religious systems. The goals of the two categories of practitioners are different. While traditional Asian training systems are based on attaining the state of *Enlightenment* without any other material compensation, sports forms strictly pursue material compensation and image in the society in which one lives. To reach the state of Enlightenment, the martial arts practitioner would go through the *Brahmajāla Sūtra*, a form of 10 mandatory rules, which are aimed at forming morals before benefiting from fighting techniques (Kumārajīva, 1981).

The intervention of psychologists beyond professional ethics, as happens in many countries with an authoritarian regime, transforms, in many cases, the athlete's behavior in a negative way, bringing him to the stage where he is unable to fit into a social system , and where he establishes himself, he reveals an authoritarian personality, who emotionally blackmails his subordinates, resorts to methods of physical and psychological manipulation, eliminating any supposed competition around him (Stark, 2007).

The sports industry, the numerous giant companies, the mass media and some symbols related to material gains, completely cancel the moral values of religions, secularizing the entire human existence. The methods used by Buddhist, Taoist, Shinto monks, etc, in order to achieve exceptional physical and mental performances, do not find their place in the world of sports. Religious practices in sports are considered mysticism, and eliminated. The athlete's positive moral values develop in favorable social contexts, and only if mentors give them this chance.

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SPORT PERFORMANCE IN DANCE – A SYSTEMATIC REVIEW OF THE METHODS USED IN PHYSICAL CONDITIONING TRAINING

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ABSTRACT. To assist academics and coaches to better understand dance and the training methods, a literature review of all pertinent articles was conducted. Although it has been proposed that dancers should add strength training into their regimen, many dance institutions are either hesitant to do so or lack the resources or knowledge necessary to do it. It has been suggested that dancers are hesitant to engage in strength training because they are concerned about muscular hypertrophy and the potential effects it may have on dance aesthetics. However, recent study has indicated that this might no longer be the case and that attitudes toward strength training are changing, especially among dance students and professionals. We conducted a search into multiple database (PubMed, Google Scholar, ScienceDirect) to gather the most important research articles to achieve our purpose. Our key word for this search was: strength training, plyometric training, dancers, ballroom, resistance training. The inclusion criteria were as follows: healthy subjects (male or female) who participated in a type of supplementary training, articles no older than year of 2000. Exclusion criteria: ballet dancers, injury related articles, elderly participants.

Keywords: *ballroom dancing, training methods, strength, dance sport*

Introduction

Given the physical requirements and artistic talent needed for performance, dancers are sometimes referred to as athletes that compete on aesthetic (Ambegaonkar, Caswell, Winchester, Caswell, & Andre, 2012).

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Historically, dance has placed more of an emphasis on aesthetic aspects, with particular attention paid to execution, movement quality, and vocabulary, especially in modern dance and classical ballet (Yiannis Koutedakis et al., 2007), than on the necessity to develop the physiological systems to satisfy choreographic demands. Additionally, it has been argued that strength is not necessary for a successful dance career and that dancers frequently view fitness as the lack of injury rather than as an essential component of dance training (Koutedakis, Stavropoulos-Kalinoglou, & Metsios, 2005).

Sports dance consists of a series of steps and figures executed with a high degree of technicality and an artistic technicality and an artistic element of considerable complexity and coordination between the two partners, put together on a musical accompaniment unique to each dance. Sports dance reveals by the perfection of its steps a world of symbols, a gesture loaded with significance, which obeys the most subtle laws of biomechanics. Steps and dance movements are arranged in choreographies based on musical cues, spatial and temporal coordinates, and the presence of several partners on the dance floor (Adam, Simion, & Iconomescu, 2018).

While the majority of dance practice involves strenuous physical activity and has been shown to improve physical indicators, it is unclear if dancers would benefit from additional training (L. Bernardo & E. Nagle, 2006; Brown, Wells, Schade, Smith, & Fehling, 2007; Roussel et al., 2014).

Numerous dancers participate in several types of supplemental training, such as Pilates strength and plyometric exercises. Despite supplemental training's increasing popularity among dancers, there are a dearth of impartial studies evaluating the effectiveness of these on dance performance (Farmer & Brouner, 2021; Koutedakis et al., 2005).

Strength training has historically been thought to be unpopular among dancers owing to the misconception that it will drastically increase muscle size and detract from the dancer's body's attractiveness. However, with the rise in choreographic requirements, these attitudes regarding further training and the requirement to enhance some areas of physical fitness to satisfy these requirements start changing (Twitchett, Koutedakis, & Wyon, 2009).

Another form of training that dancers use is core stabilization training and vibration training. Numerous studies have shown that core stabilization training and vibration at a specific frequency improve the height of the high jump and increase the range of motion (Marshall & Wyon, 2012; Wyon, Guinan, & Hawkey, 2010).

Studies in dance styles other than ballet are few, according to academics in dance health and science (Bria et al., 2011; Kostic, Zagorc, & Uzunovic, 2004). To help coaches and trainers in better understanding competitive dance sport

and recreational ballroom and Latin dancers, the main goal of this study was to locate all pertinent dance sport literature. The subject of how supplemental training affect dancers' objective physiological parameters and their ability to perform in a functional manner is still open despite mounting evidence to the contrary. This systematic review's objective is to examine how different training methods used by dancers affects their performance.

Methods

Search strategy

Two researchers conducted a search of articles on the topic. The following databases were used to collect the required articles: PubMed, Google Scholar, ScienceDirect. The keywords used to identify the required articles were ballroom dancing, training methods, strength, dance sport, resistance training, weight training vibration training.

Selection of the studies

The researchers searched the databases individually by reviewing the titles and abstracts of relevant articles. Relevant titles were those that indicated that the authors studied the effect of a type of supplemental training. Each research had to state that they looked at a certain functional measure for the article to be considered for this review, even though the type of measure and the technique of evaluation varied from study to study.

Inclusion criteria

All articles concerning the introduction of a type of training, other than specific training, in the training of dancers have been included. Articles whose results were compared with another control group or where pre- and post-intervention testing was performed. Initial interest was directed towards dance sport; however few articles were identified that address the issue of fitness training with non-specific means. Thus, to have a solid base of information we also turned our attention to articles that address modern and contemporary dance.

Results

The initial search included 5896 articles (Figure 1). All duplicate articles were eliminated in the first stage (n = 241). Afterwards articles that did not meet the criteria set in the search engines (e.g., articles older than 2000, engineering

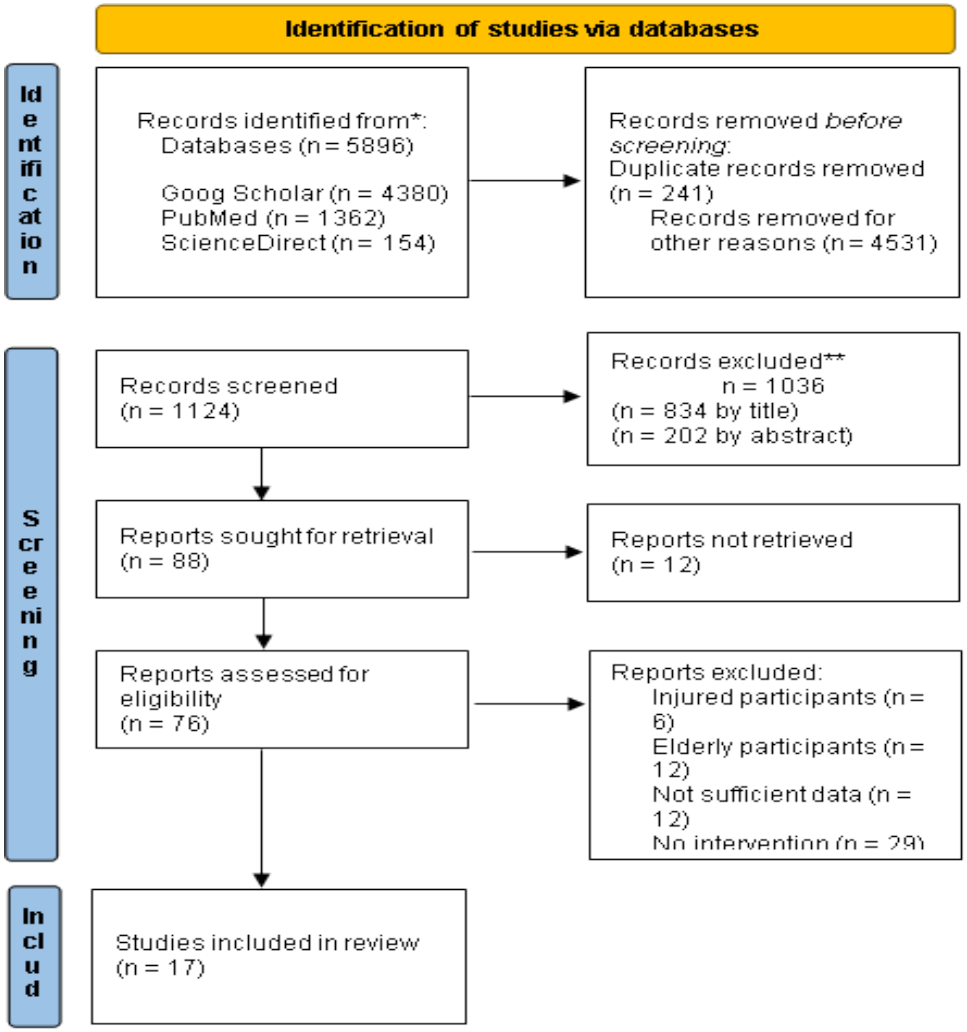

Figure 1. *Prisma diagram for included studies*

or art topic, or newsletters) were excluded (n = 4531). The screening phase included a total of 1124 articles from which 834 articles were excluded by title and 202 articles by abstract analysis. The next step was to search for full text articles to study in full (n = 88). A total of seventy-six articles were assessed for eligibility, of which six were excluded having subjects who suffered injuries. Twelve articles did not provide sufficient information on testing, twelve articles had an elderly population, and twenty-nine articles did not apply any intervention method. The remaining items (17 articles, Table 1) were catalogued according

to the additional training method(s) introduced into the dancers' training. The topics were as follows: resistance training, strength training, Pilates, stretching, plyometric training, aerobic training, or whole-body vibration.

Pilates, stretching and stabilization exercises

To attain balance and body awareness, Pilates is a mental exercise regimen that involves breathing and movement. This workout program is made to be utilized with unique equipment. Particularly among professionals, dancers are probably one of the few that receive Pilates instruction continuously throughout their careers, from childhood to performance or even beyond (Bernardo & Nagle, 2006). Due to its ease of use and low risk of tissue damage, stretching has merged as the most popular technique for improving range of motion (Marshall & Wyon, 2012). It puts pressure on the actin-myosin link, increasing the lengthening of the muscle's inactive components, which in turn lengthens the muscle at rest (Wyon, Smith, & Koutedakis, 2013). The capacity to manage body posture to create proximal stability is referred to as core stabilization. This ensures the transmission and control of force to the distal parts of the body for maximum force generation (Kibler, Press, & Sciascia, 2006).

Ahearn, Greene, and Lasner (2018) conducted research on how additional Pilates exercise (on mat and at apparatus) will influence posture, strength, and flexibility on dancers. After 14 weeks of Pilates exercises done twice a week all the participants had fewer postural misalignments compared to initial testing. Also, their flexibility increased at the level of hamstrings and iliotibial band and strength improved on the lower abdominal muscle ($p < 0.05$).

Kalaycioglu, Apostolopoulos, Goldere, Duger, and Baltaci (2018) combined Pilates training with core stabilization training. At the end of 8 weeks of interventions the authors observed statistical differences for the vertical jump. Dancers' results for posteromedial and posterolateral dynamic balance were significantly different ($p < 0.05$). In this study, in comparison with that made by Ahearn et al. (2018) there was no significant improvement on flexibility at the final testing. Furthermore, the authors observed a significant reduction in peak torque values of left hip flexor muscle group ($p > 0.05$).

In a study realized by Zhang, Ma, Liu, Smith, and Wang (2021), the authors were able to observe that following a 10-week additional training program consisting of static and dynamic balance exercises, participating subjects improved their YBT performance ($p<0.001$). In comparison to the baseline, the experimental group likewise saw a considerable decline in the double-leg floor's average errors at the Modified-Balance Error Scoring System. Also comparing the results of the experimental group with those of the control group, the authors could observe significant differences between them in M-BESS ($p = 0.031$ for tandem floor and $p = 0.038$ for tandem foam).

Pessali-Marques et al. (2020) analyzed the effect of stretching on the hamstrings using EMG assessment. Comparing the effects of constant torque stretching on a group of dancers with those of non-dancers, the authors observed that the former group recorded higher ROM values after the protocol was applied. Additionally, these findings imply that submaximal stretching intensity—defined as the point at which hamstring tension significantly increases—is adequate to promote flexibility in dancers more efficiently than in non-dancers.

Comparing the results of two groups (G1 - low intensity stretching and G2 - moderate-intensity or high intensity stretching), Wyon et al. (2013) observed that both methods produced significant changes in passive ROM. Although the values were close at the time baseline, the final test values were higher for the low intensity stretching group (left leg - 144 ± 22.5 degrees, right leg - 148 ± 14.66 degrees) in comparison with moderate or high intensity stretching group (left leg 133 ± 15,97 degrees, right leg 141 ± 6,72 degrees). Analyzing the results of the active ROM, low intensity group achieved significantly improved values after the application of the training program ($p < 0.05$). In the case of the moderate or high intensity group, although the values were improved (from 76° to 88° for right leg and from 79° to 81° for left leg) differences were not significant after intervention. The authors concluded that low-intensity stretching is preferable than moderate-intensity or high-intensity stretching for enhancing active and passive ROM.

Strength, resistance, and plyometric training

Mistiaen et al. (2012) conducted research where they evaluate physical fitness before and after 6 months of endurance, strength and motor control training on professional dancers. They found that after they participated on the program, dancers significantly improved their aerobic power index, and 75% VO_2 and, decreased their BMI. In contradiction with this finding Roussel et al. (2014) observed no difference on maximal workload, VO_{2max} and standing board jump. In a study realized by Dowse, McGuigan, and Harrison (2017) after nine week resistance training program implementation the subjects involved significantly improved their maximal strength (from 936.54 N to 1092 N, $p = 0.001$). As far as power in squat jump and countermovement jump is concerned, although increases in values were recorded at the time of the final testing, the differences between the means were not significant. However, subjects recorded statistically significant improvements on the subjective evaluation scale in terms of dance performance, control, spatial skills, accuracy and overall performance. In accordance with this study Stošić et al. (2019) found that a 10-weeks exercise program for strengthening the muscles of the torso and legs can improve

significantly explosive power values. They concluded that traditional dance training methods without supplementary exercises lack the extra training stimulus that activities to strengthen the trunk and legs muscles offer.

In a study conducted by Yiannis Koutedakis et al. (2007) they observed that 3-month of aerobic and strength training can improve significantly VO_{2max}, flexibility and strength on left and right leg. The authors found that the control individuals' dance-only training regimen failed to produce any appreciable VO_{2max} alterations by the conclusion of the 12-week observation period. Additionally, it has been shown that cardiovascular adaptations to training rely on its intensity.

Plyometric training methods are used by athletes in various sports to develop their strength and explosiveness. It describes human movement in which an eccentric muscle contraction occurs quickly, followed by a concentric muscle contraction. Plyometric workouts help a muscle achieve its optimum strength as quickly as feasible. Power describes this combination of strength and speed (McNeely & Sandler, 2007).

Kerim, Senem, Kutlu, and Umid (2014) implemented a plyometric training program on a group of 14 dancers for a duration of 6 weeks. At the end of the program, the plyometric training group recorded significantly higher values for vertical jump and peak anaerobic power than the control group. The results of this study demonstrated that plyometric training increased vertical displacement and maximal power production in the countermovement jumping test due to either enhanced motor recruitment or neural adaptations by detecting significant differences for vertical jump and peak anaerobic power. These findings imply that additional plyometric exercises that concentrate on the lower body extremities are advantageous for improving the performance of dancers. The same effect of improving vertical jump height was observed by Brown et al. (2007) who compared the effect of introducing plyometric training and weight training for dancers. Plyometric training group resulted in higher vertical jump and leg press strength scores, whereas weight training resulted in significantly higher leg press, knee curl, and anaerobic mean power scores.

Body vibration training

Exercise research has paid a lot of attention to whole-body vibration (WBV) as a training method (Rehn, Lidstrom, Skoglund, & Lindstrom, 2007).

Wyon et al. (2010) conducted research investigating the changes that occur in vertical jump after exposure to WBV for a period of 6-weeks. Analysis by group showed that throughout the intervention period, the experiment group's jump height significantly increased in comparison to the control groups.

Marshall and Wyon (2012) evaluated subjects on countermovement jump and active range of motion after they followed eight sessions of whole-body vibration training. The intervention group trained twice a week maintaining a strict position for 30 second, in first 2 weeks and 40 seconds in last 2 weeks increasing the frequency of vibration from 35-Hz to 40-Hz. In comparison to the control group, the experiment group had a higher jump height and active range of motion for both legs at the end of the intervention.

Angioi, Metsios, Twitchett, Koutedakis, and Wyon (2012) implemented on their research, on 24 four collegiate female dancers, two methods of training circuit training that concentrated on local muscular endurance and vibration training that focused on power. In their study the control group reported decrements in almost all fitness components except aerobic fitness, while experiment group reported significant increased values for muscular power (11%), upper body muscular endurance (22%) and aerobic fitness (12%) ($p<0.05$).

Table 1. Studies included in the review

Author	Aim	Subjects	Measured parameters	Intervention	Results
Zhang et al. (2021)	To evaluate the efficacy of a ten-week training program on posture	21 couples from ballroom dance	Y-balance test and Modified-Balance error scoring system (M-BESS)	NMT (n=22) and control (n = 20). NMT group – had a ten-week program divided into three phases	NMT group displayed decreased error at M-BESS test ($p<0.05$) and Increased reach at YBT
Kuliś, Sienkiewicz-Dianzenza, and Stupnicki (2020)	To determine the effects of a regular training week cycle spanning six months on dancers' anaerobic endurance	8 couples of different dance styles aged 14-26 year performed	The group performed 8 sprints on 50m distance with 15 second recovery using a Polar Heart rate monitor	The group followed a weekly cycle training with 5 training	Velocities were improved at the final test result for both male and female subject ($p< 0.005$)
Pessali-Marques et al. (2020)	This study attempted to compare dancers to non-dancers in terms of how their hamstring muscles responded biomechanically to acute stretching	46 young males, 23 undergraduate students (ND) and 23 professional dancers	During each passive knee extension EMG analysis was conducted	Each participant had used the Knee Extension Test Device (KETD)	The torque and range of motion was greater on dancers then non dancers

Author	Aim	Subjects	Measured parameters	Intervention	Results
Stošić et al. (2019)	The purpose of this study is to examine how a ten-week modern and recreational dance training program, as well as exercises to strengthen the trunk and legs, affect the coordination and explosive power of female dancers in the student age group	54 subjects were assigned, of which 27 made up the experimental group who participated in an experimental exercise program and 27 the control group	Based on six tests, the participants' coordination was assessed (Side Steps, 20 Steps forward Twirling a Baton, Skipping the Horizontal Jump Rope, Turning in 6 squares, Hand-Foot Drumming and Agility test with a Baton)	The experimental group performed Hip Hop and Dancehall dances and trunk and leg muscle strengthening exercises 3 times a week for 90 min each. The control group had no additional forms of exercise other than regular daily activities	Results revealed statistical significance between the groups for two variables of explosive power at the univariate level ($p<0.05$) and five variables of coordination at the multivariate and univariate levels ($p<0.05$, $p<0.01$).
Ahearn et al. (2018)	This study aims to investigate the qualitative and quantitative benefits of Pilates training on pelvic alignment, strength, and flexibility in dancers	Twenty female dancers, aged 17 to 22	The subject underwent an AlignaBod posture screening, upper abdominal manual muscle test, double leg lower test, straight leg raise test, and modified Thomas test as part of the screening. Participants underwent screening, took part in dancing courses for 14 weeks without interruptions, and underwent screening again.	They attended a two-hour session on pelvic alignment, followed by 14 weeks of two weekly Pilates lessons, one on the mat and one on the equipment	No differences were shown between screening 1 and screening 2. Statistically differences were obtained between screening 2 and screening 3 when Pilates classes were introduced into training
Kalaycioglu et al. (2018)	The purpose of this study was to investigate at the way a core stabilization training (CST) program affected the ballet and contemporary dance performances of college-level dancers.	The research included twenty-four dancers between the ages of 18 and 24	Physical fitness parameters were evaluated such as vertical jump performance, flexibility, dynamic balance, coordination, proprioception, muscle, and hip flexion isokinetic strength measures	During eight weeks, core stabilization exercises were done for 45–60 minutes a day, three days a week	After CST statistically significant differences were observed on vertical jump, peak torque and hip flexor muscle

Author	Aim	Subjects	Measured parameters	Intervention	Results
Dowse et al. (2017)	The purpose was to determine how nine-week resistance training will affect lower body strength	12 dancers performing ballet and modern dance	Anthropometry measurement, Biodex Balance System assessment, countermovement and squat jump, isometric mid-thigh pull	Nine-week training program with two sessions each week including resistance training exercises	Significant differences were observed at peak torque and countermovement jump and squat jump
Kerim et al. (2014)	In this study, female college contemporary dancers' peak anaerobic power and vertical leap were examined in relation to plyometric training.	27 contemporary modern dancers were divided into two groups: the plyometric training group (n = 14) and the control group (n = 13)	Countermovement jump was used to assess vertical jump height and to calculate peak anaerobic power	Experimental group performed 2 sessions of plyometric training	Significant statistically difference was seen on both peak anaerobic power and vertical jump height
Roussel et al. (2014)	The purpose of this study was to observe if any supplemental training will improve aerobic capacity and explosive strength	44 Pre - professional dancers divided into two groups (Group A which received a conditioning program and Group B that received a health promotion program)	Subjects were determined BMI, aerobic capacity with electronically braked bike ergometer and standing broad jump	Group A fallowed a conditioning program with aerobic, strength and motor control training, and Group B had no other training regime	Supplementing training sessions with a conditioning program had no significant improvement on subjects
Wyon et al. (2013)	Was to assess the effect of 3 strengthening or stretching intervention on hip and lower limb	39 female dancers were randomly divided into three groups (G1 – strength training n=11, G2 – low intensity stretching n=13 and moderate intensity or high intensity stretching n=11)	All subjects were tested regarding active range of motion (AROM) and passive range of motion (PROM)	All groups fallowed a 6-week intervention as suggested by their specific target	Regarding PROM there was not observed any statistically differences between group. For AROM strength and low intensity stretch groups revealed significant improvement compared with moderate intensity or high intensity stretch group

Author	Aim	Subjects	Measured parameters	Intervention	Results
Angioi et al. (2012)	The purpose of these study was to observe the effect of supplemental training on fitness of contemporary dancers	21 female contemporary dancers were assigned into two groups (Exercise n = 12 and control n = 9)	Subjects were evaluated for body composition, muscular power, muscular endurance, and aerobic capacity	The exercise group performed twice a week one hour of circuit and vibration training	Control group registered decreased values on all fitness parameters. Exercise group revealed significant increased values
Marshall and Wyon (2012)	The purpose of this study was to investigate at how 4 weeks of WBV affected students studying classical dance in terms of jump height, active range of motion (AROM), and leg anthropometry	117 female dancers were random divided into control and intervention groups	Subjects performed a countermovement jump using Just Jump mat and AROM was assessed using a digital camera	Experimental group trained using WBV for 30 seconds position at 35Hz for 2 weeks and 40 seconds for other 2 weeks at 40Hz whereas control group caried normal exercises	AROM and jump height was significant improved for experimental group
Mistiaen et al. (2012)	The aim of this study was to assess the musculoskeletal injury rate and physical fitness in preprofessional dancers before and six months following an exercise program for endurance, strength, and motor control.	40 preprofessional dancers (38 females and 2 males)	A field test for explosive strength and a submaximal exercise test with continuous physiological monitoring were both used to assess physical fitness. To examine how fitness training affected body composition, anthropometric measures were obtained.	6-month supplemental training consisting in aerobic endurance exercises and local strength endurance	Physical fitness improved after the 6 months of additional training program ($P < 0.05$)
Lukić, Bijelić, Zagorc, and Zuhrić-Šebić (2011)	The purpose of this study was to show the importance of strength training on dancers' performance	49 sport dancers (25 female and 24 male)	Testing protocol consist in upper body lifting, throwing medical ball from laying down and jump from the spot		

Author	Aim	Subjects	Measured parameters	Intervention	Results
Wyon et al. (2010)	The purpose of this investigation was to determine how exposure to WBV training over a 6-week period affected vertical jump.	18 females undergraduate dance majors	Authors measured jump height, calf, and thigh circumference	The control group had a comparable isometric contraction stress whereas the intervention group underwent WBV at 35 Hz for 5 minutes twice weekly.	The results showed that the vertical jump height increased considerably ($p < 0.05$) more in the intervention group than in the control group following a 6-week intervention.
Brown et al. (2007)	The main purpose was to examine resistance training in comparison with plyometric training	18 female dancers	Authors assessed height of vertical jump and jump ability	The group was divided into three small groups (Plyometric n = 6, weight n=6 and control n=6)	No significant changes were observed for control group. Instead, it was observed improvement in jump height for the other two groups
Yiannis Koutedakis et al. (2007)	The aim for this study was to assess the effects of 12 weeks aerobic and resistance training	27 females' dancers and 5 male dancers	Authors measured body mass and technical dance measurement (TDM)	The group was divided into two: experimental who carried free weight training and control who practiced only dance	There was observed increased values of TDM for experimental group ($p<0.05$)

Discussions

In our study we tried to collect the most relevant studies that address the topic of physical training. As far as we know there are few publications that address physical training in this area.

According to some reports, dancers are afraid that doing ST will make their muscles bigger and compromise their bodies' ability to maintain the necessary beauty (Yiannis Koutedakis et al., 2007; Twitchett et al., 2009).

In their research Farmer and Brouner (2021) tried to find the perception of dancers about strength training. Although there is a fear in this category of athletes from their study it could be observed that both professional dancers and students totally agreed that strength training is essential for their performance. Their findings imply that, in contrast to teachers, dancers are aware of the

potential advantages of strength for both men and women and feel that it is crucial to their entire training. It has been suggested that the dance studio should maintain its current concentration on technique, artistry, and performance aesthetics, with conditioning taking place in distinct sessions. The function of dance teachers is primarily focused on technique, artistry, and performance aesthetics. The findings show that teachers do not promote ST to the same extent that dancers do, and they do not see the development of physiological traits like strength as being crucial to a dancer's growth.

In a review made by Girard, Koenig, and Village (2015) they found that the variety of ways the intended effect may be obtained when strength training with resistance is an advantage. In general, free weights, weight machines, kettlebells, etc., may be found in fitness centers, member gyms, and university gyms without a significant cash outlay. There are several strength training programs available that may easily fit into a dancer's schedule, and if the fundamentals of exercise technique are mastered, using weights, kettlebells, or machines on your own is simple. For dancers, strength training using free weights, machines, or kettlebells is a realistic choice.

Some of the articles collected gave us information on improving physical parameters such as strength, power or aerobic endurance.

Strength, resistance training, and plyometric training has been found to increase vertical jump height in countermovement jump or squat jump (Brown et al., 2007; Dowse et al., 2017; Kerim et al., 2014).

Strength training is positively correlated with improved subjective dance performance compared to non-strength training control groups in all studies that assessed the impact of strength training on a subjective dance performance measure. Although it is unlikely that strength training directly affects dance technique, it is logical to think that increased strength may give the dancer a stronger base from which to develop. Instead of concentrating on their ability to finish the movement, the dancer may be able to concentrate on improving their technique and artistry as a result.

It is not yet clear whether WBV can really help dancers in their training. Although some studies have analyzed the results and shown that the final measurement values have been improved Delecluse, Roelants, and Versheruen (2005) observed that there was no significant changes on jump performance, knee extensor and knee flexor strength. However, studies addressing WBV have shown that research participants have improved their active range of motion.

There is little evidence supporting Pilates' efficacy, and this scant evidence is due to the use of questionable research methodologies in the published studies. Researchers and practitioners believe that there needs to be more published research on the effectiveness of Pilates in both healthy and injured individuals

(Bernardo & Nagle, 2006). However, the research analyzed in this review showed that dancers who additionally practice Pilates record significantly improved values in terms of range of motion, height of vertical jump and peak torque on hip flexor.

Conclusions

The lack of studies carried out to determine the effect of introducing an additional form of training in the training of dancers is the reason for this research. Research on subjects needs to be carried out to determine the effects of different methods and practices.

The effectiveness of various training programs could be ascertained through well-designed studies that randomly assign subjects, use a control group, measure compliance with the study intervention, include covariates in the statistical outcomes, calculate power, and use valid and reliable methods to measure outcomes.

The scientific foundation of many skills developed and used in the dance profession can only be strengthened by such study.

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STUDY ON THE RELATIONSHIP BETWEEN GENDER AND ANXIETY IN TEAM SPORTS GAMES

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ABSTRACT. This study aimed to identify possible differences in competitive anxiety and whether there is gender variability. **Methods**: The study included a total of 118 female and male athletes aged 13-24 years from 3 sports: 62 football athletes (16-female; 46-male), 33 basketball athletes (16-female; 17-male) and 23 volleyball athletes (15-female; 8-male). All 3 groups were subjected to an assessment aimed at state anxiety The following questionnaire was used for this assessment: Questionnaire for the identification of competitive state anxiety. **Hypothesis:** There are statistically significant differences in anxiety levels (cognitive and somatic) between athletes in the three sports involved in the research (football, basketball and volleyball). This study's results show statistically significant differences in competitive state anxiety among the study group, both genders and between the three categories of athletes (football, basketball, volleyball). Male subjects in this study tend to score higher to lower on competitive anxiety compared to female subjects. Football players have lower levels of competitive state anxiety. **Conclusions:** There are differences in anxiety levels (cognitive and somatic).

Keywords: *competitive state anxiety, cognitive anxiety, somatic anxiety*

Introduction

The study of anxiety is a frequently explored area in sport psychology due to the influence of emotions on sport performance. Athletes want to both meet the demands of competition and perform optimally under pressure (Thomas et al.,

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2004). But depending on certain individual characteristics such as personality type, and type of motivation (external or internal) it is possible that each individual perceives the pressure of competition differently and reacts differently to it (Ntoumanis et al., 2000). Lazarus (2000) goes further and makes a direct link between the intensity of pressure and emotions and the value goals at stake. The multidimensional theory of anxiety developed by Martens et al. (1990) suggests that anxiety consists of two subcomponents: cognitive anxiety and somatic anxiety. "Stress is the process that involves the perception of a substantial imbalance between environmental demand and response capabilities, were, failure to meet demands is perceived to have significant consequences and personal response is, an increased level of cognitive and somatic anxiety" (Martens, Vealey & Burton, 1990, p. 10).

The existing literature examining directional perceptions of symptoms associated with competitive anxiety suggests several areas that require further investigation. First, situation and individual difference variables such as sport type and competitive experience have only been examined in isolation with no investigation of the potential influence of the interaction of such variables upon the anxiety- and competition-related symptoms (Jones, 1995; Hanton et al., 2002c).

Second, no studies have empirically examined how the level of competitive experience of the participant in their respective sport may effect the direction of the anxiety response, particularly in an elite or professional sport context (Mellalieu et al., 2004).

Research objective

To identify differences in competitive state anxiety in the three categories of athletes (football, basketball and volleyball) studied and to explore possible correlations between competitive state anxiety and sport.

Materials and Methods

The study included a total of 118 athletes aged between 13 and 24, both female and male, from 3 sports and divided according to the table below:

Table 1. Percentage distribution of subjects according to gender and sport practiced

Sport	Female gender	Male gender	Percentage/sport
Football	16	46	53%
Basketball	16	17	28%
Volleyball	15	8	19%
Distribution			
By genders	40%	60%	100%

Competitive State Anxiety Questionnaire

This questionnaire was developed by Vealey, Bump and Smith (1983) having a total of 18 items with a scale from 1 to 4 (1=Not at all; 4=Very much), being divided into 2 subscales, cognitive anxiety and somatic anxiety, both having 9 items each.

The statements are like:" When I compete, I'm afraid of making mistakes; Before a competition, I worry/worry that I might not perform well; Before a competition, I feel nauseous in my stomach; Just before a competition, I notice that my heart is beating faster than usual; I get nervous waiting for the game to start."

The score for each item is as follows: 0 for never, 1 for rarely, 2 for sometimes and 3 for often. Some items receive 0 regardless of the answer given (they are not scored): 1, 4, 7, 10 and 13. Some examples of unscored items would be:" Competing against others is socially enjoyable; Setting a goal is a very important step when you compete. Team games are more exciting than individual sports. "The total score obtained is interpreted as follows: a value of less than 17 is equivalent to a low level of anxiety; a value between 17 and 24 is equivalent to a medium level of anxiety; a value greater than 24 represents a high level of anxiety.

Results

There are statistically significant differences in the level of anxiety (cognitive and somatic) between athletes in the three sports involved in the research (football, basketball, volleyball).

There are only partially statistically significant differences, as we obtained highly significant differences only for **cognitive anxiety** (sig.=.000) but not for **somatic anxiety** (sig.=.158), using the questionnaire for competitive state anxiety (cognitive anxiety and somatic anxiety).

Table 2. Differences between the three categories of athletes in terms of competitive state anxiety

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Anx. cognitive	Between Groups	647.784	2	323.892	9.100	.000
	Within Groups	4093.140	115	35.593		
	Total	4740.924	117			
Anx. somatic	Between Groups	124.539	2	62.269	1.878	.158
	Within Groups	3813.054	115	33.157		
	Total	3937.593	117			

The results of the comparisons between the groups of athletes are presented in Table 3, where we can see that the significant differences observed in Table 2 (ANOVA test results) are found in terms of cognitive anxiety between the group of footballers and basketball players (mean difference of -3.6; significance level of .017), but also between footballers and volleyball players (mean difference of -5.7; high statistical significance = .000). These differences are not observed between basketball players and volleyball players (sig.=.48).

Table 3. Differences between the 3 groups of athletes in terms of the parameters analysed.
Multiple Comparisons

Hochberg

Dependent Variable	(I) sport_ type	(J) sport_ type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Anx. cognitive	football	basketball	-3.61193*	1.28555	.017	-6.7252	-.4987
		volleyball	-5.70547*	1.45656	.000	-9.2329	-2.1781
	basketball	football	3.61193*	1.28555	.017	.4987	6.7252
		volleyball	-2.09354	1.62051	.484	-6.0180	1.8309
	Volleyball	football	5.70547*	1.45656	.000	2.1781	9.2329
		basket	2.09354	1.62051	.484	-1.8309	6.0180
Anx. somatic	football	basketball	-2.21750	1.24079	.211	-5.2224	.7874
		volleyball	-1.77349	1.40584	.504	-5.1781	1.6311
	basketball	football	2.21750	1.24079	.211	-.7874	5.2224
		volleyball	.44401	1.56409	.989	-3.3438	4.2318
	volleyball	football	1.77349	1.40584	.504	-1.6311	5.1781
		basketball	-.44401	1.56409	.989	-4.2318	3.3438

Thus, we can observe higher state of cognitive anxiety in volleyball and basketball players compared to football players.

Table 4. t-test. Comparative analysis of competitive state anxiety by gender.
Assessment of gender differences in competitive state anxiety

	gender	N	Mean	Std. Deviation	Std. Error Mean
Anx. cognitive	female	47	24.0426	6.27610	.91546
	male	71	17.3662	4.88215	.57940
Anx. somatic	female	47	20.6596	6.49507	.94740
	male	71	15.6197	4.27406	.50724

In Table 5, which systematically presents the significant results, the female population can observe higher cognitive and somatic anxiety scores.

Table 5. Significant gender differences in competitive state anxiety

	Female gender (mean±dev.st.)	Male gender (mean±dev.st.)	Difference between averages	Statistical significance (sig.2-tailed)
Cognitive anxiety	24.04±6.28	17.37±4.88	6.68	.000
Somatic anxiety	20.66 ±6.49	15.62±4.27	5.04	.000

Discussion

An important aspect in studying competitive state anxiety has been the direction in which it is used by athletes. As the literature shows, competitive state anxiety can be used on a continuum from facilitative to debilitating (Raglin & Hanin, 2000).

In this sense, we wanted to look for those factors that can move competitive state anxiety along the facilitator-debilitator axis (Grossbard et al., 2009).

The results of the meta-analyses clearly show that the relationship between anxiety and sports performance is a complex issue, especially as it is moderated by person, situation and task characteristics (Kleine 2007).

Interesting to note in the dynamics of the research, but also in the interest of this is how sport performance is articulated about self-confidence and cognitive anxiety. Woodman T., Hardy L. (2011) show that both sets of magnitudes of effect (cognitive anxiety and self-confidence) are heterogeneous. Although previous research has shown that, compared to men, women report higher cognitive anxiety (apud. Martens et al., 1990; apud. Russell et al., 1998), lower self-confidence (apud. Martens et al., 1990; apud. Jones et al., 1991; apud. Krane and Williams, 1994) and less stability before the competition (apud. Jones and Cale, 1989; Jones et al., 1991), thus findings do not explain why cognitive anxiety and self-confidence should be more related to performance for both sexes. Differences in mean effect sizes between genders suggest that pre-competition cognitive anxiety and self-confidence have an impact greater on subsequent performance for males than females.

Interpreting our results in the context of the literature we can observe both similarities and discrepancies. As far as similarities are concerned, we can mention that we find the presence of competitive state anxiety in our study as well.

The same is true for gender differences, where other researchers also detect statistically significant differences between women and men. Women and male athletes in individual sports show higher levels of competitive anxiety (Correia, 2019).

Conclusions

In conclusion, analyzing the results of the study about the research hypothesis we can say that: The hypothesis that there are statistically significant differences in the level of anxiety (cognitive and somatic) between athletes in the three sports involved in the research (football, basketball, volleyball) is partially confirmed because the differences are only significant between footballers and basketball players and between footballers and volleyball players respectively. No significant differences were found between basketball and volleyball groups.

The existence of differences between female and male athletes in anxiety levels (cognitive and somatic) was confirmed. Therefore, we can say that our results support the literature and constitute further evidence that competitive anxiety is experienced differently depending on gender and sport.

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KINEMATIC ANALYSIS OF HIP JOINT MODIFICATIONS IN SWITCH LEAP: COMPENSATORY MECHANISMS DUE TO REDUCED MOBILITY IN THIS AREA

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ABSTRACT. Artistic gymnastics include a series of artistic elements where the joints' mobility represents an essential factor for the accuracy of the execution in both beam and floor routines. The reduced mobility is responsible for the occurrence of compensatory movements. This type of repetitive and long-term compensations can damage the joints involved in execution of an accurate switch leap element. The aim of the study was to analyze the compensatory mechanisms due to reduced mobility in the hip joint that can occur during the execution of a switch leap. 6 female gymnasts (8-10 years) from C.S.S.1 Timisoara have been analyzed when they executed switch leap on the floor. The kinematic analysis was carried using inertial sensors for movement tracking technology. The evaluated parameters were: leg separation angle (LSA), lateral pelvic tilt (LPT) and pelvic rotation (PR). The data revealed a LSA of 137.5± 2.239° which corresponds to the second level of penalty (0.30 points). The compensatory movements were revealed by the level of LPT and pelvic rotation. Depending on the front leg, the compensatory tilt, represented by the elevation of the hip joint, was found on the right or left part accordingly. Regarding the pelvic rotation, this is performed in the backward direction on the same part with the tilt. The kinematic analysis of the switch leap element provides supplementary data that can be taken into consideration by the gymnasts and coaches during the training period in order to reduce the risk of injuries and the risk of falling from the beam.

Keywords*: hip joint modifications, gymnastics, switch leap, compensatory mechanisms, flexibility*

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Introduction

The complexity of the elements of artistic gymnastics requires a technical preparation and artistic mastery at the highest possible level as determinants for a cleanest execution (Vernetta et al., 2022). Biomechanical attributes of the specific movements are the most important determinants of the difficulty of the elements in women artistic gymnastics (Berisha, 2021, Fink &Lopez, 2015; Fink& Hoffmann, 2015). Regarding the artistic elements, as it is the switch leap, besides elegance a great sense of balance, strength coordination and agility are required (Bobo-Arce & Méndez-Rial, 2013; Di Cagno, Battaglia, Fiorilli, Piazza, Giombini, Fagnani & Pigozzi, 2014; Douda, Toubekis, Avloniti & Tomakidis, 2008; Vernetta, Montosa, Beas Jiménez & López-Bedoya, 2017 Miletić, Katić & Males, 2004; Vernetta, Fernández, López-Bedoya, Gómez-Landero & Oña, 2011). Moreover, mobility of a specific joint, which represents the ability to describe active movements through a specific range of motions (Jeffreys, 2016), can be considered to be a form of functional flexibility that is combined with other skills such as strength in order to obtain the maximal performance, (Berisha, 2021) and could refer to it both for a specific joint or as a global characteristic of body segments. Flexibility is an important skill in artistic gymnastics, mainly at the balance beam (Faur, 2014). Artistic gymnastics include a series of artistic elements where the joints' mobility represents an essential factor for the accuracy of the execution in both beam and floor routines. The introduction of different artistic leaps in the routines, that could be presented with a clean execution, represents nowdays a desiderate in order to obtain a higher starting mark, considering that, by comparison, the acrobatic elements have already achieved a superior level of difficulty. However, the artistic elements have to be performed as accurately as possible in order to reduce the risk of injuries. The general hypermobility of the joint, defined as an increased range of motion that exceeds the normal limits for each joint according to age, gender and ethnicity (Seckin et al., 2005) has a cyclic evolution. This is a feature that mainly characterizes early childhood and decreases with age up to 9-12 years so that after this age a new stage of growth can be observed around the age of 15, especially in girls due to hormonal constellation. After this age and especially at the time of reaching maturity, in the case of both genders, a reduction in mobility is observed (Hakim, Grahame, 2003). In artistic gymnastics this aspect could be considered as an advantage (McCormack et al 2003). Regarding the hip joint, excessive mobility can lead to different injuries such as dislocations, soft tissue injuries or painful joints (Seckin et al., 2005; Smith et al., 2005). In gymnastics, the presence of hypermobility is a frequently encountered fact in sportswomen, and although the extreme values of the range of motion at the level

of the joints have generated heated discussions between the various categories of specialists, there is still no clear consensus regarding the advantages of this hypermobility, respectively its association with risk of injury (Bukva et al., 2018; Grahame, Bird & Child, 2000; Larson et al, 1993; Decoster et al., 1997). However, the reduced mobility is responsible for the occurrence of compensatory movements, such as lateral tilt and rotation within the hip and lumbar spine joints, which are not normally involved in the execution of the elements.

In women artistic gymnastics the switch leap is an artistic element that can be performed. executed both on the floor and on balance beam, but most frequently on the beam, being an element of difficulty (0.2 points).

1.205

*Leap fwd with leg change (free leg swing to 45˚) to cross split (180° separation < **after** leg change) (Switch leap)*

Fig. 1. *Switch leap according to Code of points*

This type of repetitive and long-term compensations can, thus, damage both the joints normally involved in execution of an accurate switch leap element and also in the associated joints that are involved in the compensatory mechanisms. On the floor, usually there are no major consequences determined of these compensatory movements but on the beam there is a cause-effect link between compensatory movements and the falls from the apparatus. Both on floor but mostly on the beam executions the code of points specifies that for missing degrees of leg separation in leaps there are different levels of penalties according to the magnitude of the leg separation angle reduction. The aim of the study was to analyze the compensatory mechanisms due to reduced mobility in the hip joint that can occur during the execution of a switch leap from a kinematic point of view.

Material and methods

The study was carried out on a group of female gymnasts (8-10 years) from C.S.S.1 Timisoara have been analyzed when executed switch leap on the floor.

On the data collection day, all participants presented a good physical condition with no reported injuries. All gymnasts performed the analyzed element (the switch leap) in a miniseries of 3 repetitions (Domokos et al., 2020).

The equipment and experimental procedure The gymnast performed the switch leap element on the floor. To record the element for obtaining the three-dimensional kinematic data analysis, gymnasts have been equipped with a multiple sensor suit (Xsens Technologies BV, Enschede, Netherlands). In order to accurately track the motion of human body, the multiple sensor suit used a kinematic measurement system consisting of 17 motion trackers, attached to different body segments such as: feet, lower legs, upper legs, pelvis, shoulders, sternum, head, upper arms, forearms, and hands as previously described ("Xsens MVN User Manual," Xsens Technologies, 2018, Domokos et al., 2020) (Fig 2a).

Experimental procedure

As previously described (Domokos et al., 2020), before the element analysis, the gymnasts participated in a 30-minute general warm-up. When the warm-up period was finished, the gymnasts were randomly chosen for executing the element after they were equipped with the inertial multisensory suit, placed as described above/below, and tested. The time interval of 2-3 minutes required to complete the placement of the multisensory system did not affect the gymnasts' warm up When the stage was set, the testing regarding sensor-equipment communication was carried out. The calibration of the sensors lasted about 3 minutes and the individual recording of the analyzed element was performed in a 10-minute interval. To obtain the maximum performance, while one gymnast was tested another gymnast prepared for the test by performing light exercises in order to maintain the warm-up (Domokos et al., 2020) (fig 2b).

The International Gymnastics Federation approved the floor surface used within the present study. The study was performed with the approval of the National Gymnastics Federation, the Board of the technical team of the CSS1Timisoara and Ethical Committee of the Physical Education and Sport Faculty - West University of Timisoara. All the collected personal and experimental data complied with the GDPR legislation (Domokos et al., 2020).

a)

b)

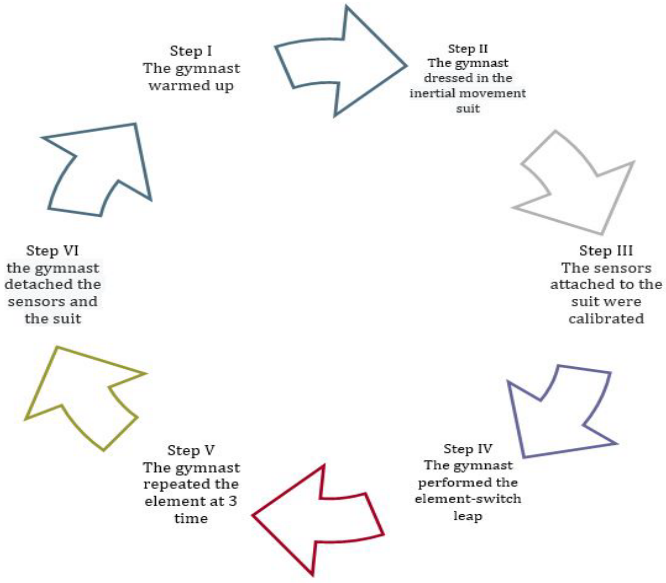


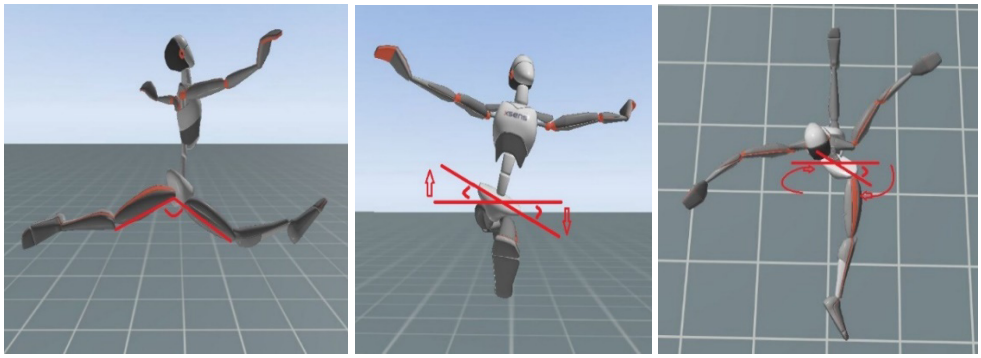
Fig 2. *a) Experimental set up and b) procedure protocol*

Data analysis

Data collection consisted of gathering data simultaneously from all 17 sensors for inertial movement tracking. To get accurate data regarding the range of motion in joint angles, the motion trackers were positioned on segments, in special locations. in order to determine the following parameters: leg separation angle (LSA); lateral pelvic tilt (LPT) and pelvic rotation (PR).

Thus, for the specific kinematic analysis of switch leap executions, the analyzed information were those recorded from the sensors were positioned on specific zones as follows:

- leg separation angle (LSA): angle between split of the legs (fig. 3a).
- lateral pelvic tilt (LPT): degree of lateral deviation (drop/hike) around an anteroposterior axis (fig. 3b).
- pelvic rotation (PR). Degree of pelvic rotation in the transverse plane around vertical axis (fig. 3c).



a) b) c)

Fig. 3. *Graphic representation of the parameters: a) LSA, b) LPT; c) PR*

The statistical analysis was performed using statistical tests: Student-t test, Two-way ANOVA, correlation with determination of the Spearman r coefficient (GraphPad v. 5.0).

Results

The data are expressed as mean values ± standard error of mean (SEM) or mean values ± standard deviation (SD) and revealed a LSA of 137.5± 2.239° which corresponds to the second level of penalty, according to the Code of Points of 0.2 points. Performing an intragroup analysis we found that for the LSA that only one gymnast (G2) presented a lesser value of the LSA which was significantly ($p < 0.05$) and very significantly ($p< 0.01$) reduced than the majority values within the group (fig.4).

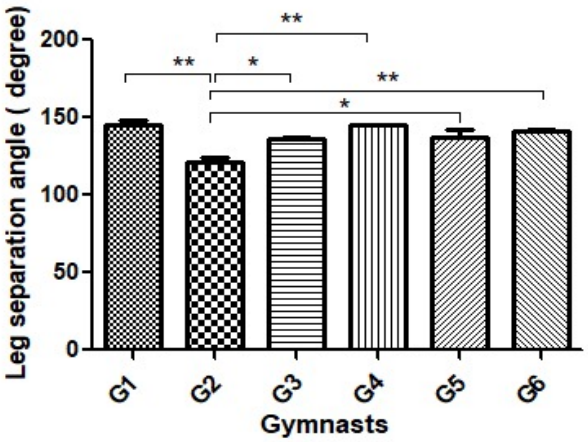


Fig. 4. *The Leg separation angle differences within the group*

When compared to the standard indicated by the Code of points, where the LSA for this element is about 180 °, our results revealed that in all gymnasts there is an extremely significant reduction of LSA ($p< 0.001$). In order to obtain the most accurate estimation, the results have been expressed as percentage from the Control value assumed to be 100%. Analyzing the pool data collected from the study group in comparison to Control expressed as mean value ± SD, the difference between the recorded data indicated a reduction of the LSA with approximately 25% (23.63 ± 5.227% vs 100% in Control) (fig. 5).

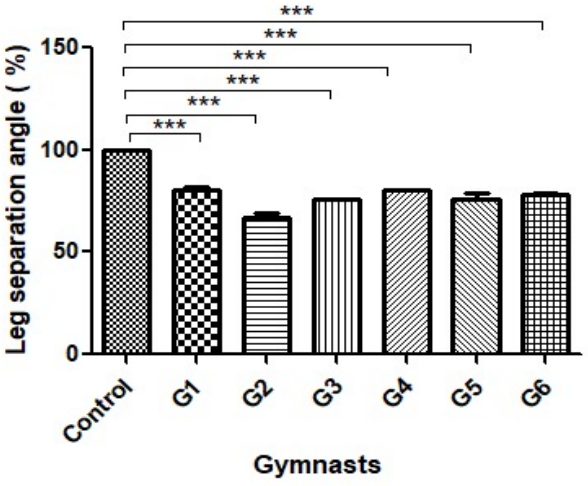


Fig. 5. *The Leg separation angle differences comparing to the standard from Code of points*

The compensatory movements were revealed by the level of LPT and pelvic rotation. Depending on the front leg, the compensatory tilt, represented by the elevation of the hip joint, was found on the right or left part, accordingly. Regarding the pelvic rotation, this is performed in the backward direction on the same part with the tilt. Analyzing the data, we found that 4 out of 6 gymnasts presented a left pelvic tilt associated with right rotation.

When analyzed the pool data regarding the degree of tilt on all executions, we found a mean deviation from the horizontal line of 12.414 ±10.97°. After analysis performed within the studied group (Two Way ANOVA followed by Bonferroni's Multiple Comparison Test) we found a few significant individual differences between the gymnasts as we depicted in fig. 6. In this case the highest tilt was found in gymnast number 4 (G4) which presented a highly significant value of the tilt in comparison with the rest of the group. Analyzing the LSA we found that the degree of this parameter in this subject is the highest one within the group (144.9 ± 0.488°) the next value being about 144.9±5.341°. Moreover, by analyzing the values obtained for all executions performed by G4 we found that this gymnast's performance was the most homogenous in comparison with the rest of the group, a feature that was observed also when analyzed the LPT (fig. 7).

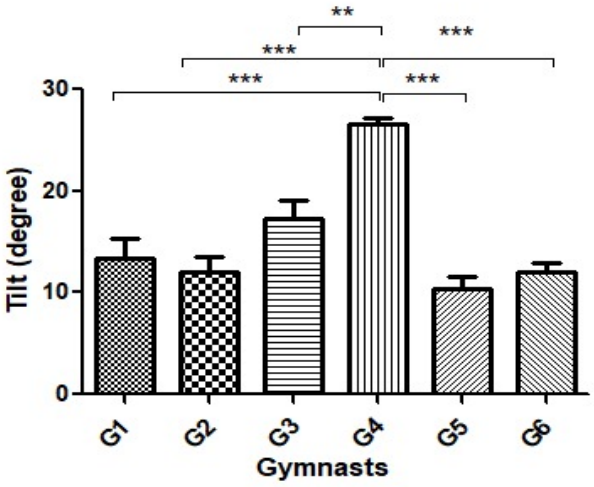


Fig. 6. *The lateral tilt degree differences within the group*

Regarding the pelvic rotation, we found also that G4 presented the highest hip rotation within the group, thus, maintaining the same trend as for the rest of the parameters. In contrast to the other parameters, we also found another gymnast (G5) that presented a significantly higher rotation ($p < 0.05$

and p< 0.01, respectively) than the rest of the group. Comparing the rest of the parameters we found that G5 presented a LSA comparable to the mean value of the group and for the LPT the results revealed even a better result by the fact that this gymnast presented the lowest value within the group suggesting that in her case the compensatory mechanism in order to obtain the larger LSA is represented only by the rotation. In comparison for G4 which presented the highest LSA the compensation was more complex, combining both rotation and the tilt. The rest of the gymnasts presented relatively high LSA without a great value for the other two parameters, suggesting that in their case they present a good flexibility according to the age group.

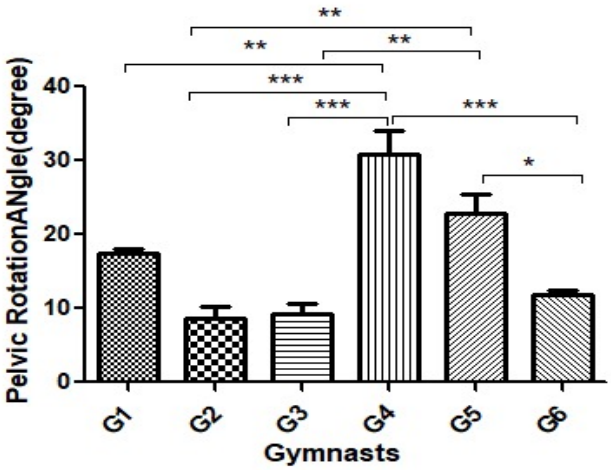


Fig. 7. *The pelvic rotation differences within the group*

By analyzing the correlation between the LSA and the other parameters we found a Spearman r correlation coefficient of 0.6244, indicating a medium positive correlation when correlated to rotation, suggesting that this parameter could be considered a highly significant determinant factor (p< 0.01) when analyzing the compensatory mechanism for obtaining a higher leg separation angle result that was not found also in the case of the tilt (Spearman r coefficient – 0.40, p-ns).

Discussions

In women artistic gymnastics, it is a costume for the athletes to try to depeche their physical limits in order to achieve the mastery in their executions (Brugemann, 2005).

During the last decades the evolution of artistic gymnastics increased dramatically in terms of difficulty of the single skills or the entire routines. An important condensation of elements with increased difficulty can be found both in the floor and beam exercises (Fetzer 1997). This was not a sufficient condition in order to obtain the highest scores from the judges. Consequently, the artistic part was developed in order to add value to the routines. For the artistic part of the routines one of the physical skills necessary is represented by flexibility. O'Connell, Posthumus & Collins (2013) characterized the flexibility through the range of motion (ROM) parameter which describes the relative position of two body segments linked by the joint. Thus, angular variables could be used in order to assess the flexibility (López-Bedoya, Vernetta, Robles & Ariza, 2013) in different joints according to the specificity of the element. In the present study several angular variables were used in order to characterize the flexibility of the hip joint in relation to the specific position of the element. In our case, using three different angular variables offered a cumulative set of information that can describe the movement in the hip joint during the switch leap execution which could add value to the visual description found in the Code of points (https://www.gymnastics.sport/site/). The visual description is a bidimensional one and can miss aspects that are important for the evaluation of the element. Thus, the lateral pelvic tilt or rotation could be assessed only on a 360° view in order to be accurate. Our work methodology with inertial sensors provides this kind of view ("Xsens MVN User Manual," Xsens Technologies, 2018) and by using it we were able to describe more detailedly all the changes that occurred during the switch leap executions.

Regarding the compensatory mechanisms, they intervene in order to correct potential deficiencies objectified by the lack of mobility. In the case of switch leap, according to our results we could find that the lateral pelvic tilt and pelvic rotation are responsible for the increasing leg separation angle. The presence of a small tilt or rotation is difficult to be seen by naked eye and this can lead to an over evaluation of the execution. However, the presence of these compensatory mechanisms help the gymnast not to be penalized according to code of points, where it is stipulated that a leg spread angle lesser than 180° is considered insufficient split by the judges (https://www.gymnastics.sport/site/).

Conclusion

The kinematic analysis of the switch leap element provides supplementary data that can be taken into consideration by the gymnasts and coaches during the training period in order to reduce the risk of injuries and the risk of falling from the beam.

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All authors contributed equally.

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ANALYTICAL PRESENTATION OF THE 2020 NATIONAL CORE CURRICULUM IN HUNGARY

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ABSTRACT. The Physical Education and Health Development learning area of the National Core Curriculum (NCC) 2020 and the framework curricula that form a coherent unit with it includes a set of goals and contents that meet the challenges of the 21st century. One of the prominent components of the 21st century image of man is that the individual is active, but at the same time capable of reflective deliberation. A person of action is characterized by the right attitudes related to movement, a physically active lifestyle, realistic self-acceptance, autonomy combined with social responsibility, openness to innovative initiatives and the ability to apply reliable solutions. A physically and mentally healthy person experiences the state of health and a harmonious life as a value. The abilities and skills related to movement as a basic competence, as well as the motor abilities and skills that are mobilized according to the given situation, are the basis for the individual to become an active member of society, and are characterized by safety in movement throughout life. A significant positive of NCC 2020 is that, in addition to speaking, reading, writing, text comprehension, orientation to quantitative, spatial-visual and temporal conditions, *movement* is also found among the basic competencies. There are *learning areas (subjects)* in NCC 2020, in the following system: Hungarian language and literature (literature, Hungarian language); Mathematics (mathematics); History and civic knowledge (history, civic knowledge, country and people knowledge); Ethics/faith and morality; Natural science and geography (environmental knowledge, natural science, integrated natural science, biology, chemistry, physics, geography); Foreign language (first and second foreign language); Arts (singing and music, drama and theatre, visual culture, motion picture culture and media literacy); Technology (technique and design, digital culture); *Physical education and health promotion (physical education)*; Community education (class head teacher's

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lesson). The learning area of NCC 2020 Physical Education and Health promotion follows the following structure: first, the *general principles and goals* of the learning area and the physical education subject are formulated; after that, *specific characteristics* of the teaching of the subject can be found in chapters 1-4 and 5-8 and 9-12 projected by grade; the next point contains the *main topics*, also divided into four grades. In the NCC, certain characteristics of physical education learning and teaching are also presented by education stage. The educational process takes place along *seven development areas*: movement culture development; motor abilities development; development of motor skills – learning to move; games; contests, competitions; prevention, lifestyle; healthy physical development, health promotion. These development areas are closely aligned with the main topics of the subject, as well as with the learning outcomes (general requirements) set as overall goals and related to the development areas.

Key words: *National Core Curriculum, Basic competencies, Learning areas, Physical education and health promotion*

Introduction

The political transition following the free elections in Hungary in 1990 raised the demand of reorganising the society. A new society always creates new value preferences. The 1990ies have brought not only economic, scientific-technical, social, moral, educational policy or education organisational changes, but they were also followed by the changes in the school curricula. The changes in the curricula of the 90ies widened the content of education. So the content of education has gradually broadened, gained a much wider interpretation, so today it does not mean only the syllabus, but comprises the "world" of values, the questions of educational policy, the transformation of behaviour, and the development of attitude, too (*Hamar*, 2012).

In Hungary, a new, modified version of the National Core Curriculum was introduced in 2020 (*Act LXX of 2019 on National Public Education*). The National Core Curriculum (NCC) 2020 and the framework curricula that form a coherent unit with it (*Content regulators matching the 2020 NCC*) the learning area of Physical Education and Health Development includes a target system and contents that meet the challenges of the 21st century. One of the prominent components of the 21st century image of man is that the individual is active, but at the same time capable of reflective deliberation. A person of action is characterized by the right attitudes related to movement, a physically active lifestyle, realistic self-acceptance, autonomy combined with social responsibility, openness to innovative initiatives and the ability to apply reliable solutions. A physically and mentally healthy person experiences the state of health and a harmonious life as a value (*Hamar*, 2022).

In NCC 2020, the Physical Education and Health Development learning area, the subject of physical education, while maintaining the traditional values of Hungarian school physical education, was supplemented with health development. This does not mean giving up the values of daily physical education, but rather we can talk about an extra pedagogical and, in some respects, health added value that can also be called Euroconform (*Hamar, Czirják, Kövesdi*, 2020). As *Valéria Csépe* (2020) defines: "Physical education is not just a gym class, but a movement that brings joy, it can include dance and a variety of physical activities. Health promotion, the creation of a healthy lifestyle, tasks that can alleviate the postural problems of elementary school children are integrated, and there is also the possibility of adapted physical education."

The structure of the NCC 2020 Physical Education and Health Development learning area

There are *learning areas (subjects)* in NCC 2020, in the following system: Hungarian language and literature (literature, Hungarian language); Mathematics (mathematics); History and civic knowledge (history, civic knowledge, country and people knowledge); Ethics/faith and morality; Natural science and geography (environmental knowledge, natural science, integrated natural science, biology, chemistry, physics, geography); Foreign language (first and second foreign language); Arts (singing and music, drama and theatre, visual culture, motion picture culture and media literacy); Technology (technique and design, digital culture); *Physical education and health promotion (physical education)*; Community education (class head teacher's lesson).

The infrastructural conditions for the learning and teaching of physical education in the educational institutions participating in public education are quite broad, so it is difficult to define uniform minimums that are valid and achievable for all schools in the development of the content to be mastered. The creation of unity mostly affects the area of student personality development, which appears in the NCC at the level of comprehensive achievement goals and achievement goals belonging to development areas. The means of implementing the educational process are the topics indicated in the NCC and the framework curriculum. The topics are made up of development tasks that include broader content and appear as optimal at the level of the requirements. The physical educators can use these components to create the content elements of their local curriculum in accordance with the local conditions – using the opportunity to choose (*Hamar*, 2020).

The learning area of NCC 2020 Physical Education and Health Development follows the following structure:

• First, the *general principles and goals* of the learning area and the physical education subject are formulated.

• After that, *specific characteristics* of the teaching of the subject can be found in chapters 1-4, 5-8 and 9-12 projected by grade.

• The next point contains the *main topics*, also divided into four grades. As an example, let's look at primary school grades 5-8 the main topics of his year: 1. Conditional and marching exercises – prevention, relaxation. 2. Tasks typical of track and field. 3. Tasks typical of gymnastics. 4. Sports games (depending on the material and personal conditions of the school, a choice of two sports games). 5. Physical education and folk games. 6. Self-defence and martial arts. 7. Forms of movement in an alternative environment. 8. Swimming (depending on conditions). 9. Adapted Physical Education.

• Finally, the *learning outcomes*, the learning outcomes set as overall goals and related to the development areas (general requirements) are recorded in the core curriculum.

Comprehensive goals, areas of development

The abilities and skills related to movement as a basic competence, as well as the motor abilities and skills that are mobilized according to the given situation, are the basis for the individual to become an active member of society, and are characterized by safety in movement throughout life. A significant positive of NCC 2020 is that, in addition to speaking, reading, writing, text comprehension, orientation to quantitative, spatial-visual and temporal conditions, *movement* is also found among the basic competencies.

The complexity formulated as a basic principle of NCC is reflected in the connections between physical education and general competences. The subject mainly contributes to the realization of the aspirations set out in the general competences and educational goals through the development of personal and social competence. Competencies related to somatic health, social-emotional well-being, safety, and human relations are given an important role. School development also covers good time management, constructive cooperation, and the development of physical well-being and motor performance.

Physical education is connected to other subjects through inter-subject integrations and cross-curricular pedagogical solutions. The most obvious cross-curricular connection between physical education and the *Arts* learning area is particularly pronounced in the subject of *singing and music*. Singing and music play a fundamental role in the teaching of dance forms of physical education (dance, rhythmic gymnastics, aerobics), mainly through the development of rhythmic ability. Dance can function not only in its interdisciplinary appearance,

but also as a common "language" across subject boundaries. The dances also play a cultural mediating role, as the student gets to know the diverse cultural traditions of our country and the customs of European nations through folk dance.

In the NCC, certain characteristics of physical education learning and teaching are presented by education stage. The educational process takes place along *seven development areas*: movement culture development; motor abilities development; development of motor skills – learning to move; games; contests, competitions; prevention, lifestyle; healthy physical development, health promotion. These development areas are closely aligned with the main topics of the subject, as well as with the learning outcomes (general requirements) set as overall goals and related to the development areas.

Learning outcomes

For the subject of physical education, the learning outcomes set as overall goals and related to the development areas are formulated first in general, and then adapted to the individual development areas. Primary school grades 5-8 in his grade, for example, like this:

By the end of the educational phase, the student:

- his/her motor performance, which has developed in accordance with his/her age and physical abilities, is such that she is able to consciously influence her own performance and fitness level;
- with his/her versatile movement skills, she successfully learns complex forms of movement;
- knows and uses age-appropriate theoretical knowledge, technical terms and correct terminology of physical education;
- his/her self-awareness, emotional-volitional skills and abilities have been properly developed through exercise, physical education and sports;
- able to interpret the sources of accidents occurring in life and health-damaging, dangerous habits and activities.

Examples of the learning outcomes of the development areas of grades 5-8:

Movement culture development

By the end of the educational phase, the student:

- executes sequences of actions consisting of combinations of learned basic forms of movement under variable spatial, temporal and dynamic conditions at a skill level.

Motor abilities development

By the end of the educational phase, the student:

• due to the level of development of the motor's abilities, he/she is able to create harmony between the elements of his/her action sequences.

Development of motor skills – Learning to move

By the end of the educational phase, the student:

• through gymnastics, rhythmic gymnastics, dance and aerobic forms of movement under the guidance of a teacher, he/she develops his/her aesthetic-artistic awareness and expressiveness.

Games

By the end of the educational phase, the student:

• consciously and expediently uses technical and tactical elements in the preparatory small games of sports games.

Contests, competitions

By the end of the educational phase, the student:

• during contests and competitions, he/she is tolerant towards his/her teammates and opponents, he/she expects the same from them.

Prevention, lifestyle

By the end of the educational phase, the student:

• exercises in a planned, orderly and regular manner according to the possibilities given by his/her family background and his/her immediate environment.

Healthy physical development, health promotion

By the end of the educational phase, the student:

• is completely independent in terms of hygiene habits, and helps his/her peers when appropriate.

Learning outcome goal to be achieved by the end of the educational phase: the *student referred to adapted physical education* should get to know the tools and methods of physical education, health promotion and sport that can help him/her to restore his/her health and motor performance to the greatest extent possible.

Summary

The title Physical Education and Health Development, which will appear in the National Core Curriculum 2020, replaced the previous title Physical Education and Sports Literacy. It can be considered a content innovation that the learning area - while maintaining the traditional values of physical education in Hungarian schools - has been supplemented with health promotion. This change points out that in the teaching of the subject of physical education, in addition to the motor-related content of health development, knowledge of health science should also have a prominent role.

The basic curriculum also covers the acquisition of age-appropriate theoretical knowledge of physical education as a comprehensive outcome goal. In the process of movement learning, theoretical awareness and explanation of cause-and-effect relationships are important, which promotes mental processes. All this enables the efficient learning of increasingly complex sequences of movements adapted to changing environmental conditions.

The overall results of NCC 2020 are developed in the form of detailed results related to development areas. The seven development areas are presented in a uniform form in every educational stage. The main topics in NCC and the framework curriculum topics are the same in the case of physical education. The recommended number of lessons and the achievement targets for the development areas are linked to the core curriculum topics - broken down into two years.

The content of the framework curriculum of physical education is based on natural forms of movement, in which both location-, position-changing and manipulative movements appear. The content elements include the system of basic sports techniques and tactics from the fifth grade, while the development of broad-spectrum coordination skills continues. The differentiated development of the conditional skills is mainly done through the acquisition of movement skills and playful practice, and then the conditional training adapted to age characteristics gradually comes to the fore. Physical education and folk games are included separately in the curriculum, as well as forms of exercise that can be practiced in an alternative environment, which receive great emphasis in modern physical education teaching due to their versatile developmental effect.

Adapted physical education, which is included in the central curriculum regulations, has been given a separate topic. The low-impact and adapted physical education from the 2012 NCC was a shortcoming that generated one of the biggest educational policy and educational management problems of the last decade in the field of physical education in Hungarian schools.

In conclusion of the study, it is important to state that the success and optimal implementation of physical education depends on the adequacy of the regulatory and professional frameworks, as well as on the content and methodological activities of physical educators. The teachers enforce, apply, customize and transform the sports professional and methodological procedures they consider optimal within the defined framework and regulations (*Hamar* et al., 2017).

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POWER DEVELOPMENT IN THE STARTING PHASE OF SPEED RUNNING

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ABSTRACT. Introduction: Short distance running is part of the maximum intensity cycling exercises, consisting of combined efforts, each step being performed as a result of a complete impulse, characterized by covering a distance in a shorter time. **Objective:** This study aims to follow the development of power for the start in short distance speed trials. **Material and method**: A 26-year-old male athlete, who has been practicing athletics for 14 years, participated in the study, based on the 100-meter flat sprint. The pre-test was performed before the preparation period, the intermediate test after one, two and three mesocycles (months) and the final test after the fourth mesocycle (after 4 months). The evaluations followed the strength with which 4 exercises were performed (deadlift, clean, power clean and squat) of 6 repetitions each. At the same time, the length of the distance covered in the first three steps from the start was followed. During the four mesocycles, the athlete participated in specific strength development training. **Results:** Following the training program for the development of lower limb power, execution speed and lower limb strength, statistically significant results were observed in 2 of the 4 exercises performed in the evaluations. Regarding the jumped step starting from the two different positions, an evolution was observed reaching from the length of 5.24m to 6.44m in the first variant, and from 5.31m to 5.93m in the second variant. In both cases the execution time of the three steps increased, reaching the value of 1.85s, respectively 1.49s. **Conclusions:** Following the results obtained in the five evaluations, we notice that the training program was developed efficiently and that the results improved in most of the evaluation tests.

Keywords*: speed, power, start, athletics.*

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Introduction

In many sports, success is largely determined by the strength of the athlete's lower limbs. In many events such as jumping, throwing, running and others, the athlete must use his strength with the greatest intensity and in the shortest possible time. In sports where the emphasis is on improving speed and strength, increasing power will help the athlete improve their performance (Adams et al 1992; Dawes & Lentz, 2012). Lower limb strength plays a very important role in athletic performance and the methods for its development are diverse, including plyometric exercises, resistance training and complex training (May et al 2010).

The speed tests are predominantly anaerobic tests, alactacyd for the 100m and 4x100m relay and lactacyd for the 200m and 400m (including hurdles tests). The mechanical efficiency is dependent on the frequency of the steps and the thrust, i.e. the length of the steps. The neuropsychic and neuromuscular systems are very much in demand, which makes these tests considered extremely hard: blood pH sometimes below 7, the body making great adaptive efforts to maintain the osmotic, acid-base and hydro-mineral balance.

Short-distance sprinting is characterized by covering a distance in a short period of time and is part of the maximum intensity cycling exercises, their efforts being combined, each step performed being the response of a complete impulse. It can be divided into four phases, namely: the start, the launch from the start, the run along the course and the finish.

By start we mean all the positions and movements performed in order to start the run with maximum efficiency. Positions and movements are subordinate to the goal of the run (speed or endurance) and the start commands. In sprints, the bottom start is used.

Sprinting is an effort made by the athlete, characterized by covering a certain distance at maximum speed. The sprint standard is the 100 meters, considered one of the most appreciated and watched events at the Olympic Games.

The start is one of the most important phases of the short-distance sprint, being the moment when the maximum speed must be reached as quickly as possible using both the speed of execution and the force with which the impulse is made. The two motor qualities put together, speed and strength, give the athlete power.

A 2010 study aimed to investigate the bilateral deficit (ie, the sum of the maximal force of an exercise performed unilaterally as greater than the maximal force of an exercise performed bilaterally) analyzed in the jump squat exercise in elite sprinters and to observe the relationship between bilateral

deficit and start performance in sprint trials. The authors stated that athletes with greater bilateral impairment produced a lower total starting force impulse and lower velocity, determinants of performance in the 60m and 100m sprint events (Bračič et al 2010).

Objective

In this study the objective is to analyze the starting power in the lower limbs for the start phase of the speed trials over the distance of 100m. A higher level of lower limb power is hypothesized to provide better performance at the start of the sprint tests.

Material and method

A male athlete born in 1995, who has been practicing performance athletics since 2008, participated in the study, often participating in the 100m event. He is 1.75 meters tall and weighs 77 kilograms, a body mass index of 25.16. In the 14 years he collected numerous national medals, both in individual events and in relay events.

The subject was tested to track the development of power, speed and strength by performing a set of specific exercises to measure lower limb power. The follow-up period of the training program was four mesocycles.

Before the training period, an initial test was performed, at an interval of one mesocycle (one month) a number of 3 intermediate tests were performed and after the fourth mesocycle (after 4 months) the final test was performed.

During the evaluations, 4 exercises were performed for the assessment of power, strength and speed (deadlift, clean, power clean and squat) of 6 repetitions each, with each test being performed in the same order. Through the maximum repetition method, the maximum capacity of the athlete was determined in order to find out the load with which the exercises will be performed during the evaluations, this being a percentage of 70% of the maximum number of kilograms that the subject could overcome in the execution of the respective exercise. The loads with which the exercises were performed were the following: deadlift with 50kg, clean with 40kg, power clean with 40kg and squats with 70kg.

At the same time, the distance traveled in the first three steps from the start was measured. The distance covered by three steps was measured starting with the feet at the same level and with one foot in front of the other. The time in which the three steps are completed in the two starting variants was also timed.

During the four months, the athlete participated in specific strength training sessions. Initially, the exercises were performed to develop muscle resistance by performing a number of 12-20 repetitions, but with an intensity of 50%-70% of the athlete's maximum capacity, with a 3-4 minute break between sets. In training mesocycles 2, 3 and 4, the objective was to develop strength by performing a number of 6-8 repetitions, with an intensity of 70%-80% of the maximum capacity, having a break of 3-4 minutes.

The Beast device was used to track the athlete's progress. This is a small device (20x19x40 mm), weighing approximately 38 grams and equipped with a magnetic plate to be attached to the metal bar with which the athlete works. The machine provides data on the power measured in watts, the force measured in Newtons, and the speed measured in meters per second with which the exercises are performed (Beast Sensors, 2014).

Centralization of the data after the tests was carried out with the help of an Excel file. The device was observed to provide for each exercise, information regarding the average for each individual repetition as well as the maximum value captured in that repetition.

At the end of the five tests, in the excel table with all the data, I calculated the average of the values of the 6 repetitions performed that day for each individual exercise, both for the average value/repetition and for the average of the maximum values. The standard deviation was calculated at each evaluation to track the constant with which the 6 repetitions of the respective testing were performed.

Statistical significance (p) was calculated using the T-test to see what percentage of the results obtained were due to chance, comparing the results of the initial test with the results of the last test performed.

Results

Changes were observed regarding all the exercises performed by the subject following the tests performed. The data was divided by each exercise separately to be able to follow the evolution from one test to another.

Deadlift with 50kg:

The results of the five power assessments of the 50-kilogram deadlift. In the initial test, the average of the 6 repetitions was 561 W, in the intermediate tests, 563 W, 670 W, 672 W, and in the final test, 734 W. At the same time, the standard deviation in each test was followed, evolving as follows: 115, 82, 122, 133, 125. The T-test result for the comparison of the initial evaluation with the third testing was p=0.004, and for the comparison with the final testing p=0.03.

In the deadlift exercise, measurements were made regarding the execution speed of the 6 repetitions. The results of the five evaluations evolved gradually, having the following values: 1.04, 1.05, 1.21, 1.14, 1.31. The data has statistical significance with a p value of 0.03, although the standard deviation remained roughly around 0.18.

The force with which the deadlift exercise was performed did not show a constant evolution throughout the four mesocycles, as a result of the initial testing the average value of the six repetitions was 538 N, in the second testing it was 534, in the fourth testing it went up to the value of 580, to decrease to the value of 558 in the last test. The six repetitions were performed fairly constant in the tests 1, 2, 3 and 5, except for the 4th test where the standard deviation had value of 60, which is 3.4 times higher compared to the other ratings. Comparing the initial testing with the final testing, a value of p=0.06 was obtained, this being statistically insignificant.

The data obtained in the deadlift exercise showed that the speed developed during the training period, the results being statistically significant, in contrast to the execution force where the results have no statistical significance. However, in terms of power, an evolution was observed from one test to another.

Clean with 40kg:

Following the analysis of the results of the 40 kg clean exercise in terms of the power of the lower limbs, an upward evolution was observed after the first two mesocycles, and then a downward slope of the results was observed, at the final testing obtaining a lower value than in the first test, from a value of 575 W initially to a value of 546 W at the end. During the five assessments the six repetitions were performed more and more consistently, reaching from a standard deviation of 103 to a value of 59. Balancing the initial and final testing it was observed that the data are not statistically significant (p=0 ,16).

As with the power rating, the average values curve is upward with a peak at the third test and then a downward slope. From an average running speed of 1.30 m/s in the initial testing, it reached the value of 1.40 m/s in the third testing, and in the end obtaining a lower value than in the first evaluation, the running speed being 1.25 m/s. The execution was more and more consistent, with the standard deviation getting smaller and smaller. However, the results were not statistically significant, yielding a p-value of 0.19.

The strength in the execution of the clean exercise remained approximately constant throughout the five evaluations, with the results fluctuating between 430 N and 445 N. Following the application of the T-test, a p=0.16 was obtained, which means that there are 16% chances of the results being random, the value being statistically insignificant.

The results of the three monitored parameters were categorized as not being statistically significant, which means that the poorer results obtained in the last two tests are due to an incorrect execution technique or the fact that muscle fatigue intervened.

Power clean with 40kg:

Following the statistical analysis of the results in terms of power in the power clean exercise, it was observed that the data are insignificant (p=0.08). Initially, the average value of the six repetitions was 556 W, at the second test it seemed that the results were following a favorable course (592 W), then, at test number 3, the value returned close to the initial one (557 W). In the last two tests it was noticed that the results dropped a lot, obtaining values of 518 W and 527 W. The standard deviation had very close values in test 1, 2 and 4 having the values of 30, 36 and 33. In the test of third, a larger standard deviation was observed, which means that the repetitions were not performed as consistently. At the final testing, the lowest value of the standard deviation was obtained (19), representing a greater constancy in the execution of the exercise.

According to the results of the five tests, the execution speed follows a curve similar to that of the previously described power parameter, obtaining the following average values: 1.28, 1.35, 1.26, 1.19 and 1.21. Comparing the first test with the last test it was observed that there is more than 5% chance that the data was obtained by chance.

Regarding the strength, according to the results illustrated it could be observed that the values remained approximately constant, oscillating between 435 N and 439 N. Applying the T test on these data a statistically insignificant value was obtained (p=0.44).

Squat with 70kg:

During the preparation period it can be seen that the power with which the squatting exercise was performed increased a lot until the third test, reaching from a value of 422 W to a value of 676 W, then until the end it decreased to the value of 592 W. It was also observed that the standard deviation gradually decreased from the value of 168 to 23 at the final testing, meaning that the repetitions were performed more and more consistently regardless of the power exerted by the lower limbs. Applying the T-test, it was proven that the data is highly statistically significant, with the p value of 0.02.

Regarding the execution speed of the squats, it was observed that the values increased and remained approximately constant in the last tests, the squat being initially performed with a speed of 0.57 m/s, so that in the final testing it reached be executed with an average speed of 0.78 m/s. The repetitions were

performed more and more consistently, with the standard deviation decreasing from the value of 0.22 to the value of 0.3. The p-value was 0.03, which is statistically significant.

Similar to the pattern observed for power and speed parameters, the mean force value increased and the standard deviation value gradually decreased. Comparing the initial assessment with the final assessment, it was observed that the results are statistically significant (p=0.03).

As for the step jumped starting from the two different positions, an evolution was observed reaching from the length of 5.24m to 6.44m in the first variant, and from 5.31m to 5.93m in the second variant. In both cases the execution time of the three steps increased, reaching the value of 1.85s and 1.49s, respectively.

Discussions

Strength training, Slimani says, is an effective training regimen for improving muscle strength in young athletes. However, "age" and "gender" had effects on height with respect to the jump squat exercise. This finding may be explained by maturation and sex-specific physiological characteristics. In the same paper it was specified that longer periods of strength training (≥8 weeks) are more effective in inducing better results in the jump squat exercise in both child and adolescent athletes compared to short-term interventions (<8 weeks) (Slimani et al, 2018).

Gacesa carried out a study whose purpose was to investigate the variable values of power in athletes involved in different sports disciplines and to compare these values in relation to the specific requirements of each sport discipline. He observed that the highest strength values were measured in athletes who practiced volleyball and basketball, the results being statistically significant (Gacesa et al, 2009).

Meng Ni, in a 2016 study stated that a 3-month muscle strength program significantly reduced bradykinesia and increased muscle strength and power in elderly patients with Parkinson's disease. Strength training is an effective way of training to improve physical function and quality of life for people with Parkinson's disease (Ni et al, 2016).

The results of a study carried out in 2010, suggest that the distances covered in the one-legged jump and the one-legged triple jump exercises are good indicators for predicting performance in the first 10 m after the start (Habibi, et al., 2010).

Force application technique is a determinant of performance in the 100 m, which is not the case for the maximum force that subjects can apply on the ground. The orientation of the maximum force applied to the running surface at the time of acceleration is more important than its amount (Morin et al 2011).

According to Slawinski, to get the best possible start, performance sprinters designed their center of gravity as close to the finish line as possible. He stated that greater muscle strength and better arm coordination lead athletes to have a greater rate of power development and to impart greater center-of-gravity velocity (Slawinski, et al., 2010).

One study compared ballistic exercise training to strength training with weights. Both forms of training have been shown to be effective in the short term, but in the long term, weight training provides better results by improving maximal strength (Cormie et al 2010).

A study carried out on 12 sportswomen analyzed the neuromuscular activation of the lower limbs performing the jumping squat exercise, with different rest periods. The results showed that statistically significant improvements ($p=0.001$) were achieved after the 30 second, 1 minute, 2 minute and 3 minute breaks. After a 5-minute break, the results were statistically insignificant ($p=0.43$). We can say that we get better results in terms of the strength of the lower limbs if they perform the exercises with breaks of maximum 3 minutes (Satavand et al 2021).

Conclusions

In conclusion, the training program for developing the power of the lower limbs was 50% effective, obtaining statistically significant results in 2 of the 4 exercises performed during the evaluations.

After the training, the performance improved in the first three steps from the start, which means that the training is effective for the development of power in the start phase of speed tests on short distances.

Specific training for power development is very important, but the perfecting of the execution technique should not be neglected in order to obtain the best results with the least effort, i.e. to be as efficient as possible.

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COGNITIVE DEVELOPMENT THROUGH MOVEMENT GAMES IN ELEMENTARY SCHOOL PUPILS

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ABSTRACT. Introduction. As one of the most fundamental activities of childhood, dynamic game can have a primary significance as a mean of recreation and gradually advance to a major pedagogical influence. Movement games are an ideal means of education, fulfilling the highest level of movement, motor and cognitive development, personality shaping and social integration, ensuring the formation of a strong profile of the primary cycle graduate. The way the student responds, applies and adapts to the rules imposed by the game directly influences memory, thinking, language, creativity, sensations and perceptions, thus, its implications hold a significant percentage in cognitive development. **Objectives.** 1) knowing of the implications of motion games in the cognitive development of primary-cycle pupils; 2) increasing the attractiveness of physical education lessons; 3) learn to spend free time as actively as possible. **Methods.** The knowledge test contains 10 items and was applied to 54 students in the 3rd and 4th grades in rural areas, divided into control group - 27 students and experimental group - 27 students, following the implementation of a dynamic game program applied to the experimental group during the school year 2021-2022. Knowledge testing verifies how they have understood the games and the ability to use, adapt or build them in a personalized way. **Results.** The knowledge test has a maximum score of 10 points, each question being scored differently. The average score for the experimental group is 9.11 points and for the control group is 6.27. The difference between the result obtained by the experiment group and the control group is 2.84 points, a difference that confirms the proposed objectives given the dynamic game program applied to the experiment group.

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Conclusion. Applied dynamic games aim to stimulate students' thinking, attention, memory and creativity in a fun way that does not provide the fear of rejecting their own ideas, rewarding and encouraging all attempts to build new dynamic games.

Key words: *cognitive development, movement games, elementary school.*

Introduction

Play, through the various forms it takes, is a method that never loses the curiosity of researchers and teachers, regardless of the discipline by which it is applied. Its usefulness starts by getting used to different rules, accumulating new information without the appearance of boredom, to awareness of involvement in activities, bearing defeat, developing courage and teamwork (Șchiopu & Verza, 1997). All the more, the contribution of the play represents a higher contribution, especially at the level of the primary classes, positively influencing the child in preparing for adult life.

It is known that the valences of physical education act on many levels, including cognitive development, improving thinking, attention, memory, creativity, and modeling a balanced, autonomous and prepared behavior to deal with the challenges of society. Physical education and sport classes have a positive influence on physical, cognitive and socio-emotional development and it can even be said that it is the only discipline that manages to have implications on all these educational components, contributing to the improvement of school performance (Corbin, Pangrazi & NASPE, 2004; McCluskey et.al, 2021; Yachmenev & Rubanovich, 2017). The dynamic play performed during the classes will provide a base for spending free time, succeeding through the learning process to ensure the optimal acquisition of the physical, socio-emotional and cognitive development: attention, memory, language, thinking, creativity or imagination, formation of sensations, perceptions and representations. (Wyver, 2019). Carson and Predy (2019) points out that regardless of the type of games or whether or not they are directed, children successfully participate in the learning process in a stimulating and enjoyable way.

Dynamic games are a main means of harmonious development of elementary school student, being performed to ensure physical development and motor skills. The use of motion games as an active system in the formation of general and specific competences of the discipline, has a favorable effect in the development of students, especially at the primary level, representing in the

same time one of the most important methods used for the elevate degree of fascination that has on the childhood period. When we talk about the movement game, it is mostly done outdoors, because it requires a more generous space to be able to achieve the proposed objectives. For example, from our experience in the department, if we propose to children in the primary class to carry out activities through motion games, outside, outdoors, they will unanimously agree to this way of performing the lesson. We mention that the game in the physical education lesson, in different forms, gives them the opportunity to manifest themselves freely and thus the main educational components are strengthened. The creativity of the physical education teacher makes the difference between a monotonous lesson and a lesson full of emulation and conscious participation on the part of students regarding the acquisition of multidisciplinary knowledge, also bringing into play elements from other disciplines that make up the national curriculum. This way of teaching has the effect of a strong consolidation of the accumulated knowledge palette, offering possibilities to select knowledge, to build strategies for solving requirements and to cooperate in solving problems. During the game, there is an assimilation of impressions and reactions that leads to the development through functionality, training and organization of a mental nature. Therefore, through play specific behaviors are manifested, practical and mental action schemes are developed that stimulate and fuel the development process. Outdoor motion games will involve children in leisure activities, managing to be more active and more cognitively and socio-emotionally responsive, with positive results on learning and forming the global personality.

From studies conducted (Carson & Predy, 2019; Wyver, 2019; Abdelkarim et al., 2017) as well as the opinion of several authors (Cârstea, 2000; Matveev & Novicov, 1980; Stănescu, Ciolcă & Urzeală, 2004) it is considered that movement games have a multitude of positive influences determined by the following characteristics:

- it's have been part of the physical activity of the individual since ancient times;
- it's an activity that produce self-stimulation, maintaining a high level of interest for knowledge and exploration;
- it's can be organized during lectures, recreations, in extracurricular activities or in their free time and have a broad creative initiative in choosing the means to achieve the intended goal;
- being based on the natural way of movement and manipulation of one's own body demonstrates native or acquired abilities, ingenuity, creativity, in other words a behavior appropriate to moral ideals;
- develops interpersonal relationships: collaboration, respect, critical spirit, self-criticism and observation, assuming responsibilities;

- it starts from the simple, reaching through repeated and methodical use, to the complex, ensuring the formation of competencies using the approach of several ways of solving for the proposed contents;
- it helps to develop their motor skills in a pleasant and accessible form;
- at the cognitive level they can positively influence executive functions like inhibitory control, working memory and cognitive flexibility, which are the basis of the general development of the child;
- it's increasing the memory productivity thus the game manages to impregnate it a categorical voluntary character from preschool age and with continuous imprint throughout the primary cycle on the rules fixation, recognition and reproduction;
- helps the development of oral or action language by actively participating in the communication process; The children's vocabulary is increased by describing their own actions or those of their teammates, which will bring positive results for verbal communication and the accumulation of new knowledge.
- through them, students experience the active environment, adapt to new situations, maintain optimal physical and mental health, stimulate their permanent need for movement and favor the use of physical activities as a way of spending free time;
- they can assess students' ability to apply the acquisition of knowledge and skills.
- they are more preferable to be made outdoors, to combine the factors of hardening of the body but also offering the opportunity to be allowed to unfold and express as close as possible to their natural behavior, also the relationship of movement game - outdoor activity is relevant knowing that the level of health and development can be achieved especially if it is achieved in places with maximum oxygen intake and rays of sun, cheerful and colorful nature;
- develops moral and willpower qualities as diligence, distributive attention, capacity for anticipation and courage;
- prepare the student for the introduction to the labor market: physical and psychological fortification, it creates skills and habits for group collaboration, for the application of their own actions, for the combination of joint effort in order to achieve a goal and for the joy of living - happy children will become active and optimist adults involved in the activities of the society.

Through play, as the acquired skills develop in accordance with the child's stage of development, the desire to apply them in informal activities increases. Through experimentation, the child will be able to invent many games in which to apply the skills obtained: games on the playground, cooperative games,

games with various themes or musical games. A program loaded with such games will give the child pleasure and the challenge of experiencing new things with maximum interest throughout his life.

Objectives

- knowledge of the implications of movement games in the cognitive development of primary school students;
- increasing the attractiveness of physical education lessons;
- enriching the baggage of knowledge for spending leisure time in the most active way possible.

Method

The knowledge test consisting of 10 items was applied to the control and experiment groups in 2022 may, following the completion of the implemented program. The test was attended by 24 third-graders and 30 fourth-graders pupils. During the implemented program, the students from the experimental group participated in various games that were explained, offering also various possibilities of adapting them according to the conditions existing in the area where they live in order to be performed in their free time, while the control group students followed the application of the curriculum in a classic way. Knowledge testing verifies how students in the experiment group understood the games and the ability to be able to use or build them in a personalized way compared to the baggage of knowledge accumulated by the students in the control group.

Results

For the analysis it was resorted to the calculation of the sum of the scores obtained by both groups as well as to the average of the scores obtained in total, by classes, groups and per item separately.

The maximum sum of the scores is 270 points, and according to Table 1, the experiment group managing to accumulate a total of 246 points out of which 104.25 points by third graders and 141.75 points by fourth graders, and the witness group managed to accumulate 169.5 points out of which 79 points by third graders and 90.5 points by fourth graders. Third graders were able to answer questions to almost the same extent as fourth-graders from both groups, with item scores even higher than the fourth graders on some questions.

Table 1. The points sum obtained by both groups

Involved students	Experimental group	Control group
3rd graders sum	104.25	79
4th graders sum	141.75	90.5
Total sum	246	169.5

Table 2. The average of the score obtained by both groups

Involved students	Experimental group	Control group
3rd graders avg	8.68	6.58
4th graders avg	9.45	6.03
Total avg	9.06	6.30

The knowledge test shows a maximum score of 10 points, each question being scored differently. The average of the score obtained on each group and class according to Table 2 shows that the third graders in the experiment group obtained an average of 8.68 points and the fourth graders an average of 9.45 points, while the students in the third graders control group obtained an average of 6.58 and the fourth graders obtained an average of 6.03 points. The average total score obtained by the experiment group is 9.06 points, and for the control group it is 6.30 points. The difference between the result obtained by the experiment group and the control group is 2.76 points, a fairly large difference that confirms the validity of the proposed hypothesis, given the diverse program of games applied to the experiment group. The experiment group also scored very close to the maximum, only 0.94 less than the maximum 10 points awarded.

For the interpretation of the knowledge test, it was taken into account the calculation of the average score obtained also on each question, comparing the results obtained by both groups with the maximum score granted for each item.

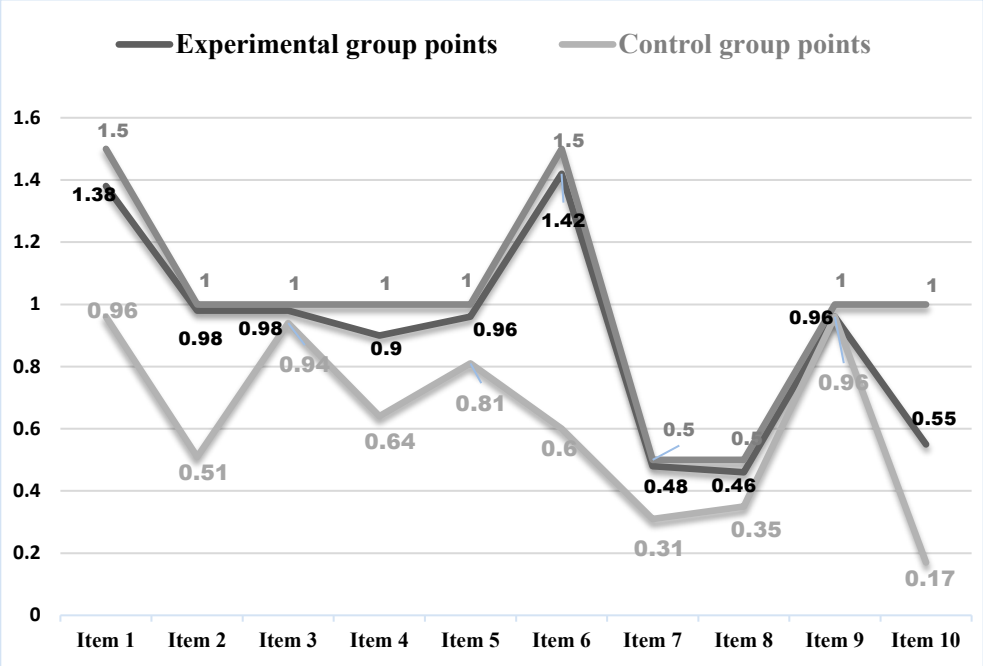

Figure 1. *Average of points distributed on each item for experimental and control group*

• Item 1 refers to the ticking of the boxes having games that have in their content the motor skill of running, the maximum score awarded being 1.5 points, 0.5 points for each box correctly ticked. The experiment group accumulated an average of 1.38 points and the control group an average of 0.96 points. The difference between the maximum score and the experiment group is 0.12 points, and between the maximum score and the control group is 0.54 points. The students in the experiment group averaged the score 0.42 higher than that of the students in the control group. Regarding the distribution of the average score by group and by class, for the experiment group the third graders obtained an average of 1.37 points and the fourth graders an average of 1.40 points, and for the control group the third graders obtained an average of 1.12 points and the fourth graders an average of 0.83 points. Although for the control group the students of the fourth grade are of a higher age, the students of the third grade recorded a higher average score on this question.

• In item 2, the students had to list two movement games that can be made with the handball, respectively the football one, being able to obtain a maximum score of 1 point, 0.5 points for each game listed. The students in the experiment group did very well, obtaining an average of 0.98 points, and the

students in the control group obtained an average of 0.51 points. The students of the 4th grade in the experiment group obtained the maximum score compared to those from the 3rd grade who obtained an average of 0.95 points. For the control group, the third graders recorded a better score average than the fourth graders students, respectively 0.66 points compared to 0.4 points. The difference between the experiment group and the control group is 0.47 points.

- The maximum score on item 3 is 1 point and was obtained by correctly ticking the box that names the game that follows the development of breathing. Both groups involved in the test scored very well, close to the maximum: 0.98 experiment group points and 0.94 control group points. The third grades from each group recorded a maximum score, and the fourth grades obtained an average score of 0.96 points for the experiment group and 0.90 points for the control group.
- Item 4 gave a maximum score of 1 point and was awarded for listing two things that the student can use to be able to make a ball that would have the shape and size of a tennis ball. They showed creativity, especially in those within the experiment group who scored 0.9 points, 0.26 more than the control group that scored 0.64 points. The students of the experiment group of the third grade obtained the average of 0.83 points and those of the fourth grade averaged 0.96 points, and the students of the control group of the third grade averaged 0.83 points and those of the fourth grade 0.5 points. Among the most options listed by the students are paper and clothing items.
- Item 5 also has the maximum score of 1 point, awarded for listing two material resources used instead of bowling pins, for making the game Pins. Both groups obtained an average score close to the maximum, the experiment group having the average score of 0.96 points and the control group an average score of 0.81 points. The 4th grade from the experiment group obtained the maximum score and the 3rd grade of the same group 0.91 points, while from the control group, the 4th grade scored 0.76 points and the 3rd grade scored 0.85 points. The students' most ingenious solutions were bottles, glasses, milestones and even wood cut to about the same size and arranged like pins.
- The sixth requirement consists of 3 sub-tasks, each corresponding to the ticking of a single correct answer for which 0.5 points are obtained, with a total score of 1.5 points. The first item has as a requirement to tick the correct answer for the main muscle group developed through the game The Fight of the Roosters, the second item the choice of the main resource used to make the game Transport with Rolling, and the third item requires the choice of the number of balls necessary to perform the game Countries. The experiment group accumulated a score average of 1.42 points, of which those in 3rd grade obtained an average of 1.33 points and those in 4th grade obtained an average

of 1.5 points. The control group obtained an average of 0.6 points, of which those from 3rd grade obtained an average of 0.5 points and those from 4th grade an average of 0.68 points. The difference between the average of score of the experiment group and that of the control group is 0.82 points.

- Item 7 is an open question where students must name a game that takes place on music, accumulating for a correct answer a maximum score of 0.5 points. The experiment group accumulated a score average by 0.17 points higher than the control group, respectively 0.48 points and the control group averaging 0.31 points. The score obtained by class is as follows: the experiment group – the 3rd graders an average of 0.5, the 4th graders an average of 0.46, and the control group – the 3rd graders an average of 0.33, the 4th graders an average of 0.3 points. In both groups, the students from the 3rd grade obtained an average score higher than the ones from 4th grade. Among the most famous games performed on a musical background are the Musical Chairs, the Ice Cream and The Bear is Sleeping.
- The requirement of item 8 is to name a game that develops attention. From the maximum score of 0.5 points, the experiment group obtained an average of the score of 0.46 and the control group an average of the score of 0.35. Depending on the average per grades and group, in the experiment group, the 3rd graders scored 0.41 points, the 4th graders scored the maximum of 0.5 points, and in the control group, the 3rd graders scored 0.29 points and the 4th graders 0.4 points. The most listed games are: Remember the number, Reverse Command, Clockwork, The Hide and Seek and The Ducks and Hunters.
- In item 9, the students must draw lines from the column with images to the column containing the corresponding word, each correctly drawn line being awarded 0.25 points, and the maximum score obtained is 1 point. The images depict body positions specific to athletics, gymnastics, football and handball, which are approached through playful activities during the school year. This requirement is the only one in which the students of both groups recorded the same average of the scores of 0.96, being also very close, at a difference of 0.04 points, to the maximum score granted.
- The last requirement verifies the memory and creativity of students as a result of the games implemented in the planning during the 2021-2022 school year. They must build a relay or game that has in its content resources such as balls, milestones and ropes, in order to obtain a maximum score of 1 point. It is the question on which the students recorded the lowest score: the experiment group with the average score of 0.55 points and the control group the average score of 0.17 points. Students who described a relay or a game were able to describe their own ones without listing those performed during the physical education class, and some of them were made in class to encourage students to have a desire to practice their own activities in their free time as well.

Conclusion

The contribution of the use of movement games is founded in the efficiency of the physical education lesson, in the determination of students to participate in activities with pleasure and enthusiasm, in the formation of motor skills that will make him aware of his possibilities.

The involvement of students in performing movement games during physical education lessons is an important basis of knowledge on how to spend their free time, offering desire to stay outside, make new friendships and have a healthier lifestyle. The time spent through the game stimulates the student to observe, to be attentive and creative, to think and forces him unconsciously to seek and find solutions to solve the requirements by collaborating with others.

Applied dynamic games aim to stimulate students thinking, attention, memory and creativity in a fun way that does not provide the fear of rejecting their own ideas, rewarding and encouraging all attempts to build new dynamic games. The students learned that there are no ideas or misconceptions, but only things that can be improved, of course with the help of the teacher.

We consider the game as a method that combines the traditional with the modern, managing to guide the student in going through the most attractive and interactive cycles of education, offering a stable and strong foundation to successfully face the challenges of adult life.

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TREATISE ON TRIBALISM AND MYSTICISM IN SPORT: MOS MAIORUM VS. LEX NON SCRIPTA

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ABSTRACT. There is a belief that tribalism and mysticism have no major role to play in current sport performance environment. Consequently, sport visions are implemented based upon the intrinsic recommendations of the system itself. However, a deeper investigation of the inter-human interactions on a group level of the world of sports may offer another way of understanding the complexity of human-to-group interrelation in our field of study. This paper examines the literature relating to tribalism from a sociological, psychological and philosophical point of view and its relevance to the world of sport. A better understanding of how group identity, traditions and unwritten laws shape the community's morality judgments can lead to a more rational and healthier way of undertaking reforms of policies.

Keywords: *tribalism, sport, philosophy, group interest, morality.*

Introduction

Indoctrination into tribalism

There is, if seen from outside the box, a continuum of tribalism structure and identity in our society since times immemorial. It started as a form of social structuring and governance that, through the ages, gave way to newer and more

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complex forms of organizing nations or people. Even though simpler by comparison, tribalism emerged from a deep personal and subjective root: clan and by proxy the family-relations.

The drive for survival and fear of the conceptual "others" meant that the clans based on birth relations opened the way for tribalism. It would allow various size social groups to create an aura of perceived safety from their tribal-bubble. Thus, creating a strong feeling from an early age that the conceptual "us" means life as opposed to the conceptual "they", which could come and perturb "our" way, was mandatory. Imposing beliefs on younger minds had the effect of materializing an invisible blackmailing entity that would coerce the members of the community to prioritize their group rather than pursuing personal desires and drives, that may, at a first glance, put the tribe in danger (Maffesoli, 1996).

In our modern times, the feeling of belonging to a tribe can have its foundation on other "reasons" but all can be reduced to survival: survival in the workplace, survival in the school, survival in the living community or survival in the group. The foundation can take a more convoluted form than the simple reduction stated previously but in the end will have the same tribe-generating outcome. Once the tribe is formed, the next step is the materialization of the blackmailing and coercing, invisible and non-governed authoritarian aura that would drive the individual to submit to the group. It must be stated that this abstract entity oozes out of the beliefs and principles of the group as a whole, and it isn't the creation of a mastermind behind it all. In the end, it is a self-regulated, automated oppression system for the group (Maffesoli, 1996).

At a macro-scale, tribalism stopped being the official form of governance but there is one field of human life that it is prevalent: sports.

Identity is currently in the spotlight in discussions of politics, society and consumption, according to Gabriel and Lang (2006). Additionally, people involved in sports are preoccupied with the validation of their own identity as authentic by the others or the group (Gabriel & Lang 2006, p. 89).

Members of a sports-tribe have a strong emotional attachment to an entity, whether it is a club or a legacy (Jurisic & Azevedo, 2011). Sports-tribes differ from sport communities in that they: do not control members' life, are rather than playful stanch, are ephemeral, and are legacy oriented (Goulding et al., 2013). In a postmodern sense, the tribe is revered for its ability to unite members with some sense of social hierarchy, thus forming a hive-mind controlled collective (Cova & Cova, 2002; Maffesoli, 1996).

Tribal membership is based on social connecting, hedonic-based value rather than utilitarian equity, with dyadic communication and emotional exchange as central components of the collective relationship (Veloutsou, 2007). To illustrate, sports-tribal network influence and a preference for interpersonal influence

come before general social membership; in fact, tribal members may be more loyal to the tribe to which they belong than to the social context it represents (Ruane & Wallace, 2015).

Ardent legacy-focused relationships have been described as tribes, with the formation of a community or tribe stemming from an emotional bond with the common traditions of the members (Jurisic & Azevedo, 2011). Sports-tribes are supportive of their members (Luedicke and Giesler 2007) and are united through shared interpersonal and social experiences (Cova 1997), as evidenced by the hive-mind of a group of sport tribe members gathered at a random event. Sahlins (1961) presents an anthropological view of tribalism that includes segmentary lineage (kinship that binds tribe members together), social structure (tribe members' perceived sense of unison), sense of community (tribe members' ability to coexist harmoniously), and defense of the tribe (tribe members' emotionally charged enmity toward opposing tribes).

Mos maiorum (the custom of our ancestors)

According to Schouten and McAlexander (1995), subculturally created laws can be shared or imitated by a much larger community outside of the core subculture, and can even be adopted by the higher hierarchy. We see clear evidence of this in the sports subcultures where members may adopt tribal customs that they never experienced, yet they blindly obey the seemingly stronger customs associated with the smaller sports tribe. Tribal mos maiourm is a distinct subset of society that self-selects based on a shared commitment to a specific legacy, shared feeling of membership, or togetherness activity. Other characteristics of a tribal mos maiorum include an identifiable, hierarchical social structure; a distinct ethos, or shared set of beliefs and values; and distinctive jargon, rituals, and models of symbolic expression (Schouten & McAlexander, 1995).

Sports customs, according to Green (2001), are segments of tribal society that embrace specific cultural elements of their own, such as: a shared set of identifiable beliefs, values, and means of symbolic expression. A sports-tribe is not a single subculture in and of itself, but that each tribe incorporates distinctive values and beliefs, and each provides varied venues for symbolic expression of those values and beliefs. These sports collectives can be accessed through both direct and indirect participation. Participation in a sport-tribe is rarely limited to one type of involvement.

A former footballer, for example, may only play once a week but still subscribes to the original mos maiorum of their tribe, follows the legacy build through the decades and never questions the metaphysics of tribe-created way of thinking. Regardless, this may involve social interaction with other members

of the tribe, which results in members "learning" the tribes's unique values and beliefs, i.e. members are socialised into the specific spors-tribe, and the tribe's values and beliefs are reinforced as a result of this process.

Lex non scripta (unwritten law)

Conventions in sports are often referred to as unwritten rules. Unwritten rules, also known as moral laws in sports, are rules that are not written down in documents. Although no official regulation exists, it is more akin to a promise kept by tacit public consent. Unwritten rules generally apply to actions that provoke or mock opponents in situations where victory or defeat has already been determined. In soccer, for example, a player on a winning team should not intentionally provoke or play tricks on a losing opponent with a dribble, such as a stunt. This unwritten rule does not apply only to team sports like basketball, soccer, and baseball.

Is this kind of behavior in sports truly respectful and considerate? The essence of unwritten sports rules, then, is respect for opponents? Is retaliation often justified when the opposing team violates these unwritten rules? The position in favor of the unwritten rule emphasizes the importance of' respect and consideration for others' (Feezell, 1986; Keating, 2018; Simon, 1991). While sports are based on competition, it is easy to lose dignity if there is no courtesy and respect for the competitors.

In other words, in the world of competitive games, where the unwritten rule protects the team's solidarity and dignity regardless of the outcome and provides a device for checking each other, it has the effect of pre-emptively restraining play against sportsmanship. However, there are as many opponents of unwritten rules in sports as there are supporters. The opposing viewpoint contends that what fans want is a game in which the players give their all, not friendship between the players. It is also said that when the score difference is large, what is required is 'invigoration' rather than 'comfort' (Dixon, 1999, 2000; Russell, 2018).

Sporting competition can teach us many valuable lessons. Some argue that losing is more valuable than winning in competition.

Mysticism in sport

There has been a significant increase in writings over the last thirty years that have identified the potential of sport to act as a vehicle for experiencing the religious and mystical dimensions of life and, as a result, a sense of psychological well-being. Modern athletes frequently use religious and spiritual

metaphors to describe self-transcendent experiences that appear to have a supernatural origin. There are numerous documented testimonies from athletes from both the "mainstream"—for example, football, hockey, golf, and tennis—and so-called "extreme sports" who have had experiences that have been interpreted as mystical, occult, or religious (Murphy & White, 1995).

Peak experiences (Ravizza, 1984), states of flow (Csikszentmihalyi, 1975), moments of deep play (Ackerman, 1997), and Zen states (Herrigel, 1999) have been used by psychologists and sport theorists to describe athletes' experiences of the mystical and being-in-the-zone. These positive psychological states can be legitimately grouped with mystical and religious experiences and are commonly referred to as altered states of consciousness (ASC). Taking athletes' ASC at face value, which is frequently rich in religious and mystical language, a number of contemporary authors have made the dubious leap of implying that sports can provide an avenue to mystical and religious experience in and of themselves.

While this small corpus of writings on mysticism in sport provides interesting and insightful commentary, one could argue that it lacks theological rigour at times, as well as etymological naivety. Theological terms like "mystical" and "numinous" (Prebish, 1993) are frequently applied to sporting experiences.

Conclusion

Given that tribalism in sport seems to have a strong grip of the individual's decision making through the legacy and traditions it permeates, it is worth considering the degree of alteration policies and laws in the field of physical education and sport have been subjected to. The shackles that such a tribal mentality puts on individual morality, principles and wills may be detrimental in the long run due to the core nature of the tribal society: the preservation of the status quo through the traditions and unwritten laws passed down through the generations.

The existence of mysticism, unwritten laws and tribal customs in the field of sports closes the doors to individual-oriented policies and should always be challenged. Testing the policies implemented based on decades or centuries old uncontested-traditions will, eventually, reshape our field into an objective representation of individual moral framework, rather than the group or collective mentality.

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COMPARISON BETWEEN UNIPEDAL AND BIPEDAL PLANTAR FLEXIONS USING TIME UNDER TENSION METHOD

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ABSTRACT. ***Introduction.*** Bodybuilding is a sport that requires all muscle groups to be similarly developed, bringing an aesthetic physique to the observers. The development of the triceps surae may be a difficult goal to achieve for some athletes. Considering this, we chose to focus on a new training method that induces less stress in muscle groups: the time under tension. ***Objective***. The purpose of the study was to compare exercises used for calf hypertrophy using the time under tension method and to identify the optimal situations in which this method could be used. ***Methods***. Ten subjects, 6 male and 4 female, age of 25.7±4.9 years old, height 174.7±9.5 centimeters, body weight 82±17.8 kg and with varied levels of fitness, participated in the study. The plantar flexions were done with body weight only on one and both feet. The exercises we tested were done on a 3 second cycle: 3 seconds on the upwards movement and 3 seconds for the downwards one. The subjects performed a total of 10 repetitions for each exercise. ***Results.*** A significant statistical difference was found between the types of plantar flexion measured. This indicates that the analysis of time under tension plantar flexion should take into account the actual type of movement done. ***Conclusions***. Time under tension method for calf muscle hypertrophy should take into consideration the movement characteristics for the focused muscle group. Our results showed that postural balance and body position can influence the force and power output of plantar flexion.

Keywords: *time under tension, triceps surae, plantar flexion, calf muscles, forces.*

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Background

Sports performance is the notion used for the special results obtained in competitions following a training plan. Trying to improve the deficient aspects brings new solutions, new strategies and ideas. Man is the only being capable of self-knowledge, a being that feels the need to evolve and assert himself both in his eyes and in the eyes of others. That is why every result obtained motivates the athlete to continue. In sports, we talk about performance and achievement as an essential and characteristic reason for athletes (Bompa & Buzzichelli, 2019; Noffal & Lynn, 2012).

Muscle hypertrophy is a complex process with many factors involved, continuous adaptation of muscle fibers and must be stimulated in different ways for the best results. Thresholds that need to be crossed to stimulate muscle mass growth vary from person to person and no one can naturally reach them passively. This process can be seen after about seven weeks of following an effective training plan. Also, this process can take longer or less depending on age and gender (Blaauw & Reggiani, 2014).

Because the means we used in this experiment use the TUT method it is important to know the minimum requirements of intensity and mechanical work that must be achieved to stimulate muscle hypertrophy (Taber et al., 2019).

In 2018, a study is carried out whose results prove that exercises with an intensity of at least 40% of 1RM (one repetition with maximum weight) performed until volitional failure can cause an increase in muscle mass to a similar extent as those that are performed with a greater intensity even when their volume is equalized (Lasevicius et al., 2018).

In 2019, another study carried out on 23 female subjects between the ages of 21 and 27 without sports training shows us that exercises performed until volitional failure with an intensity of 30% of 1RM benefited from the same results as those performed with an intensity of 80% both increased muscle mass and strength (Dinyer et al., 2019).

Another 2015 study of 18 highly trained male subjects between the ages of 18 and 35 with similar 1RM performance shows that athletes who used 30-50% of their 1RM with repetitions to failure had better results than those who used 80% of 1RM (Schoenfeld et al., 2015).

The Time under Tension (TuT) method can be implemented in the training program using any exercise at a different tempo of movement. It is important that the weight used by this method is at least 30% of 1RM to allow the athlete to perform repetitions over a time interval of at least 40 seconds. The TUT method involves the slow execution of the exercise, for a few seconds both in the concentric or positive movement but also in the eccentric or negative movement of the movement. This can be done with a tempo of at least 3-0-3, i.e. 3 seconds concentric part, 3 seconds eccentric part (Mang et al., 2022).

Objective

While there are a multitude of frequently used exercises for the triceps surae, we decided to investigate the forces generated in the less implemented Time Under Tension method. The aim of our research was to investigate, test and compare the bidepal and unipedal plantar flexions used by athletes practicing both recreational and performance fitness.

Methods

Subjects

Ten subjects, 6 male and 4 female, age of 25.7±4.9 years old, height 174.7±9.5 centimeters, body weight 82±17.8 kg and with varied levels of fitness, participated in the study.

Before the start of the study, the subjects were informed about its requirements and any ambiguities regarding participation were answered. The written consent to participate in the study was also received, as well as the consent for the processing of personal data, respecting the rules of ethics and deontology that a scientific research imposes.

Methods and the Steps of the Research

The plantar flexions under TuT method were measured on the BP400600HF force platform which can be used for engineering, medical studies, orthopedics and rehabilitation. It was designed for accurate ground reactive force measurement and measures the three orthogonal forces along the X, Y and Z axes producing a total of 6 outputs.

The test days began by preparing for exercise, i.e. performing a gentle warm-up of the joints for 10 minutes to prevent injury. After the warm-up, a test measurement was performed to accustom the subject both to the execution of the movement on the measuring platform and to acclimate them to the tempo of the exercise. For each individual subject, the ground force measurement platform was calibrated using the initial position of the exercise. Each subject performed 10 repetitions for each of the three types of plantar flexions: bipedal, right foot and left foot.

Each plantar flexion was performed with the tempo 3-0-3: i.e. 3 seconds concentric movement, 0 seconds maintaining the final position, 3 seconds eccentric movement so that each repetition has a total of 6 seconds. Between each repetition, the subject rested for 60 seconds to prevent the execution of a faulty movement and promote recovery. After completing the plantar flexions, the subject performed the post-exercise recovery of the body.

Results

Table 1. Descriptive statistics for the ascending and descending average forces for each of the 3 plantar flexions (bipedal, right food and left foot)

	Group	N	Mean	Std. Deviation	Std. Error Mean
F_ascend	Bipedal	10	49.38	11.33	3.58
	Right Foot	10	34.94	24.22	7.66
	Left Foot	10	28.36	15.06	4.76
F_descend	Bipedal	10	-43.84	13.97	4.42
	Right Foot	10	-87.92	28.69	9.07
	Left Foot	10	-71.23	13.65	4.32

Table 2. Results of the independent sample t test for the 3 plantar flexions (bipedal, right food and left foot) for the two conditions: ascending and descending forces

		N	t	df	Sig. (2-tailed)
F_ascend	Bipedal vs Right Foot	10	1.71	12.76	0.11
	Bipedal vs Left Foot	10	3.53	16.71	0.00
	Right vs Left Foot	10	0.73	15.06	0.48
F_descend	Bipedal vs Right Foot	10	4.37	18.00	0.00
	Bipedal vs Left Foot	10	4.43	17.99	0.00
	Right vs Left Foot	10	-1.66	12.88	0.12

An independent-samples t-test was conducted to compare ascending force in bipedal and left foot conditions. There was a significant difference in the scores for bipedal (M=49.38, SD=11.33) and left foot (M=28.36, SD=15.06) conditions: t (16.71) =3.53, p = 0.00. These results suggest that TuT method does have an effect on ascending force between bidepal and left foot.

An independent-samples t-test was conducted to compare descending force in bipedal and left foot conditions. There was a significant difference in the scores for bipedal (M=43.84, SD=13.97) and left foot (M=71.23, SD=13.65) conditions; t (17.99) = 4.43, p = 0.00. These results suggest that TuT method does have an effect on descending force between bidepal and left foot.

An independent-samples t-test was conducted to compare descending force in bipedal and right foot conditions. There was a significant difference in the scores for bipedal (M=43.84, SD=13.97) and right foot (M= 87.92, SD= 28.69) conditions; t(18.00) = 4.37, p = 0.00. These results suggest that TuT method does have an effect on descending force between bipedal and right foot.

The results of the independent-samples t-tests for the other conditions showed no statistical significant difference: bipedal and right foot forces on the ascending movement, right and left foot on both the ascending and descending movements.

Conclusion

The fact that there was no statistical difference between bipedal and right foot ascending forces but there was one between bipedal and left foot is interesting if viewed through the fact that all subjects were right hand dominant. TuT seems to influence the ascending forces differently depending on which part of the body has more dexterity. We suggest that a larger study should be conducted in the future to test this on a wider population because, if this is a general effect of TuT, it could mean that its implementation should be dependent on the dominant hand of the subject.

At the same time, there have been significant statistical differences between bipedal and either foot for the descending forces. It seems that from a neuromuscular control point of view TuT can influence the forces generated on either foot. Considering the fact that most of the work of the calfs is to push not to pull the body, this result may be normal. This means that TuT should be used for a more general workout of the calf muscles to cover both the eccentric and concentric movements.

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ENHACEMENT OF SWIMMING KINEMATICS AND PERFORMANCE THROUGH PROPRIOCEPTION

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ABSTRACT. Proprioception is closely linked to control of movement, and it has been shown that athletic performance is based on good proprioceptive abilities. The purpose of this study was to examine whether the weighting of the fist joints (in the form of weighted fabric wrist cuffs) has an impact on the swimming technique and thus on performance in freestyle swimming. A number of 16 male subjects with a medium age of 20.74 years took part in our study and were distributed into 2 separate groups: experimental group and control group. Calculations were made using descriptive statistics and the data for the participating subjects proved to be statistically relevant. Using stimulating elements for proprioception can render positive effects on the swimming technique in freestyle swimming and thus on athletes' performance.

Keywords*: motor control, proprioception, sports performance, training methods*

Introduction

In the last century, two theories were postulated regarding the command to move: first, it was associated with central signals (Helmholtz, 1867; von Holst, 1954) and second with the peripheral sensory feedback (Sherrington, 1900). However, in the last 50 years, studies have shown that the command to move has a peripheral origin, at least for the perception of limb movement, and the

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focus subsequently shifted to identifying the predominant sensory receptor. Recently, it has been agreed that feedback from muscle spindle receptors is the most important source of proprioceptive information (Gandevia, 1996; Kandel et al., 2000; Smetacek & Mechsner, 2004; Collins et al., 2005), although arguments have also been made over the years for receptors in the joints (Boyd & Roberts, 1953; Ferrell et al., 1987; Gelfan & Carter, 1967) and skin (Edin & Abbs, 1991; Gandevia & McCloskey, 1976; Provins, 1958).

Proprioceptive training is an intervention aimed at improving proprioceptive function. It focuses on the use of somatosensory signals such as proprioceptive or tactile afferents, when there is no information from other modalities such as vision available. (Aman et al., 2014). In this understanding, proprioception can be defined as the ability of an individual to integrate sensory signals from central integrated mechanoreceptors in muscles, tendons, joint capsules, ligaments, and skin (Salles et al., 2015), thereby determining positions and movements of body segments in space (Han et al., 2016, 2013, 2013; Goble, 2010, 2009; Suprak, 2011). Submodalities of proprioception in this relation are: kinestesia, joint position and force sense (Salles et al., 2015).

Later microneurographic studies suggest a possible cutaneous contribution to kinesthesia; cutaneous receptors in the hand (Edin, 1992, 2004; Edin & Abbs, 1991; Grill & Hallet, 1995; Burke et al., 1988; Hulliger et al., 1979) and around the knee (Edin, 2004) may provide information about the position and movement of nearby joints.

A growing number of researchers, particularly in the fields of exercise, sport, and rehabilitation, are recognizing the importance of central processing of proprioception in understanding human movement. For example, there is evidence that central processing of proprioception may play a role in athletic performance (Pop & Ilisei, 2021; Han et al., 2015; Smetacek & Mechsner, 2004).

In competitive sports such as swimming, precise and coordinated body movement is key to success. In recent decades, training methods have changed largely due to the fact that the role played by sensory information in neuroplasticity through use-dependent mechanisms is better understood. Proprioception is considered the most important source for promoting task-specific neural development (Han et al., 2016; Goble, 2010).

As shown in several studies, swimming training programs incorporate elements of resistance training to increase the load on the muscular system. Overloading the muscular system, increases muscle strength and thus the swimming propulsion. This rather direct link between muscle strength and swimming speed has been confirmed in various studies (Gourgoulis et al., 2019, 2006; Barbosa et al., 2008; Cochrane et al., 2015; Dingley et al., 2015; Garrido et al., 2010; 2010; Girold et al., 2012; Morouco et al., 2012; Newton et al., 2002).

Regardless of the apparent training results, it is not certain how strength training affects proprioception, although authors have described the effects of muscle strengthening on proprioception (Salles et al., 2015).

In addition, we did not find studies related to the improvement of coordination and motor control in relation to athletic performance in general and swimming technique in particular. Therefore, the aim of our study was to investigate the effect of loading the distal upper extremity with weighted fabric wrist cuffs on swimming technique during front crawl stroke (FCS).

Methods

Sample

16 male undergraduates (average age 20.74 years, mean height 176.3 cm, mean weight 73.8 kg) were part of this study. The subjects have been swimming for 3 ±0.2 years on average and on a regular basis, taking part in 3 training sessions/week. All subjects were in good health condition, without any history of upper limb injuries. They were divided equally and randomly distributed in 2 groups: control group and experimental group. All participants were asked to sign an informed consent document before entering the study.

Experimental Procedure

Participants were briefed not to perform any other swimming activities during the 8 weeks of the experiment, to reduce any potential influence on the study results. For 8 weeks, both the control and the experimental group attended the swimming program consisting of 3 sessions per week (Monday, Wednesday, and Friday) at the same time and place. After an 800 m warmup by choice at moderate speed, each swimming session consisted of drills meant to improve the FCS technique. Emphasis was laid on one-arm drills, followed by combined exercises closer to the full stroke on 50 m. The experiment group put on the weighted fabric wrist cuffs (WFWC) after completing the warmup and removed them after finalizing the FCS technique drills. WFWC weighed 150 grams.

Measurements

We measured the time necessary to complete 50 m FCS, starting from the water using a FINIS 3x300M stopwatch. We decided upon this approach, in order to rule out potential differences based on poor/good start from the block. Each subject had 2 attempts with 3 minutes in between. The best attempt was recorded as the initial time. The same procedure was repeated after the experimental period of 8 weeks.

Statistical Analysis

We computed average values for each measurement, both for the initial and the final ones using SPSS, IBM Corporation Armonk, NY.

The distribution of the measured parameters was determined using the Shapiro - Wilk Distribution Test prior to statistical testing. Based on the results of the test (value of the distribution coefficient, p), a normal distribution was found for the parameters measured in the initial measurements and in the final measurements; a normal distribution was also found for the experimental group ($p > 0.05$ in each of the mentioned measurements). The normal distribution determined in both measurements denotes a linear evolution/involution of the subjects (all subjects responded similarly after training).

Table 1. Descriptive analysis – time parameter

Group	Mean value	Standard deviation	Median	Shapiro – Wilk
Initial measurement				
Time 1 – control group	51.84	± 6.239	50.84	0.901
Time 1 – experiment group	39.85	± 5.98	39.24	0.08
Final measurement				
Time 2 – control group	48.65	± 5.32	47.51	0.554
Time 2 – experiment group	37.5	± 6.21	35.99	0.057

Table 2. Descriptive analysis – speed parameter

Group	Mean value	Standard deviation	Median	Shapiro – Wilk
Initial measurement				
Speed 1 – control group	0.975	± 0.118	0.98	0.961
Speed 1 – experiment group	1.27	± 0.167	1.27	0.490
Final measurement				
Speed 1 – control group	1.03	± 0.106	1.05	0.728
Speed 1 – experiment group	1.36	± 0.186	1.34	0.239

The t-test for paired samples and the t-test for independence were used to determine statistically significant differences and to validate the results obtained in both groups.

The paired samples t-test was used to check whether there were significant differences within the groups between the initial and final tests. In the control group, the results obtained led to the conclusion that the statistical analysis performed made it possible to detect non-significant differences between the initial and final test for both the time and speed parameters. The value of the statistical coefficient p in both cases was $p = 0.072$ and $p = 0.054$, respectively, values that are above the threshold of 0.05, confirming the null

hypothesis and refuting the initial hypothesis. In other words, no increase in performance can be detected between the two tests. It must be stated that differences in performance were there from the beginning between the two groups. The mean of the control group determined based of the initial test is 51.84 sec, while the same mean determined for the experimental group is 39.85 sec. This difference was also statistically proven following the Independence t-Test.

After both the first and the last test, the statistical coefficient p was calculated. Based on this coefficient, it was found that there were statistically significant differences after both the first and the last test ($p = 0.001$ and $p = 0.002$, respectively).

However, within the experimental group, the obtained results led to the conclusion that the performed statistical analysis allowed the identification of significant differences between the initial and the final test, both in terms of the parameter of time and the parameter of speed. The value of the statistical coefficient p in both cases was $p = 0.015$ and $p = 0.012$, respectively. It can be noted that both values are below the threshold of 0.05, which leads to rejecting the null hypothesis and confirming the hypothesis we proposed.

Discussion

This study primarily aimed at providing a training method for increasing FCS performance through improved technique. We investigated whether applying WFWCs has an influence on a better understanding of the FCS swimming technique on 50 m events.

We wanted to analyze if there is a causal relation between the stimulation of proprioception and the development of swimming performance through improvement of motor control. Starting from previous studies which revealed that visualising the execution of certain movements in a mirror improves the quality of execution (Pop et al., 2016), we assumed that using WFWCs will stimulate motor control through activating proprioception.

The buoyancy phenomenon diminishes kinesthesia (sense of motion and position of limb segments). If some authors claim that afferents transmitted through proprioceptive mechanisms are ambiguous in a full gravity environment (Feldman, 2009), then this mechanism is even less reliable in the water. Nonetheless, a correct perception of the body and thus absolute motor control is necessary to achieve swimming performance.

The approach we started from is used as a treatment method in adults with static brain lesions, where studies prove that weighted distal upper extremity using WFWCs increases the input of proprioception and has a positive influence on biomechanical parameters (McGrunder et al., 2020). Although

weighting in our study meant using the same load – according to some studies this set-up leads to the proprioceptive muscle spindles becoming more sensitive (Salles et al., 2015) – our results show an improvement in performance: statistically significant (p = 0,072) enhancement in time, final measurements as compared to initial measurements, as well as in speed (p = 0,054).

The obvious limitation of the study is represented by the suggested approach to compare the experimental group to the control group. As anticipated and discussed above, the results of the control group showed not statistical relevance. At the end of the study, it became clear that the relevant statistical differences are within the experimental group: initial as compared to final time and speed. Nonetheless, the control group functioned as an additional verification factor.

Conclusions

To our knowledge, we are the first to investigate the effects of distal upper extremity loading on improving technique and performance in swimming. Training with WFWC led to performance improvement of the FCS technique on 50 m, an improvement proven by the tests. A simple comparison can lead to the observation that the control group, which did not train using WFWC, did not experience significant evolution in performance, while the experiment group, which trained using WFWC, experienced a significant improvement in performance.

The results indicate that training with WFWC is related to improvements in motor control and coordination of the upper limbs during 50 m FCS events. It has been confirmed that stimulation of muscle spindle receptors, which are the main source of proprioceptive information, can have a positive effect on athletic performance, even in a less stable environment such as water. However, more research on this topic is needed to establish its evidence.

The next step in our research will be investigating the kinematic and kinetic effects of using this type of proprioceptive training since this study focused more on analysing the swimmer's performance.

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FUNCTIONAL ASSESSMENT IN NEUROMOTOR REEDUCATION

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ABSTRACT. Today's neuromotor reeducation domain is filled up to the brim with all sorts of approaches. The only way of actually telling the good from the bad is conducting good and thorough studies, as well as having palpable evidence about the level of efficiency. The first step in doing that is having more specific tests that finely assess the motor function of a patient suffering from CNS lesions. This paper could be considered as a trial run for an even bigger step in terms of validating a supposed more specific tool of motor assessment. Two already validated and widely used tests in patients with stroke or in patients from the ICU are used, and the data collected is used to see if this new tool has a good, if any relationship with the previous. Apparently, in all three circumstances, primary, secondary and final assessment a strong relationship was found and the statistical significance was very promising. On a personal note, one specific and important difference between the already in clinical and scientific use and the new test was that the new test could detect motor improvement when SIAS failed to do so, and even more so than DEMMI could. That for the therapist is a very important aspect being able to finely tune their means of approach. Also, for the patients it could have better and more positive psychological outcomes, because now even if before when a regular test would not show them improvement at all, now even after a smaller amount of time but with targeted means of work, they have something to show for.

Keywords*: Assessment; functional, neuromotor reeducation; FRA*

Introduction

In neuromotor reeducation, we have a multitude of tests that focus on either on the individual's resources or on a more functional level. When a say resources I mean of course qualities like strength, endurance, mobility, balance,

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control etc. But when we talk about a more functional level, and in rehab, the instruments used frequently, do not quite get the motor component as precise as it would be needed (Zwolińska, & Gąsior, 2020).

The most used tests today follow thresholds or milestones way too spread apart, and some are just missing, in order for you to have the nuances you need to detect an evolution in motor function (Saunders, et al., 2016).

This subject is a very bountiful and once pursued it can lead to a way that can increase the rhythm of progress, and also will help filter through the multitude of approaches in the field in terms of useful or less useful. Without a proper tool to more efficiently assess motor function, that way isn't that accessible. After almost 12 years of practice in the motor rehab, I have developed specific tool, and I will try and find out if it correlates to other tests that have be validated and used on a wider scale in the world today.

Included pathologies

We can group lesions in the central nervous system (CNS) after its location: cortical, in the basal nuclei, brain stem, cerebellar; vascular nature: hemorrhagic or ischemic stroke, hypoxic or anoxic; degenerative and so on. As long as we find an integral circuit through which we can introduce information to the cortex, and we get a response back from there, also said response should be reproducible and alterable through guidance (Mang, Campbell, Ross, & Boyd, 2013), the subjects can enter the study.

With a lot of these lesions, hypertonia can manifest itself. Just to have a clear understanding of what I mean by that, and also the types I consider when talking about that phenomenon: Spasticity – in which we meet resistance to a movement at a much higher speed or a sudden movement within its range of motion (ROM), or change in direction in the joints that it manifests in the limbs or trunk in a very specific manner (unidirectional); Dystonia – is a movement disorder that bring forth either prolonged or intermittent involuntary movements. It causes twist-like kind of movements within the axis of a joint or joints, repetitive movements, altered gait (asymmetrical most common); Rigidity – in contrast to spasticity the resistance manifested within mobilization of a joint, the segments have difficulty moving in more than one direction (antagonistic even). The angle or speed do not influence movement as much as changing direction. Movement can and is present but it has to be slowly executed. Changing direction leads to co-contraction (Sanger, Delgado, Gaebler-Spira, Hallett, & Mink, 2003).

The presence of dyskinesias obviously will mean delays in the reeducation programs (Siniscalchi, Gallelli, Labate, Malferrari, Palleria, & De Sarro, 2012), but the main focus in this study is to observe the correlation (if any) between a personal tool of evaluation and two other instruments already validated and widely in use.

Assessment

World Health Organization (WHO) proposed for a long time now ICFDH (International Classification of Functioning, Disability and Health), which defined components of function and disability and also a degree of participation. This later degree describes 9 subdomains of activity and participation like: learning and applying knowledge, general tasks and requirements, communication, mobility, self-care, home maintenance, interpersonal and human relationships, major life areas and of course a civic and social life within a community (Weimar et al., 2002).

Observing and measuring the abilities of a patient is a complex task. If we assess more aspects within an area, we will get a more realistic status of motor function and we will find ourselves closer to a truthful functional state as a whole. Testing a singular area like motor function comes of course with its challenges, but this form of evaluation remains even at present the most important tool for having a good perspective of the bigger functional picture (Reiman & Manske, 2011).

So far, we are unaware of ways to permanently get rid of hypertonia induces by CNS lesions. The necessity of managing this condition is of the utmost of importance because otherwise, we risk muscle retractions and joint ankylosis is far too high especially when the patient stops or dramatically decreases the level of physical activity. Unfortunately, we do not have a significant number of studies that tackle the most effective ways of management, be it pharmacologically, conservative or combined when it comes to this subject but the great hope is to change this in a near future. If we have more specific and sensitive tools to properly assess, and we design double or single-blind, randomized controlled trials, we will be able to get closer to the afore-mentioned objective (Thibaut, Chatelle, Ziegler, Bruno, Laureys, & Gosseries, 2013).

Therapeutical approach

Assessment and therapy lie really close together. The therapeutical method regards the active engagement of the patient. Exclusion for this study will firstly consist of an incomplete neuromotor circuit. Meaning it is absolutely necessary to be able to introduce information within the system, and also to have motor responsiveness to the stimuli. If this phenomenon is present, no matter how small the response, then we have a subject of study. In translation, we have the receptors that take the information and move it through afferent pathways for it to get processed in the CNS, only for it to be lead back out as a response through efferent pathways to the effectors (muscles). If we take out any of the components of this integral system, the method will fail and thus not apply (Dayan & Cohen, 2011).

Therapy starts at the first developmental motor milestones at ground level, and fights gravity step by step, until it reaches orthostatic position and higher. The beauty of this global approach is that in order to get to a more advance stage of function, you have to check or get as many as possible of the previous stages before the one in discussion. Once we reach a higher point in the evolution of motor function, all the other steps will be maintained through the inertia of engagement in movement and continuous repetition (Bönstrup, Iturrate, Hebart, Censor, & Cohen, 2020).

We can skip a few steps, and then later come back and check them also, or we can skip stages whole, and still have independent higher motor function. The problem isn't with skipping stages. The problem will consist of a drop in the overall quality of higher motor function. The more stages we skip or leave unconsolidated (dependent on support), a drop will be fairly apparent in: balance, muscle tone fluctuation, coordination. Also, if the subjects have involuntary movements, these often lead to even more dysfunction and a deconditioning. But this need not be the case. We see an improvement within these aspects if the missing stages are addressed, acquired and consolidated. But you can also attribute an element of safety when taking this approach. Whenever patients have a sense of distress, they can reach lower stage and get to a safer place like sitting or getting down on the ground without the danger of falling and hurting themselves (Muratori, Lamberg, Quinn, & Duff, 2013).

A complete report of ROM in all joints is not necessary because once the patient is placed at a particular functional level, the faulty stages are outlined and the same goes for the stages that are missing, and for these, we can assess mobility and assess if prerequisites are met to go further. Joints and segments will be much more visible in this manner (Satariano et al., 2012).

Neuroplasticity can be defined as the ability of the CNS to respond to stimuli, both intrinsic or extrinsic, in order to reorganize its structure, its function and connections; it can be described on many levels: from molecular, to cellular, to systemic or behavioral. It takes place during a child's developmental timespan, as a response to the environment, as support for the learning process, as a response to sickness or it maybe even caused by therapy. Therefore, plasticity can be considered an adaptive trait when the results generate positive outcomes and maladaptive when it generates negative effects like dysfunction, or simply worsening a preexistent condition. However, a distinction must be made between adaptive plasticity and compensatory behavior. Those behaviors that already were in existence prior to getting CNS lesions (Cramer et al., 2011).

There is a bountiful display of evidence that suggest how physical therapy contributes through repetitive tasks, always carefully dosing either by volume or intensity of activity, and acquiring functional stages in the fight against gravity (Rietberg & Kwakkel, 2014).

Correlation

We give to each consecrated assessment tool the variable X, and Y shall be used for the personal tool. For this study, we used a Pearson test to establish a correlation coefficient "r" with an absolute positive or negative value of ± 1, and 0 there is no correlation between variable. A coefficient "r" ≥ 0.7 suggests a strong correlation. The nature of this correlation is symmetrical. This means that we can predict a rise or drop in values from X to those of Y, and implicitly the same goes for vice-versa (Malgady & Krebs, 1986)

With a hypothesis like "if there is a rise in X there will be a rise in Y, the same goes for negative values", there will need to be set a threshold of statistical significance. In scientific literature threshold is noted "p" and it should be set at ≤ 0.05, in other words with an incidence of occurrence for at least 5% or lower of possible cases (Hung, Bounsanga, & Voss, 2017).

The correlation diagram or the scatter plot, is a diagram in which we find along the course of two axes (x, y) with the total scoring visible for each one, just so the relation between the two variables can be visibly observed. In our scatter-plot we find the relation points between the analog values from each axis dispersed into 4 imaginary quadrants. If the direction is ascendent from the lower left quadrant to the upper right, there will be a positive relation. If the direction is descendent from de upper left quadrant to the lower right, there will be a negative relation (Friendly, & Denis, 2005).

Methods

Subjects

A number of 20 patients, stroke (cerebral) sufferers that were at different timelines away from the vascular accident, and they also find themselves at different functional levels at the moment of first assessment and during the course of intervention and evaluation over a time-span of 2 months. Out of these 4 strokes were hemorrhagic and 16 were ischemic. Less than half of these did not benefit from therapy right after the stroke or even short after that. Regardless of the functional level of the subjects, another essential condition for inclusion in this study was that they should be cardiovascular stabilized.

During this timeframe, all patients will undergo a number of 24 neuromotor reeducation sessions, each lasting 1 h. In other words, 3 session per week. We give homework to caregivers daily but no more than 2 or 3 exercises within the functional level in which the patient currently is. These homework exercises really speed up how patients reach the next micro-objectives or stage, on the hierarchical chain of stages in the progressive so-called fight against gravity. During the two monitored months, all other therapies have been placed on hold as to limit the external possible interferences. Also, within this period there were

no changes in medication schemas, and those whom already were participating to psychological counselling, they continued to do so.

The EEGs were clean and did not show signs of chaotic discharges. Patients with degenerative disorders of the CNS did not take part of the study. Also, patients with aphasia, be it a problem of comprehending or expressing language, did not take part of the study. The general pool of subjects consisted of just adults, 10 male and 10 female. The average age within the subject pool is 63.9 years, with the lowest age 24 and the highest 83.

Assessment tools

I have chosen instruments that monitor motor function with a wider range than most and widely used. Out of these in searches the most prompted was „Stroke impairment assessment set" (SIAS) and „The de Morton Mobility Index" (DEMMI). SIAS – Stroke impairment assessment set, this tool (Liu, Chino, Tuji, Masakado, Hase, & Kimura, 2002) is designed to detect different levels of motor function as well as the degree of disability of post-stroke patients in clinical contexts. It is structured in 9 categories of motor function: tonus, sensory function, range of motion (ROM), pain, spatial and visual orientation, language, hearing (bilaterally). All these are arranged in 22 items of evaluation. The coding system is from either from 0 to 3 or from 0 to 5.

Each item is assessed in accordance with their performance during testing. It takes about 10 minutes to be completed without requiring special equipment. Because this tool is based on a more traditionally neurological type of examination, SIAS can be used by a wide array of specialists from the field or at least tangentially to it, without requiring an extensive training (Chino, Sonoda, Domen, Saitoh, & Kimura, 1996). This instrument, as you can see, follows motor function in lower and upper limb, muscle tone, osteo-tendinous reflexes, sensory function, ROM, pain level, functional level of axial musculature, cognitive function in relation with language and of course the unaffected side (Liu, Chino, Tuji, Masakado, Hase, & Kimura, 2002).

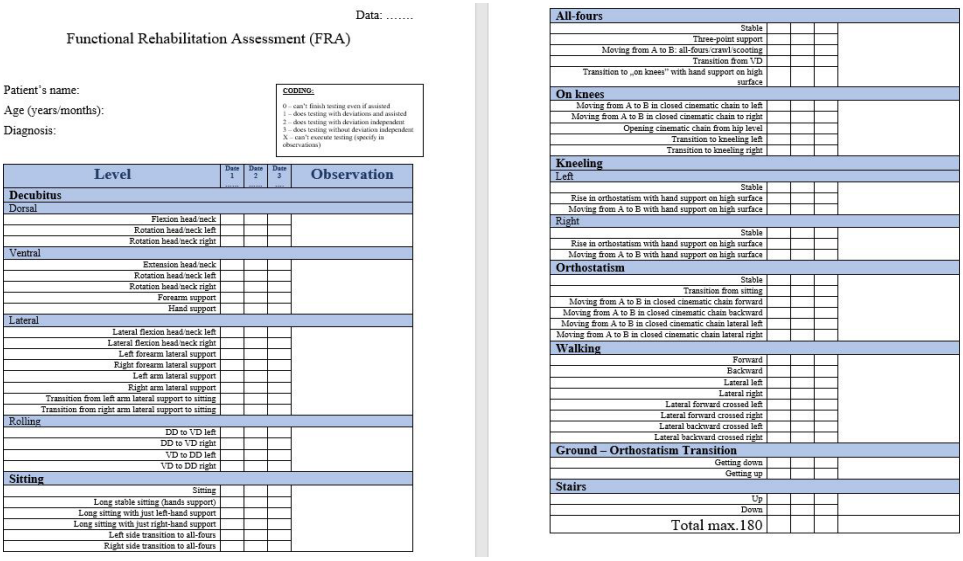
For a few cases as we can expect, patient found themselves to be right in the time that hypertonia started to manifest itself or was in effect (Katoozian, Tahan, Zoghi, & Bakhshayesh, 2018). For this test, seeing that it investigates ROM, pain level and control on lower and upper limbs, for some cases from the first test until the end period of two months you can detect a regress. Increase in involuntary muscle tone will decrease ROM and increase pain levels, but without necessarily decrease motor function. So having many more aspects tested in motor function, we don't always answer the question about motor function as a pure phenomenon if it actually decreased. A fully trained specially know these aspects and can plan the strategy accordingly as to increase motor function without having plateaus of stagnation or worse, decrease in motor function.

DEMMI - De Morton mobility index (DEMMI) is designed for assessing mostly the elderly with a range starting from acute to chronic and in clinical setting. It checks out non-vestibular balance, dynamic and static posture from decubitus, sitting and orthostatism, strength. The average time for completion of said assessment is around 10 minutes and it does not require any special equipment. Evaluation can be made on the bad, side off bed and in the same room with the bed (De Morton, Davidson, & Keating, 2008).

The least most appreciated aspect of this instrument is for motor function for lover levels. Although the patient may have a positive evolution with notable acquisitions, DEMMI does not record them. The physical therapist might notice them but objectively he can't point them out. This can be in some instances quite the liability, taking away from the general compliancy to therapy (Braun, Grüneberg, Coppers, Tofaute, & Thiel, 2018). We are seeing the same problem as with SIAS. We need to maintain factors of internal motivation for patients through active approaches if we can lead them towards results. FRA – Functional rehabilitation assessment, is basically a defragmentation of human movement from the lowest level until we reach a dynamic orthostatism. It has set stages, which if you follow you can see are the same ones pediatricians evaluate in their basic motor assessment.

One important advantage of using this test is time. It takes only 3-4 minute to complete. Another advantage for this test is its main focus on the motor aspect. Stages are set as big milestones and then they are fragmented into individual items. Of course, they do not only check that the milestones are each reached by a patient, but the transition between them also must be assessed. We must understand that for each stage you need a certain amount of resourced to achieve execution either of sustaining a milestone or transitioning from one to the other. If for pathological reasons, we do not have enough of one particular resource (strength, endurance, mobility, balance, control) that does not mean that we can't reach function. The other resources can always compensate and a stage can be achieved. Afterwards if it's possible, you can come back and smooth out the compensation. Therefore, in this manner we don't not need to assess each individual resource of a patient every time we test.

As you can plainly observe in figure 1, all the stages and transitions follow the body's work against gravity from lying down to orthostatism and vice-versa, but in a way which is safe. For an experienced therapist this evaluation is done really fast. The patient starts from decubitus lying on the floor or on the bed and goes further from there. A patient can be stimulated and the movement may be facilitated, but if the assistance is too great, that will cost in the end scoring. If the movement does not happen even with assistance for one or a few close stages, then the assessment stops there.



Data: .....

Functional Rehabilitation Assessment (FRA)

Patient's name:

Age (years/months):

Diagnosis:

CODING:

0 – can't finish testing even if assisted
1 – does testing with deviations and assisted
2 – does testing with deviation independent
3 – does testing without deviation independent
X – can't execute testing (specify in observations)

Level	Date 1	Date 2	Date 3	Observation
Decubitus				
Dorsal				
Flexion head/neck				
Rotation head/neck left				
Rotation head/neck right				
Ventral				
Extension head/neck				
Rotation head/neck left				
Rotation head/neck right				
Forearm support				
Hand support				
Lateral				
Lateral flexion head/neck left				
Lateral flexion head/neck right				
Left forearm lateral support				
Right forearm lateral support				
Left arm lateral support				
Right arm lateral support				
Transition from left arm lateral support to sitting				
Transition from right arm lateral support to sitting				
Rolling				
DD to VD left				
DD to VD right				
VD to DD left				
VD to DD right				
Sitting				
Sitting				
Long stable sitting (hands support)				
Long sitting with just left-hand support				
Long sitting with just right-hand support				
Left side transition to all-fours				
Right side transition to all-fours				

All-fours				
Stable				
Three-point support				
Moving from A to B: all-fours/crawl/scooting				
Transition from VD				
Transition to „on knees" with hand support on high surface				
On knees				
Moving from A to B in closed cinematic chain to left				
Moving from A to B in closed cinematic chain to right				
Opening cinematic chain from hip level				
Transition to kneeling left				
Transition to kneeling right				
Kneeling				
Left				
Stable				
Rise in orthostatism with hand support on high surface				
Moving from A to B with hand support on high surface				
Right				
Stable				
Rise in orthostatism with hand support on high surface				
Moving from A to B with hand support on high surface				
Orthostatism				
Stable				
Transition from sitting				
Moving from A to B in closed cinematic chain forward				
Moving from A to B in closed cinematic chain backward				
Moving from A to B in closed cinematic chain lateral left				
Moving from A to B in closed cinematic chain lateral right				
Walking				
Forward				
Backward				
Lateral left				
Lateral right				
Lateral forward crossed left				
Lateral forward crossed right				
Lateral backward crossed left				
Lateral backward crossed right				
Ground – Orthostatism Transition				
Getting down				
Getting up				
Stairs				
Up				
Down				
Total max.180				

Figure 1*. Functional Rehabilitation Assessment (FRA)*

Database

Please do not alter the formatting and style layouts that have been set up in this template document. As indicated in the template, papers should be prepared in single column format suitable for direct printing onto paper with trim size 192 x 262.

Initiale pacienti	varsta	sexul	SIAS	SIAS	SIAS	DEMMI	DEMMI	DEMMI	FRA	FRA	FRA
V.A.	68	m	34	32	40	20	27	27	14	43	53
T.G.	47	m	50	55	56	27	27	27	49	67	77
P.B.	83	m	57	60	64	27	30	30	89	108	123
L.I.	79	m	54	57	60	30	33	44	82	101	125
V.L.	61	m	55	59	62	30	41	48	79	100	124
R.E.	66	m	21	62	65	0	48	57	7	124	169
M.A.	59	m	68	71	73	57	62	74	135	167	177
R.A.	24	m	70	73	74	67	85	100	165	179	180
D.G	46	m	54	64	65	27	33	36	112	136	138
M.I.	64	m	25	46	55	0	33	44	8	69	133
S.E.	67	f	73	75	76	74	85	100	173	178	180
P.I.	55	f	70	72	73	74	85	100	167	173	178
D.E.	63	f	63	65	65	53	62	62	162	167	169
L.E.	72	f	27	34	37	0	15	15	11	26	45
D.Z.	79	f	58	62	65	53	53	57	85	130	158
O.V.	52	f	74	75	75	57	67	67	169	176	177
R.O.	71	f	65	68	71	27	36	48	103	127	144
P.C.	66	f	71	72	74	67	67	74	163	172	179
C.D.	82	f	17	41	62	0	15	27	5	25	67
U.O.	74	f	63	68	72	57	62	67	155	169	176

Figure 2. *Excel database – with color-coding*

An initial assessment takes place with all three instruments. Same assessment will take place at one-month distance and another one after two months. The tests used will be SIAS, DEMMI and my own personal test FRA (Functional recovery assessment). The total scores from each instrument, will be registered within Excel spreadsheets following analysis, through which a correlation coefficient and the statistical significance can be determined. Yellow will be used for the initial assessment, green for the one-month one and finally blue for final assessment.

Correlations

Six relationships will be established between SIAS / FRA and DEMMI / FRA during the initial, intermediate and final evaluation. For each of these we shall find out the correlation coefficient "r" and the statistical significance "p". The data analysis took place in excel as you can see in figure 3. After we have found the required data, we kept the color coding yellow for initial, green for intermediate and blue for final like we see in figure 4. Verifying how strong the relationship between two or more variable is one of the most used statistical procedures out there. Correlation methods in research have found a wide area of applicability for quite a range of circumstances. Firstly, to determine if a positive or negative correlation exists between the designated variables. Secondly, to measure the degree of statistical significance associated to the correlation in cause. Thirdly, to find out the level of variability, for which the independent variable can be explained by the dependent variable. Lastly, to establish the performance with which the linear regression can estimate the logged data.

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.942645285
R Square	0.888580133
Adjusted R Square	0.88239014
Standard Error	6.345517506
Observations	20

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	26.78924944	2.639090113	10.1509415	7.088E-09	21.24472685	32.333772	21.24472685	32.33377202
X Variable 1	0.275848428	0.023023284	11.9812805	5.175E-10	0.227478302	0.3242186	0.227478302	0.324218554

Figure 3. *Excel data analysis*

	PROPRIU 1	PROPRIU 2	PROPRIU 3
SIAS 1	r: 0.943 p: 5.175E-10 (0.0005)		
DEMMI 1	r: 0.935 p: 1.486E-09 (0.0001)		
SIAS 2		r: 0.952 p: 1.072E-10 (0.00071)	
DEMMI 2		r: 0.903 p: 4.858E-08 (0.0005)	
SIAS 3			r: 0.884 p: 2.425E-07 (0.0002)
DEMMI 3			r: 0.854 p: 1.683E-06 (0.0002)

Figure 4. *"r" and "p" with color-coding*

Results

SIAS - FRA

The results from the initial, intermediary and final assessment between SIAS and FRA are of a positive correlation. Correlation coefficient "r" is 0.943 and "p" is less than 0.0005 for the initial set. From the intermediary data, the results are again with a strong "r" of 0.952 and a "p" of 0.0001. As opposed to the first to sets of results, in the final assessment results with got an "r" of 0.884 and a "p" of 0.0002. The relation is still a strong one but less strong than the other two. From speculation, we could attribute this happening to the defragmentation of motor function into smaller stages in FRA and after two months, there could be more variability due to that.

SIAS - FRA

The results from the initial, intermediary and final assessment between DEMMI and FRA are also of a positive correlation. Strong relation from the initial set with an "r" of 0.935 and "p" of 0.0001. The results after one month of therapy will show a strong correlation with an "r" of 0.903 and a "p" value of 0.0005.

Breaking down into smaller stages in FRA especially for higher function made it possible to detect even the more subtle of changes in motor function. Even thou a patient clearly has made some changes either after the one-month marker or at the two-month marker, we can observe that for DEMMI the same like with SIAS, function stagnates or we might even observe a regress, but motor wise that is simply not the case. Even if the last set of results are not as great as the first two, the relation is still strong with an "r" of 0.854 and a "p" value of 0.0002.

Discussion

We have to notice the specificity and efficiency of the three tests in being able to monitor motor function. In FRA, we could observe a progress in both intermediary and final evaluation. SIAS is the second runner up getting really close to appreciating motor function having just one regress and two stagnations. And lastly, out of the three observed was DEMMI where we registered a total of 9 stagnations. As we could see from all six analyzed circumstances, the correlations between SIAS and FRA or the later and DEMMI exist and are strong. By using two widely used instruments to verify if a relation exists, we could reduce the instrumental noise, a phenomenon observed in more than one setting.

Although it is not yet a validated product, it is, nonetheless one of extreme importance in medical and sports rehab, to be more specific in physical therapy, where motor function is the main focus. A specific tool was missing, a tool which could address exactly this function. Without such an instrument, through which we could measure and quantify progress or regress in a more objective manner, the capacity of making assertions or predictions concerning the potential of reaching certain objectives or results will be somewhat faulty.

If one specific instrument like FRA could gain ground, it could open the possibility in verifying the impact we actually have, using all the different approaches out there. We could get more data from more patients, where we can keep score of even more variables, clinical significance, predictability and so on. Having these elements to rely on, a doorway for even more interdisciplinary work will be created, which would finally help in obtaining a clearer picture of motor function and its importance when the wellbeing of people is in discussion.

Too often clinicians argue almost like a mantra about the lack of a more specific approach, because most specialist work with patients for a limited timeframe of one or several weeks. In such a short collaboration, one can simply

can't reach the end goal, functional independence. I side with them in a sense that one can't obtain big acquisitions or reach the final objective in a short amount of time, but that is still no reason to change my mind about the approach selected. If the number of specialists would treat motor function with a more similar perspective was bigger, it would not matter if the patient would change the therapist or city or clinic, and the patient will in the end reach the end goal. An assumption can be made that the objective of independence can be achieved faster this way than with endless compromises that will in fact lead to sequalae, decompensations and deconditioning.

Of course, this assumption can be scrutinized and accompanied with many questions regarding the conditions through which a specific instrument came to be or objective was set. The hope is that we as a community have surpassed that point in time were we just place our trust in one specialist even if that particular individual is really good and has a vast experience in his field. No denying that specialist is a valuable resource, but the evidence from a researched area or at of intersections of multiple areas will outweigh the opinion of said specialist.

Conclusions

This study wanted to undergo of verifying if a not yet validated instrument for assessing motor function had any relationship with two others that are validated and widely used. In the data analysis, a strong relationship could be observed.

FRA defragments motor function into more items at a finer scale, thus we could observe motor function progress were the other two fail to detect any change or even worse a regress. This is an important factor not just for the sake of scoring patients but for internal motivational aspects. It is not rare when patients get demotivated when they get retested and see no positive changes. With this new tool, we can more objectively assess and convince patients of their work's worth. It is important that when they draw a line that they would be at a win.

The possibilities of expanding research will be able to grow considerably, and the results of such research could help us in developing and also filtering through the multitude of approaches already out there, in the field of rehabilitation.

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THE RELATIVE AGE EFFECT IN JUNIOR FEMALE BASKETBALL PLAYERS

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ABSTRACT. Introduction: Sports activity interferes with physiological growth, adaptability accelerating and perfecting structural, functional and mental differentiation. The performance model is dependent on the total capacity of the players, on the psycho-social system resulting from the perfection of the executive functions, of the morphological, physiological, informational and decisional subsystems. **Objective:** The objectives underlying this work are the discovery and determination of the relative age effect (RAE) that leaves its mark on the system of failure or success in the lives of athletes, basketball players. By following the birth months of the athletes of a certain year, we try to prove that there is a close connection between the age advance in the life of certain athletes and their career success. The premise of the study is to analyze the impact of the RAE effect in the U16, U18 and U20 categories of the Romanian junior women's basketball teams. **Material and method:** In order to demonstrate a connection within this subject, the method used was the structuring of sportswomen in several age categories and the analysis of their results**. Results:** According to the conducted study, the existence of the relative age effect among the selected ones is found, but not in the way that those born in the first months of the year would have a substantial advantage**. Conclusions:** The results confirm the fact that there is a possibility for the younger ones to evolve with efficiency similar to their older colleagues.

Keywords: *relative age effect, women's basketball, performance, success.*

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Introduction

The relative age effect (RAE), also known as the date of birth effect, is used to describe a bias which may be found in the upper echelons of youth sports or sports clubs. The relative age effect is defined as the distant age difference between two children who were born in the same year, where the one born earlier benefits from an advance in physical and mental development and growth. (Delorme, 2009)

Thus, when speaking about their selection, those who are first focused on are the ones born in the early months of the year. Team members are selected based on their chronological age, and this can often influence success in sports career.

The relative age effect is relevant for professional sports where the "best of the best" are chosen, so knowing some specific selection methods can represent a long-term advantage. Understanding the impact of the relative age effect on individual and collective performance in a team sport is important not only for the sports club that gains added value, but also for each athlete and coach who become successful and achieves professional development. The relative advantage that some individuals have due to their date of birth can be wasted if not properly capitalized on in specific contexts through preparation and dedication.

Objective

This exploratory study aims to analyze the impact of the RAE effect in the U16, U18 and U20 age categories of the Romanian women's national basketball teams.

The study intends to find out whether female athletes from the national teams were selected due to the relative age effect and to what extent it influences their performance.

Material and method

The study analyzes the relative age effect in sports and its connection to performance for 36 participants from the Romanian women's national basketball teams, who participated in the European Basketball Championship 2022. The athletes are divided as follows:

- *for U16* - 12 players are part of the U16 group and are 16 years old, (most of them) being born in 2006, with 2 exceptions (born in 2007 and turning 15, but who are eligible for the category they belong to);

➢ *for U18* - 12 players are part of the U18 group, most of them being born in 2005, with the chronological age of 17 years and three exceptions who are born in 2004 and currently are 18 years old, thus falling into this category;

➢ *for U20* - 12 players, most of them being born in 2002, who are 20 years old, except for two athletes who are born in 2003 and are 19 years old.

Data collection

For data collection, we accessed the website of FIBA basketball federation https://www.fiba.basketball/, and then we selected the team categories, U16, U18 and U20, female athletes. We took the identification data of the female athletes, their months of birth, but also statistical elements about their performance in the game (such as the efficiency and minutes of playing time, but also how many games they played in that championship. From the website of the basketball federation, we also collected data on the points scored and rebounds from under the basket).

We structured the public information about the players related to their competition groups, and divided them into 4 quarters, hereafter referred to as Quintets or Q, by months of birth. Even if there are some exceptions among the female athletes and not all of them are born in the same calendar year, those representing age exceptions are eligible for being part of that group and may even have overcome certain barriers to get there. Thus, since there are 12 months, divided into 4 quarters, each Q includes 3 months. So we have Q1 for the months of January, February, March, Q2 for the months of April, May, June, Q3, which includes July, August and September, and Q4 with the remaining months, October, November and December. The variables that will be taken into consideration for carrying out this study are:

✓ ***dependent variables*** – performance during the game (operationalized by: efficiency, minutes of playing time, points scored and rebounds from under the basket);

✓ ***the independent variable*** – month of birth.

Statistical analysis

The obtained results were centralized in tables and interpreted statistically with Microsoft Excel program.

Results

The charts created for each team table include the top 3 athletes ranked for the dependent variables mentioned above (efficiency, points and rebounds).

The minutes of playing time were excluded from the analysis, because they are influenced by the coach's game strategy. The following tables present the centralized data, as follows:

Table 1. The Romanian national basketball team Under 16

No.	Athlete	Club	Date of birth	Month	Height	Minutes	Games	Efficiency	
1	S 1A	ACS Dan Dacia	06.02.2007	February	168	17.9	7	4.6	
2	S 2A	CSM Ploiesti	08.02.2006	February	184	18.6	7	6.6	
3	S 3A	ACS Dan Dacian	16.02.2006	February	177	7.5	6	-0.3	
4	S 4A	ACS Sepsi-SIC	19.02.2006	February	185	24.1	7	6.6	**Q1**
5	S 5A	ACS Dan Dacian	01.03.2006	March	187	4.3	5	-0.4	
6	S 6 A	CSM Ploiesti	31.03.2006	March	184	8.8	7	4.1	
7	S 7A	ACS Dan Dacian	03.08.2006	August	180	34.5	7	11.3	**Q3**
8	S 8A	ACS Dan Dacian	28.08.2006	August	174	15.5	7	3.9	
9	S 9A	ACS Champions Bucuresti	07.09.2006	September	180	26.1	7	11.4	
10	S 10 A	CSM Ploiesti	07.09.2007	September	175	16.7	7	1.3	
11	S 11A	ACS Dan Dacian	21.08.2006	September	166	31.1	7	4.1	
12	S 12A	ASBC Valbon Arad	13.11.2006	September	192	2.7	2	0.5	**Q4**

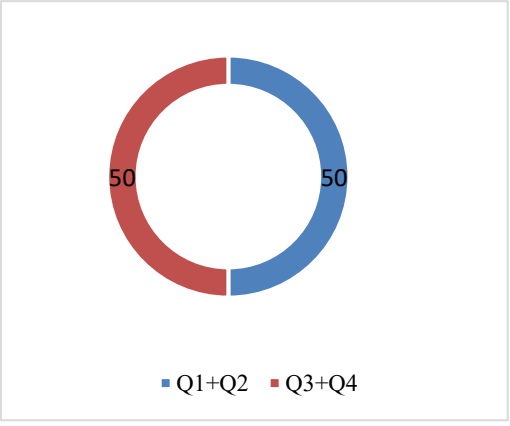

Fig. 1. *Chart for Table 1*

In this team category, we noticed that the relative age effect was highly visible, which is reflected in the composition of the team. 50% of the entire team is born in Q1, meaning they proved to have very good playing skills, which led to them being part of the national team.

Table 2. The Romanian national basketball team Under 18

No.	Athlete	Club	Date of birth	Month	Height	Minutes	Games	Efficiency	
1	S 1B	CSS Bucuresti	13.01.2004	January	180	22.8	4	-2	
2	S 2B	CSTBv Olimpia CSU Brasov	01.01.2005	January	168	4.5	7	-0.1	**Q1**
3	S 3B	LPS Satu Mare	18.01.2005	January	191	15.3	7	5	
4	S 4B	CSS Alexandria	17.02.2005	February	175	27.9	7	3.7	
5	S 5B	Cs Olimpia Bucuresti	17.05.2005	May	171	32.1	7	4.7	**Q2**
6	S 6B	ACS KSE Tg Secuiesc	11.07.2005	July	178	26.4	7	10.7	
7	S 7B	CSS 4 Bucuresti	26.09.2005	September	173	5	7	0.3	**Q3**
8	S 8B	LT Nagy Mozes	26.10.2005	October	162	12.4	7	2.1	
9	S 9B	C.S Agronomia Bucuresti	02.11.2005	November	169	23.3	7	10.9	
10	S 10B	CSS Bega Timisoara	18.12.2005	December	187	3.9	3	0.7	**Q4**
11	S 11B	CS Crisul Oradea	31.12.2004	December	168	5.3	7	-0.1	
12	S 12B	CSTBv Olimpia CSU Brasov	25.12.2004	December	170	22.1	7	7.9	

In Table 2, we notice that for the U18 team there is a slight change in the age effect situation, namely we no longer have a large share of athletes in Q1, but, as this is a larger age category, other aspects apply.

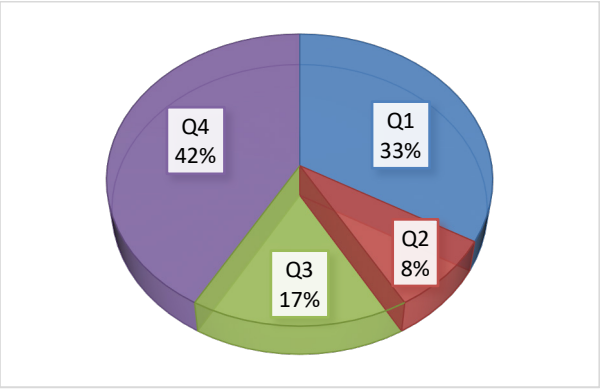

Fig. 2. *Chart for table 2 (Q1-January, February, March; Q2-April, May, June; Q3-July, August, September; Q4-October, November, December)*

Table 3. The Romanian national basketball team Under 20

No	Athlete	Club	Date of birth	Month	Height	Minutes	Games	Efficiency	
1	S 1C	ADC Parque del Sureste	28.01.2002	January	185	10.4	7	3.1	
2	S 2C	BC Sirius Târgu Mures	28.02.2002	February	174	15.1	6	7.3	**Q1**
3	S 3C	CSM Târgoviste	09.02.2002	February	174	4.2	7	0	
4	S 4C	Satu Mare	01.03.2003	March	170	30	6	8.8	
5	S 5C	Academia CSU Simona Halep	11.04.2002	April	176	27.7	7	9.4	
6	S 6C	CSS Alexandria	18.05.2002	May	182	3.9	7	1.1	**Q2**
7	S 7C	CSU ROOKIES Oradea	15.06.2002	June	172	6.7	5	0.2	
8	S 8C	ACS Sepsi-SIC	11.07.2002	July	187	22.1	7	8.7	**Q3**
9	S 9C	CSS Alexandria	22.07.2002	July	165	31.4	7	8.6	
10	S 10C	CSS Alexandria	31.10.2002	October	160	18.2	7	2.3	
11	S 11C	Wright State USA?	26.11.2003	November	182	20.4	7	9.4	**Q4**
12	S 12C	CSS Alexandria	08.12.2002	December	180	18.3	7	2.3	

If we take a look at the table and at its related chart, we notice that the share of female athletes who are part of Q3 and Q4 is higher than that of female athletes born in Q1 and Q2.

In Table 3, we notice that the relative age effect occurred in relation to the selection of female athletes. The predominant female athletes in this team category are the ones born in Q1 and Q2, leaving little space available for those born in Q3 and Q4.

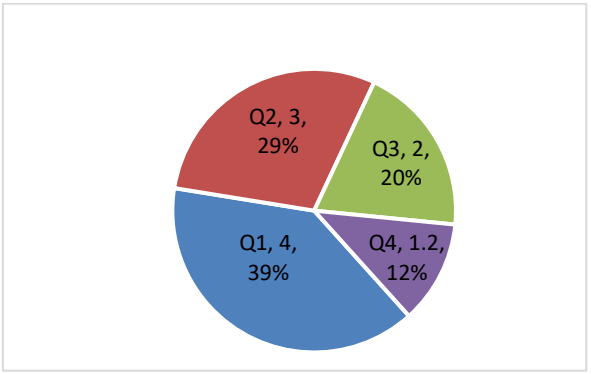

Fig. 3. *Chart for Table 3 (Q1-January, February, March; Q2-April, May, June; Q3-July, August, September; Q4-October, November, December)*

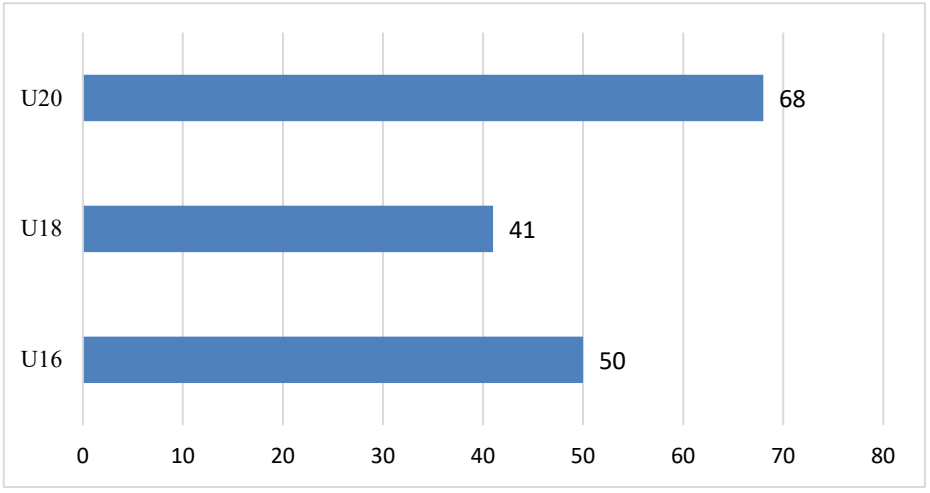

Fig. 4. *Comparison between the U16, U18 and U20 teams*

As we can easily observe, team U20 is the only one of the three where we have a marked relative age effect applied in the selection process of the female players. The percentage is 68% for female athletes who are part of Q1 and Q2, and 32% for the female athletes who are part of Q3 and Q4.

Chart 4 represents a comparison between the U16, U18 and U20 teams, whose purpose is to find out which of them has the largest share of female athletes born in Q1 and Q2 compared to Q3 and Q4, thus proving the presence of the relative age effect.

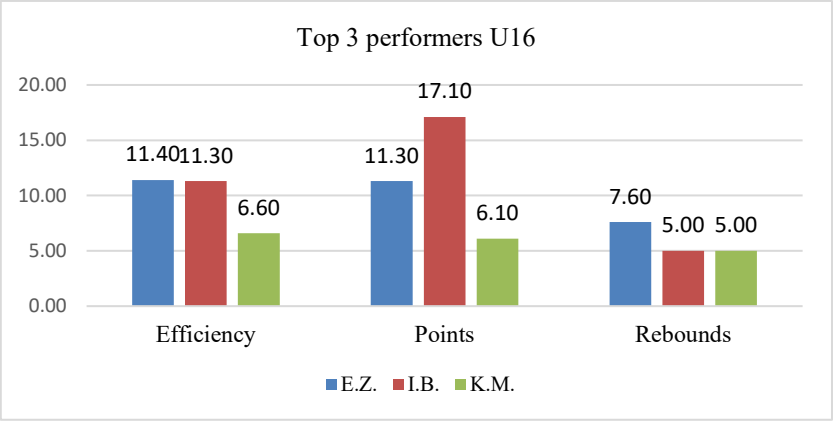

Fig 5. *Top 3 performers U16*

We should point out that in this category, although the relative age effect is present, the first two players in terms of efficiency, scored points and rebounds are part of Q3.

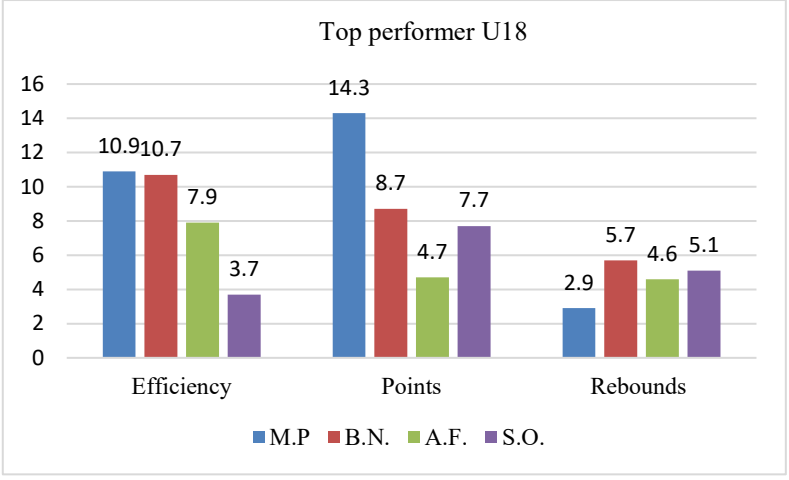

Fig. 6. *Top performer U18 for table 2*

The fictitious example we give for this situation is the European basketball championship 2022, for which, in order to participate in the U18 team, you must be born at least in 2004 and in 2005, at the most. In this national team, not only do we not have the relative age effect, but we see a completely opposite effect, where the best turned out to be those born later.

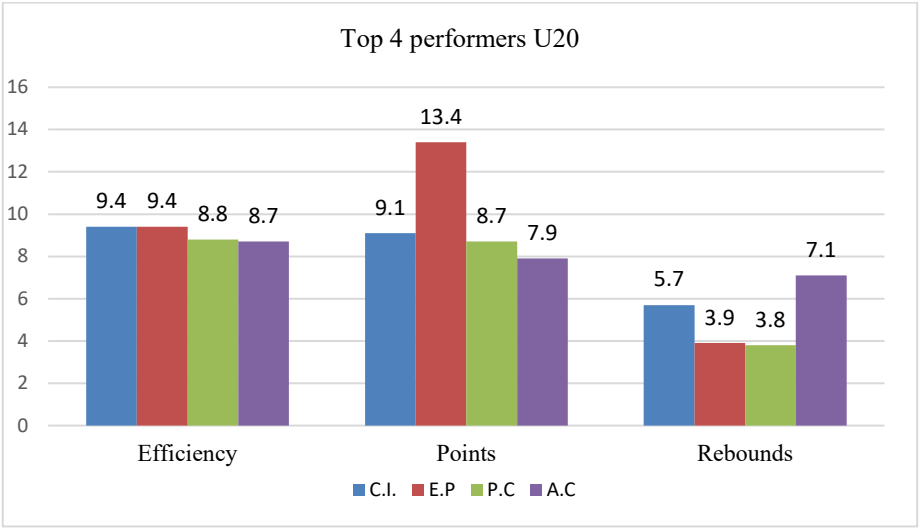

Fig. 7. *Top 4 performers U20*

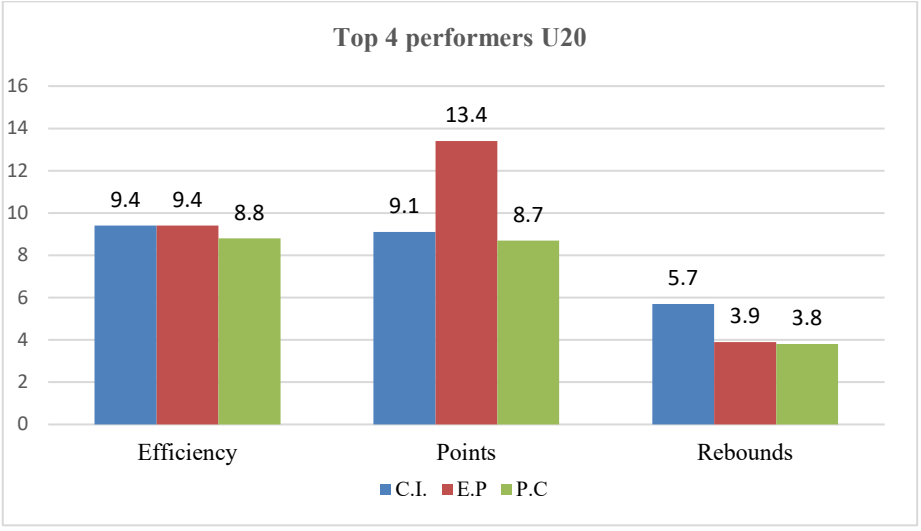

Fig. 8. *Top 4 performers U20*

In this structure, we gave two small forwards in the same age category, namely C. I. and P. C. We can say both athletes are very talented and their results speak for themselves, but the ratio here is a little bit more complex. Both C.I. and P.C. are born in the same year, but both are also one year younger than the other team members.

Discussion

The relative age effect (RAE) is constantly mentioned in the literature, including as regards basketball. For example, the purpose of the study carried out by Kelly, A. L., 2021 is to follow the path taken by the members of regional youth basketball teams in England, from the U16, U18 and U20 categories, to the senior national teams. The result was that the number of players allocated to the mentioned teams was almost double for those born in Q1 and Q2 compared to those born in Q3 and Q4.

Riaza and Calvo (2020) pointed out in their study the presence of the RAE in the U14-U18 age categories, where, out of 7502 measurements a 44% presence of the relative age effect was found, a percentage that decreases with the age of the subjects.

Conclusions

The results largely show the presence of the relative age effect, i.e. 50% in the U16 category, and 68% in the U20 category. The only group in which the RAE is found in a different form is the U18, where the younger ones, more numerous, ended up playing alongside older colleagues.

In the U18 category, the RAE is interpreted differently; thus, 75% of all team members are a year younger, yet their performance was better. Each team we have analyzed included some exceptions. Female athletes who meet the minimum age, but handle the requirements performing better than their colleagues.

It is true that those in Q1 are more likely to be better than those in Q4, but this depends on the 3 effects that were extensively explained in the first part of this paper. These are the Matthew Effect, the 10,000-hour rule, and, only at the end, the relative age effect. However, there will always be exceptions that deviate from the rule.

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INFLUENCE OF ISOINERTIAL EXERCISES ON LOWER LIMB POWER AND STABILITY OF VOLLEYBALL PLAYERS

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ABSTRACT. Introduction: Flywheel training devices have initially been used as means of astronaut conditioning in outer space during long missions. The system uses a rotating disc to store the energy during the concentric phase of the movement and converts it to resistance during the eccentric phase. The inertia of the flywheel offers the load of the exercise performed. Later, these devices started being used in injury rehabilitation and performance training. **Objective:** The objective of the study was to measure the effect of isoinertial exercises using a flywheel training device on lower limb power and stability. Also, we wanted to verify if a positive correlation can be found between force, power and stability. **Methods:** 15 female volleyball players were included in the study N=15. During 4 months the subjects trained twice a week using the flywheel device. Initial and final tests were performed using OptoJump, Y balance test and the device's own measuring system. The measured parameters were average power, average force, jump height and composite reach distance index. **Results:** Significant improvement have been found between the initial and final results for power, force, jump height and composite reach distance index $p<.01$. **Conclusions:** A flywheel isoinertial training device can be seen as a viable alternative for power and stability development for volleyball players.

Keywords: *power, stability, volleyball, isoinertial*

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Introduction

Lower limb power is very important in a sport such as volleyball. Along with strength conditioning of the players, we must also focus on they're well-being. The game implies a fair number of jumps and landings in all kinds of situations. Thus, to have healthy and well prepared players that can express themselves throughout the season, we have to explore available training methods.

To increase the skeletal muscle's capacity to build strength, new training techniques are continuously applied (Arsenis et al., 2021). Flywheel training devices have initially been used as means of astronaut conditioning on the International Space Station. During long missions, the human musculoskeletal system starts to lose mass being exposed to weightlessness. A 2004 study indicated that this resistance exercise counteracts quadriceps atrophy and lessens the more significant sural triceps muscle atrophy in confined people, and as a result, it should be a valuable tool for astronauts (Alkner & Tesch, 2004). Since then, these systems have started to make their way into strength and conditioning programs, sport performance centers and rehabilitation clinics. Used in performance training it has been found that flywheel isoinertial resistance devices have similar results as weight resistance programs (Arsenis, Gioftsidou, Smilios, Malliou, & Chatzinikolaou, 2020).

The system uses a rotating disc to store the energy during the concentric phase of the movement and converts it to resistance during the eccentric phase. The inertia of the flywheel offers the load of the exercise performed. Given the fact that the force applied depends on the subject's strength and stamina, it can vary between sets and even repetitions as time progresses (Beato, Madruga-Parera, Piqueras-Sanchiz, Moreno-Perez, & Romero-Rodriguez, 2021). With this setup, even if the power declines when fatigue sets in, we might claim that the load is at its maximum for each repetition. Having this in mind, flywheel exercises are beneficial for athletes and untrained people alike, for the young and fit and for the injured or old (Beato, Maroto-Izquierdo, Hernandez-Davo, & Raya-Gonzalez, 2021). The advantage stands in the natural load variation during the exercise. Authors of the research Effect of Flywheel Resistance Training on Balance Performance in Older Adults discovered that flywheel resistance exercise training increased older adults' muscle power while also improving balance and mobility (B. A. Sanudo et al., 2019).

Objective

The objective of the study was to measure the effect of isoinertial exercises using a flywheel training device on lower limb power and stability. Also, we wanted to verify if a positive relation can be found between force, power and stability of the lower limbs.

Materials and Methods

15 female volleyball players age between 16 and 32 were included in the study N=15. During 4 months the subjects trained twice a week using the flywheel device for a total of 32 sessions. The training protocol was structured as following: In the first 4-week cycle, 3 sets of 12 repetitions were performed twice a week. The second cycle had 4 sets of 10 repetitions. The third month contained 4 sets of 8. The last month 5 sets of 6 repetitions were executed also twice a week.

After accommodation with the testing protocol, initial (i) and final (f) tests were performed using OptoJump, Y balance test YBT and the flywheel device's own measuring system, the kMeter2. Following was the sequence of the testing methodology: Y balance test was performed first. After it, 3 countermovement jumps were measured with the best value recorded. Lastly, squat power was assessed from a set of 6 repetitions with only the last 3 maximal reps (3RM) being registered. The first three repetitions are used to set the flywheel in motion.

With OptoJump, the counter movement jump height was measured CMJ (cm). With the Y balance test, the dynamic stability was assessed by calculating the composite reach distance index of the lower quarters, the average was represented by CRD (%). Average squat power AvP(W) and force AvF(N) was measured with the kMeter2 and L flywheel attached (0.050 kgm^2)

The statistical analysis has been performed using SPSS. T test was used to compare the initial and final values of the jump height, lower limb power and lower limb stability. Pearson Correlation was used to verify if the values from the initial and final tests do, or do not correlate in between themselves.

Results

Significant improvement has been found between the initial and final results for composite reach distance index, squat power/force and jump height $p<.01$. We treated each parameter separately and compared the means of the initial and final measurements. The results are represented in the graphs bellow.

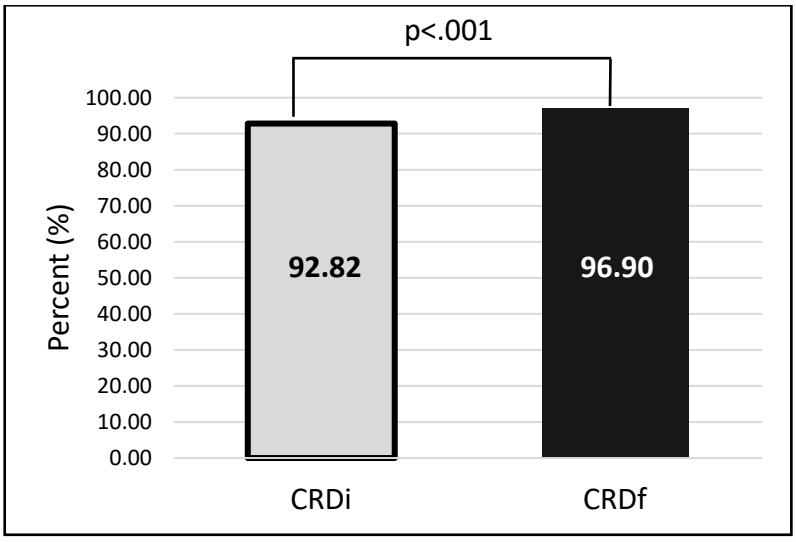

Figure 1. *Composite reach distance index*

We have found an increase of 4.08% between the initial and final measurements for lower limb composite reach distance index. The difference may be small but it is statistically significant with a value of p<.001, SD=3.19%.

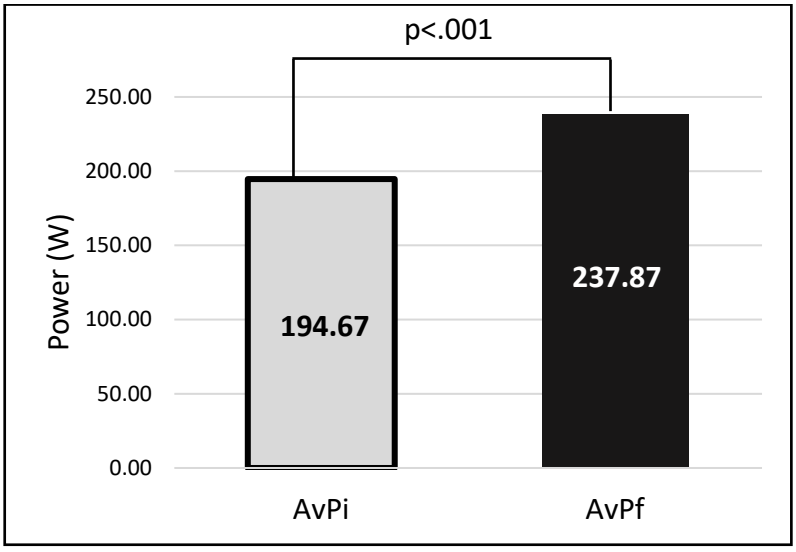

Figure 2. *Average lower limb power*

Using the flywheel device, the increase in average power for the 3 RM squats has been recorded at 43.2 W. The increase is substantial with p<.001, SD=32.88 W.

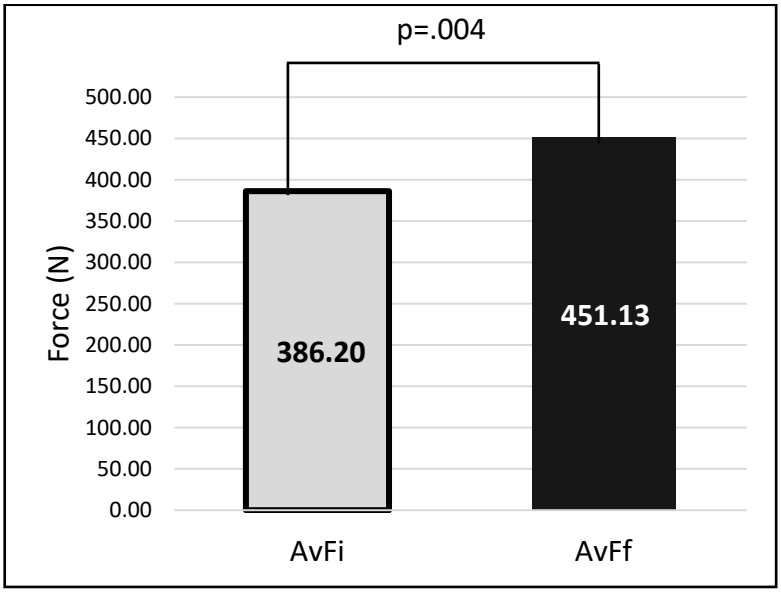

Figure 3. *Average lower limb force*

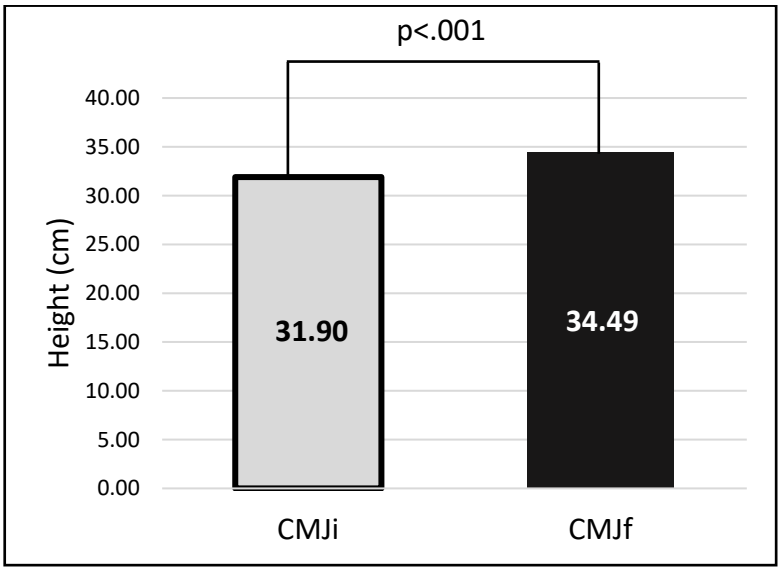

Figure 4. *Counter movement jump height*

An increase can also be observed in the measurement of 3RM squat average force. We found a difference of 64.93 N, $p<0.01$, SD=72.12 N. The values of the counter movement jump have also increased by a small, but significant amount of 2.59 cm on average $p<.001$, SD=1.66 cm.

Table 1. Initial measurement correlations

		CRDi	AvPi	AvFi	CMJi
AvPi	Pearson Correlation	0.259	1	0.513	.639*
	Sig. (2-tailed)	0.352		0.050	0.010
	N	15	15	15	15
AvFi	Pearson Correlation	-0.171	0.513	1	0.485
	Sig. (2-tailed)	0.542	0.050		0.067
	N	15	15	15	15

* Correlation is significant at the 0.05 level (2-tailed).

As we expected, in the initial results average power positively correlates with counter movement jump height r=.64, p=.01. At the same time, a slightly weaker correlation can be found between power and force values r=.51, p=.05. This is considered normal, as force is a component of power.

Table 2. Final measurement correlations

		CRDf	AvPf	AvFf	CMJf
AvPf	Pearson Correlation	.271	1	.731**	.549*
	Sig. (2-tailed)	.329		.002	.034
	N	15	15	15	15
AvFf	Pearson Correlation	.461	.731**	1	.665**
	Sig. (2-tailed)	.084	.002		.007
	N	15	15	15	15

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The following associations for the final measurements have been discovered: Again, average power positively correlates (this time stronger) with average force r=.73, p=.002 and with jump height r=.55, p=.03. A slight positive relation is seen between power and stability. Furthermore, we see average force correlating with jump height r=.66, p=.007 and slightly with the composite reach distance r=.46, p=.08.

Discussions

In a 2021 study, it has been found that in comparison to baseline, there were significant differences after training in squat jumps (SJ), and countermovement jumps (CMJ), as well as ratings of felt exertion, heart rate, and reported muscular pain. Additionally, compared to conventional training, the SJ and CMJ were much lower following inertial flywheel training (Lopez De Haro, Olcina Camacho, & Timon Andrada, 2021). Possibly the lather can be more efficient in some cases, when time is of the essence. Another study concluded that flywheel resistance exercise training is a suitable method of exercise for enhancing strength and functional capacity in older adults (B. Sanudo, de Hoyo, & McVeigh, 2022). Besides strength, balance can also be improved as the same author discovered in a different study named Improved Muscle Strength, Muscle Power, and Physical Function After Flywheel Resistance Training in Healthy Older Adults (Sanudo et al., 2022).

A review conducted in 2022 included studies that were conducted between 2004 and 2019. 100 women were involved, volume ranged from 1 to 4 sets and 7 to 12 repetitions, and the frequency ranged from 1 to 3 times per week. The training period spanned from 5 weeks to 24 weeks. According to recent research, flywheel training can improve physical results in both young and old ladies and is both safe and time-efficient. With this knowledge, doctors may be more likely to recommend flywheel training as an effective stimulus for physical improvement as well as an excellent protection against accidents or falls (Raya-Gonzalez, de Keijzer, Bishop, & Beato, 2022).

In comparison to training with only the athletes' own body weight as resistance, a 6-week flywheel routine appears to induce more favorable adaptations that protect athletes from hamstring and ACL injuries and improve their performance during repeated shuttle sprints (Raya-Gonzalez et al., 2022). This is clearly the case of our study, although more data is needed to compare this training system to free weight resistance training.

A study from 2016 that included 8 teams (4 volleyball and 4 basketball for a total of 38 women and 48 men) found that regular workouts can be improved by include a weekly eccentric overload squat training session. This increases lower limb muscle strength without causing patellar tendon complaints.

Future research will examine the effectiveness of the current workout paradigm in sports that frequently require forceful jumping to prevent or treat patellar tendinopathy (Gual, Fort-Vanmeerhaeghe, Romero-Rodriguez, & Tesch, 2016).

Conclusions

A flywheel isoinertial training device can be seen as a viable alternative for power and stability development in female volleyball players. Even though the parameters we tracked improved, we could not identify strong significant correlations between lower limb stability and power/force values.

It has been observed that increasing the lower limb power, although directly correlated with jump height, does not drastically increase the latter. This makes us believe that countermovement jump height is influenced by other factors besides lower limb power and force.

Although correlation does not imply causation, we have found a stronger connection between the stability parameter CRD and force, rather than the power of lower limbs. Future consideration of the issue is necessary.

This system's mobility and safety during use and storage are undoubtedly benefits. Despite not being able to completely replace conventional training, it produces outcomes that are comparable. The conditioning instructor decides how to use a combination of traditional techniques and modern technologies to the athletes' advantage.

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THE EFFECTIVENESS OF PASSIVE EXERCISES ON ARTERIAL BLOOD GASES IN MECHANICALLY VENTILATED SUBJECTS FROM INTENSIVE CARE UNITS

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ABSTRACT. Introduction: Mechanically ventilated critically ill subjects are often given strict bed rest and sometimes completely immobilized because of the severity of their illness and the administration of drugs such as sedatives. Active mobilization is not possible in subjects under deep sedation and unable to follow commands. In this scenario, passive therapy is an interesting alternative. **Objective:** This study aimed to evaluate the effectiveness of passive exercises on arterial blood gases in mechanically ventilated subjects from intensive care units. **Methods:** Five mechanically ventilated subjects participated in the study. The subjects were assigned to one study group, which received passive exercises for one daily session, including ten repetitions in three series per articulation. Arterial Blood Gases were assessed by arterial blood sample analysis with the Stat Profile Prime Plus device. **Results:** The results revealed a marked improvement in arterial blood gas exchange as compared to baseline reflecting an increase in FIO2- the inspiratory fraction of oxygen, pO2- partial pressure of oxygen, and pO2/FIO2- the ratio between the partial pressure of oxygen and the inspiratory fraction of oxygen and a decrease in CO2- carbon dioxide. **Conclusions:** The passive exercise showed a slight trend of beneficial changes at the cellular level in mechanically ventilated subjects since the first day after admission, which may indicate a reduction in the inspiratory fraction of oxygen and at the end, extubation of subjects.

Keywords: *passive exercise, mechanical ventilation, intensive care, arterial blood gas*

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Introduction

Mechanically ventilated critically ill subjects are often given strict bed rest and sometimes completely immobilized because of the severity of their illness and the administration of drugs such as sedatives (Younis & Ahmed, 2015). The challenges to mobilizing critically ill subjects include the safety of tubes and lines, personnel and equipment resources, sedation practices, the patient's size, the time, and the priority of mobilization. All these factors may persist for days to weeks and delay active mobility use (Vollman, 2010). The impact of immobility on the subjects may encompass functional decline and associated neuromuscular, and musculoskeletal weakness, impaired coordination, delayed weaning from mechanical ventilation, and prolonged hospital stay (Berry et al., 2014). Early physical exercise is essential to limit the occurrence of complications related to bed rest. Active exercises are not possible in subjects under deep sedation and unable to follow commands, and in this scenario, passive exercises are an interesting alternative (Pinheiro et al., 2017). Another relevant aspect was the fact that the subject's movement was reproduced manually by a single physical therapist, demonstrating that the protocol can be performed in places with limited resources. A single session of manual therapy improves lung function, inspiratory muscle strength, and oxygen saturation, and reduces dyspnea, fatigue, and heart respiratory rate (Yilmaz et al., 2016). Early physical therapy programs for mechanically ventilated subjects increase oxygen saturation, and arterial oxygen pressure and decrease complications, length of intensive care stay, and reduction of healthcare costs (Meawad et al., 2018). Evidence suggests that passive range of motion exercise for mechanically ventilated subjects is a safe and effective intervention that can significantly impact a patient's clinical outcomes (Fahmy, Ibrahim & Kandeel, 2021). Passive exercises were well tolerated in critical intensive care subjects, ventilated, and sedated, such exercise could be the most appropriate form of activity for these subjects in the early phase (Amidei & Sole, 2013). The exercise that can be performed from the moment the subject is admitted to intensive care are low in intensity, since the subject usually remains in bed, especially those who are mechanically ventilated (Medrinal et al., 2018). Mechanically ventilated patients are traditionally considered too sick for early physical therapy and mobilization. It has been demonstrated that a loss of muscle mass and strength rapidly occur from the first days of bed rest together, with insulin resistance and an inflammatory process (Akoumianaki et al., 2017). The passive exercises showed a slight tendency for beneficial changes at the cellular level in mechanically ventilated intensive care subjects from the first days of admission (Vollenweider et al., 2022).

For intensive care subjects, the term "early mobilization" refers to the application of physical therapy (for example, passive mobilization, active mobilization, and respiratory muscle training) and possesses prominent superiority if it is initiated from an early stage (less than 5-7 days) (Yue et al., 2018). When initiated shortly after the start of mechanical ventilation, mobilization can play an important role in decreasing the duration of mechanical ventilation and hospital stay (Hashem, Nelliot & Needham, 2016). Physical exercise in intensive care should have the appropriate intensity and type depending on the condition of the subject (Jang, Shin & Shin, 2019). Invasive mechanical ventilation is a life-saving procedure applied to critically ill subjects to achieve adequate pulmonary gas exchange and unload excessive respiratory muscle work (Peñuelas, et al., 2019). Arterial blood gas analysis is a common test ordered in critically ill subjects, without influencing subject care. It is used to check the function of the subject's lungs and how well they can move oxygen into the blood and remove carbon dioxide (Chandran, et al., 2021). Sedative and analgesic treatment administered to critically ill patients need to be regularly assessed to ensure that pre-definite goals are well achieved as the risk of complications of oversedation is minimized. The choice of sedation scale measuring the level of consciousness could be made by the Richmond Agitation scale (RASS) (Thuong, 2008). Passive physical exercises are performed without voluntary muscle contractions, the articulated segments being mobilized by external forces, which replace the mobilizing muscle force (Trinity & Richardson, 2019). Pure-assisted passive mobilization is performed by a physical therapist, it is also called manual mobilization and is considered the most precise form of passive mobilization (Cordun, 1999).

Objective

This study aimed to evaluate the effectiveness of passive exercises on arterial blood gases in mechanically ventilated subjects from intensive care units.

Methods

The current study was carried out in the intensive care unit of Cluj-Napoca The Regional Institute of Gastroenterology and Hepatology "Prof. Dr. Octavian Fodor", in the period from September 2021 to February 2022, to identify the effectiveness of passive exercises on arterial blood gases in mechanically ventilated subjects from intensive care units.

Subjects

Five mechanically ventilated and sedated subjects (males=3 and females =2) with a score on the Richmond Agitation scale of -4 to -3 participated in this study. The subjects were recruited from the intensive care unit of Cluj-Napoca The Regional Institute of Gastroenterology and Hepatology "Prof. Dr. Octavian Fodor", in the period from September 2021 to February 2022. Their age was between 45 to 79 years. All subjects were assigned to one study group and received a passive exercise protocol for one session per day, for five days.

Inclusion criteria: the age subjects to be over 18 years and to be mechanically ventilated for at least 24 hours. Exclusion criteria: subjects with hemodynamic instability, who have active bleeding, with neuromuscular diseases, who have recently suffered a myocardial infarction, increased intracranial pressure, or recent fractures.

For assessment: Arterial gasometry was measured at the Stat Profile Prime Plus machine which is a complete analyzer that combines blood gases, electrolytes, metabolites, and CO-oximetry, normal values are: pH – 7.35-7.45; partial pressure of oxygen pO2 – 75 to 100 mmHg; partial pressure of carbon dioxide pCO2 – 35 to 45mmHg.

The subject's state of consciousness was assessed with the Richmond Agitation Scale (RASS) to describe their level of alertness, agitation, and sedation. This scale ranged from -5 to +4 which means: a score of 0 to +4 the subject is alert, restless, or agitated; -1 subject awakens with sustained eye opening and eye contact; -2 subject awakens with eye-opening and eye contact, but not sustained; -3 subject has any movement in voice response but no eye contact; -4 subject has any movement to physical stimulation; -5 subject has no response to any stimulation (Sessler el al., 2002).

Procedures

The procedure was explained to every subject's relative, and informed consent was signed. The study had approval from the Ethical Committee of the "Babeş-Bolyai" University and from The Regional Institute of Gastroenterology and Hepatology "Prof. Dr. Octavian Fodor".

Baseline data was noted before starting the protocol, including age, gender, region, admission diagnosis, ventilatory mode, and score on the Richmond Agitation Scale of all the subjects.

Before starting the protocol, the subjects were laying in dorsal decubitus with the head elevated at an angle of 30° without suffering any medical procedure for 30 min. The sample for arterial gasometry was collected by the resident doctor 5 min before the passive exercise session and 15min after ending the session (Saad, 2020).

The protocol was performed manually by a single physical therapist, for five days, one session per day in three series of ten repetitions. The physical therapist, initiated, led, and ended the movement rhythmically, with the tension of the soft parts at the end of the movement four times, the repetition rate is maintained at each tempo. The movement sequence was from distal to proximal, favoring also the veno-lymphatic return. The application of the socket and counter socket was also considered. The sockets change was gentle and minimal in position, avoiding any discomfort for subjects.

Ankle flexion (dorsiflexion), ankle extension (plantar flexion), and circumduction were performed in the lower limbs in the ankle joint. In the hip joint, the flexion consisted of near the anterior face of the thigh to the pelvis and circumduction. Flexion, abduction, and circumduction were performed at the level of the upper limbs in the shoulder. At the level of the elbow joint and fingers - flexion and extension. At the fist level, flexion, extension, and circumduction. At the level of the head and the cervical segment flexion, extension, and rotation movements to the right and the left.

Statistical design and data analysis

Statistical analyses were performed using EXCEL WINDOWS 10. Descriptive statistics of arterial blood gas parameter scores before and after the application of passive exercise in mechanically ventilated subjects were used for mean and standard deviation. The t-test for comparing the mean values obtained before and after the application of passive exercises. All statistically significant differences were determined at a 95% confidence interval and significance was set at $p \leq 0.05$.

Results

The purpose of this study was to evaluate the effectiveness of passive exercises on arterial blood gases in mechanically ventilated subjects from intensive care units. The subjects were assigned to one study group which included five mechanically ventilated and sedated subjects from The Regional Institute of Gastroenterology and Hepatology "Prof. Dr. Octavian Fodor" of Cluj-Napoca. Data obtained pre and post-protocol regarding arterial blood gases were statistically analyzed and compared.

The study included five subjects, three males, and two females with an average of 61.6 years and a standard deviation of 8.30. The subjects came from Cluj County, with a percentage of 60% from the rural environment and 40%

from the urban. Regarding the state of consciousness, 40% fell to -4 (no response to voice, only movement or eye-opening to physical stimulation) and 60% to -3 (movement or eye-opening to verbal stimulation).

PH - hydrogen potential, the average pH value before and after applying the protocol was 7.4±0.075 and 7.4 ± 0.032. There was no significant difference, the percentage of decrease was 0.0002. The average of FIO2-the inspiratory fraction of oxygen, before and after applying the protocol was 43.75±8.34, respectively 35.62±3.20. This registers a difference of 8.13 percent and a p-value of 0.006. The mean value of pO2-partial pressure of oxygen was 107.5±24.90 and 118.78±23.13 respectively, registering an increase of 11.28 percent and a p-value of 0.13. The average value of CO2- carbon dioxide before and after applying the protocol was 28.97±7.67 and 26.87±3.72, with a decreasing percentage of 2.1. The average of the pO2/FIO2-the ratio between the partial pressure of oxygen and the inspiratory fraction of oxygen was 278.12±80.61 respectively 315.28±87.23, with a significant increase of 37.16 percent.

Table 1. The result of variable

Variables	Before	After	Difference	t-test	p-value
pH	7.4±0.075	7.4±0.032	0.0002	- 0.01	0.98
FIO2	43.75±8.34	35.62±3.20	8.13	4.04	0.006
pO2	107.5±24.90	118.78±23.13	11.28	-1.60	0.13
CO2	28.97±7.67	26.87±3.72	2.1	1.31	0.21
pO2/FIO2	278.12±80.61	315.28±87.23	37.16	-1.99	0.0690

Data are expressed as mean ±standard deviation
PH- hydrogen potential; FIO2-the inspiratory fraction of oxygen; pO2-partial pressure of oxygen; CO2- carbon dioxide; pO2/FIO2-the ratio between the partial pressure of oxygen and the inspiratory fraction of oxygen.

Discussion

Mechanical ventilation is a life-support therapy that improves carbon dioxide retention, and acid-base equilibrium. Mechanically ventilated subjects develop intensive care unit-acquired weakness as a result of their immobility and sedative administration (Yue et al., 2018). Interest in early mobilization and rehabilitation of critically ill subjects has grown in the last decade in response to increasing insights into long-lasting impairments experienced by many survivors (Denehy, Lanphere & Needham, 2017).

This study was conducted to analyze and investigate the effectiveness of passive exercises on arterial blood gases in mechanically ventilated subjects from intensive care units. Five mechanically ventilated subjects from both genres were assigned to one group that received a passive exercise protocol. All the subjects were evaluated before and after the protocol measuring Arterial Blood Gases (PH- hydrogen potential; FIO2-the inspiratory fraction of oxygen; pO2-partial pressure of oxygen; CO2- carbon dioxide; pO2/FIO2-the ratio between the partial pressure of oxygen and the inspiratory fraction of oxygen). The result of the study proved that a marked improvement in arterial blood gas exchanges as compared to baseline was reflected by a significant statistical increase in the pO2-partial pressure of oxygen and the pO2/FIO2-the ratio between the partial pressure of oxygen and the inspiratory fraction of oxygen and a significant decrease in FIO2-the inspiratory fraction of oxygen and CO2- carbon dioxide.

The improvement of arterial blood gases could be explained that passive movement improves ventilation, central and peripheral perfusion, circulation, muscle metabolism and alertness, and countermeasures for venous stasis (Gosselink et al., 2008). Early mobilization was shown to improve forced vital capacity, maximum voluntary ventilation, and arterial oxygenation (Zafiropoulos, Alison & McCarren, 2004). The result of this study agreed with the result of (Saad et al., 2020) who found chest physiotherapy protocol in form of (manual hyperinflation, vibration, percussion, suctioning, upper and lower limbs exercise, and end position) is an effective method for improving arterial blood gases of mechanically ventilated subjects.

Conclusions

Based on the findings of this study passive exercise is an effective method for improving arterial blood gases in mechanically ventilated subjects. The passive exercise showed a slight trend of beneficial changes at the cellular level in mechanically ventilated subjects since the first day after application of the protocol, which may indicate a reduction in the inspiratory fraction of oxygen and at the end extubation of subjects, and fewer days of intensive care unit.

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THE SPECIFICS OF THE MOUNTAIN BIKE – DOWNHILL CASE STUDY DH FLOW RIDE COMPETITION BISTRIȚA

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ABSTRACT. Specialized articles and publications reveal the impact that mountain biking registers worldwide today in the field of outdoor sports and mobility. The aforementioned field is under rapid development, a fact revealed by the increasing number of practitioners, the competitions organized throughout all continents, addressing a wide range of ages and proficiency categories, from amateurs to high-performance professional athletes. Mountain biking is gaining popularity in Romania as well, where several competitions (Enduro, Downhill, Cross) are organized, engaging numerous competitors. Most of the locations where downhill skiing is practiced (and mechanical means of ascent are present, especially chairlifts) have become areas adapted for practicing mountain biking in the off-season.

Keywords: *mountain bike, downhill biking, natural areas, implications*

Introduction

Bistrita counts among the aforementioned areas. The chairlift of the public slope (the controversial *Cocoș* ski slope) has been adapted for the transport of bicycles to the peak. The array of slopes display various degrees of difficulty, thus facilitating the practice of mountain biking in its many forms, as well as the organization of competitions. The growth of the Mountain biking phenomenon in Romania is supported in practice by an increase in adapted spaces in natural areas for this type of recreational activities.

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The study of the currently specialized literature, in addition to the study of layout models of different mountain biking locations reveals important aspects applicable in Romania. These aspects will outline criteria for evaluating destinations and quantifying the impact of mountain biking.

Objectives of the study

• analysis of specialized literature (up-to-date);
• identification of the main specific aspects of mountain biking as a recreational and sporting activity, considering the angles of methods of practice, technique and specific materials;
• specification of the main characteristics of the specific effort
• knowledge of the current methods of evaluation and management of sports events dedicated to mountain biking
• development of evaluation methods of the negative effects (erosion, pollution) that appear in the areas intended for cycling through the development of routes (ramps, turns, suspension bridges)
• the objective survey of the level of mountain biking in Bistriţa.

Mountain Cycling (general considerations)

Mountain biking represents a rapidly developing field within the outdoors recreational sports sector, which has recently registered a surge throughout the world. Current studies reveal that the mountain bike phenomenon contributes a number of social and economic benefits to regional areas and the wider community by stimulating tourism and recreational spending. It is stated that mountain biking contributes $133 billion to the US economy, creates nearly 1 .1 million job opportunities and supports sustainable growth in rural communities (Newsome, Davies, 2009) It is estimated that the MTB phenomenon will continue to grow in popularity, due to technological innovation (Electric bike), which facilitates easier access to natural areas (O'Donnell & Carroll, 2003, White et al., 2006).

The concept of mountain biking involves many different forms of practice in terms of motivation, skills, and equipment, thus the main categories are; *Cross Country*, *Touring*, *Downhill, Free Riding, Dirt Jumping* (Goeft & Alder, 2001). The routes vary from forest roads, mountain paths, routes with complex layouts of the terrain configuration (ramps, turns, suspension bridges, etc.), to rugged extreme routes. A. Cross Country: includes a wide range of participants, from inexperienced to passionate riders, using groomed trails, such as disused railway tracks, access roads and park management (Newsome, 2009). Standard mountain bikes, (with

little to no suspension), limit access, reducing it to less technical options. There are also the competitive versions of Cross Country over different distances that include flat sections, uphill and downhill, obstacles (logs, rocks/jumps).

B. Touring: cyclists concerned with long routes, (sometimes involving camping). Because they have to carry camping equipment, wide, low-gradient trails through natural areas are used.

C. Downhill: involves a high technical level and specialized equipment (highly sophisticated full-suspension bikes adapted for downhill riding on difficult trails.

Downhill bikes are heavy and therefore shuttle services are often provided. The route is characterized by turns, steep inclines, jumps, short sections of flat terrain (Newsome, Davies, 2009).

D. Free Riding: riders looking for technical challenges, (rocks, logs and overhangs, associated with steep downhill segments (Newsome, Davies, 2009).

F. Dirt Jumping: with specific jumps and jumps, therefore an extremely technical variant (Newsome, Davies, 2009).

These activities can have a significant impact on the environment if not properly designed and constructed. All these emerging categories are relatively new, yet are rapidly establishing themselves at the world sports level, becoming Olympic Sports events in record time.

MTB field involves a specific issue that refers to:

1. the increased risk of injury caused by specific developments involving high speed of travel, reduced visibility (Horn et al., 1994, Kerr, 2003), technical trails or design and construction flaws of the trails. There are many examples of lawsuits in the U.S. blaming the unsatisfactory management of the natural area for cycling accidents (Newsome, Davies, 2009).

2. the impact on the natural environment caused by the incursions of the increasing number of participants into the natural environment, the specific arrangements that modify the natural design of the relief, thus leading to the general erosion of the paths, the reduction of water quality, the disturbance of wildlife and changes in the vegetation.

Case Study- DH Flow Ride Bistrița

In spite of its novelty of the field, Mountain biking is spreading globally and rapidly establishing itself as an Olympic sport. The first world championships recognized by the UCI took place in 1990, and subsequently, the cross-country discipline was nominated as an Olympic sport in 1996, in Atlanta.

In Romania, the first unofficial competition took place near Sibiu in 1995, followed by the first National Championship held in Poiana Braşov in 1997. In 2004, Romania had its first and only participation in this sport discipline at the Olympic Games, through the athlete Tudor Oprea).

The city of Bistrita is a city of withstanding mountain biking tradition (in the DH area, 30 athletes enrolled in various clubs have claimed, over time, important medals and places on the podium in national and international competitions). More than 1000 amateur practitioners of this sport are registered in cycling clubs or associations: *Bistritz Racing Club*, *Bistrita DH*, *Tura cu copaci* (community of mountain bikers).

Nowadays, the municipality of Bistriţa provides three locations for the practice of mountain biking:

1. The Schullerwald Forest-School, a landscaping project started in the summer of 2013, includes trails dedicated to MTB (a circuit of 1.7 km. with different degrees of difficulty), trails additionally accessible to mountain runners. This project has been of interest to the practitioners of outdoor physical activities, which will shortly benefit from the modernization of the area, sports fields, play areas dedicated to children, recreational points, climbing panels, etc.

The location is ideal for organizing running competitions, tourist orientation, mountain biking, competitions which can accommodate many participants.

2. The Codrişor Bike Park fosters numerous routes equipped with ramps, turns and other MTB-specific facilities. During its 15-years lifespan, the area has developed significantly, the routes have diversified and become technically complex, bridges and suspended route segments have been implemented. The location amasses over 12 km of route, with the longest trail of 2.2 km and 230m altitude difference.

The first national DH cycling competition hosted by Bistriţa FlowRide Cup 2017 took place here, gathering 106 cyclists from Romania (contest categories *Junior*, *Elite Masters, Hobby*).

3. The *Cocoş* Bike Park, located near Bistriţa, benefits from the gondola lift of the ski slope in the winter season (the design of the bicycle park increases the functionality of the cable installation).

The project in question aims to enhance the *Wonderland* investment area, which includes the *Cocoş* ski slope and the future *Alpine Coast*, with the final goal of increasing the activity level of the complex throughout the year. Up to date, 4 routes with progressive degrees of difficulty have been created.

The project increases the appeal of the area and capitalizes on the pre-existing investments, including the adventure park, the three bicycle routes used by amateur cyclists and the cable transport facility, equipped with 37 support structures for the transport of bicycles.

The trails are located in the vicinity of the ski slope, on an area of approximately 75 ha, starting from the upper plateau (the top of the chairlift), and contain tracks of different lengths (max. 3 km) and difficulty degrees:

- Downhill (Family line, Race line, Flow line, Jump line);
- Cross country (family and race lines, enduro, marathon)
- Pumptrack, dirt line (at the base of the slope)

All four routes are practicable:

- Downhill route - advanced degree of difficulty; level difference 250 m; length 1.7 km.
- The Flow trail - medium level of difficulty, level difference 250 m; length 2.6 km.
- Family trail - easy level of difficulty, level difference 250 m; length 4 km.
- A-LINE trail – medium-easy degree of difficulty, level difference 250 m, length 2.5 km.

All routes take advantage of the topography of the area, having minimally affected the local forest, and display specially designed features such as ramps, trampolines, slope breaks and raised mantels.

Conclusion and suggestions

In spite of the controversy around the location and functionality of the *Cocoș* slope in the winter season, the facility is increasingly becoming an area of interest for mountain bikers (enduro and downhill).

This is mainly due to the *gondola* cable climbing facility that allows the transportation of bicycles to the upper area located at an altitude of approximately 700 m. This fact allowed the setting up of a bicycle park of many routes with different degrees of difficulty (2 downhill routes: *Family* and *Race*, two cross-country routes, *Jump*, *Marathon*, *Natural Pump* track and *Dirt line*).

The park dedicated to MTB totals almost 15 km of route arranged with ramps and trampolines, with an average difference in level of 250 m. This allowed the municipality of Bistrita to host numerous competitions, the noteworthiest being the national stages of downhill mountain biking in the 2021-2022 editions (*Cupa Flow Ride,* Bistrița).

The case study refers to the comparative analysis of the last editions, an analysis that will highlight the evolution of the field revealed by the large number of participants, the performances achieved and the superior technical level. In conclusion, the current *Cocoș* Ski Slope near Bistrița can become an important regional (even national) destination for practicing mountain biking.

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MANAGERIAL STUDY ON PERFORMANCE LEVEL WITHIN CSS - SPECIALIZATION IN WINTER SPORTS (HARGHITA COUNTY)

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ABSTRACT. The study of management research of the educational system of performance in winter sports in Harghita County presents a spreadsheet situation for an Olympic cycle period with medal results for winter sports – biathlon, ice hockey, figure skating, cross-country skiing. The goal of the research consists in identifying the most valuable results in the given sport through SWOT analysis. The hypothesis of the research starts out from the presupposition that through a sport management analysis based on a progress rate, according to the evolution during the Olympic cycle, there can be chosen from the CSS M-Ciuc young athletes who can reach the III-IV stage of training at national and international performance level. We believe that based on the results, through the use of a specially proposed, age-adapted training program optimal high-level performance can be reached. We propose a SWOT analysis for every winter sport apart in order to identify the strengths and weaknesses within the activity of organizational structures, as well as opportunities and the causes that threaten from the outside the activity conducted by the managers of ISJ Harghita.

Keywords: *winter sports, progress rate, sport management, SWOT analysis*

Introduction

Leading the sport phenomenon means the art of efficient management through the adaptation of new methods of leadership and modernization of the structures of the sport organizations and in the present case, we start out

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from the sports vocational education level within the school sport clubs in CSS M-Ciuc, Harghita County.

This level requires special attention especially given that its management starts out from the economic sector, modern development materials, halls, ice rinks, cross-country ski trails, biathlon shooting range, special equipment.

Within this context, the present problems needed to be taken over by a "specialized sports manager" with activity focused on performance requirements at junior age level within the CSS M-Ciuc, Harghita County.

Budgetary sources come primarily from MED, in fact economic profit carefully managed and oriented towards the sports practiced within CSS M-Ciuc, Harghita County. Organization, leadership and control have been focused on the following objectives and resources: *human*, *financial*, *material*, and *informational*, which make decisions within sports management, because "the managerial control checks the project plan and managerial efficiency" (Griffin, 1990, quoted by Colibaba, 1998).

Specifically, for the education system at the CSS M-Ciuc level in Harghita Country, the implementation of the design, planning, organization, leadership and control of the product, as stated by Kotler (1986), "marketing is successful only when technical departments work tougher with the financial department", has been promoting the individual sport performance of each department.

It has been seen that human resources at the level of the group of teachers-trainers were under the pressure of sports performance at the national and international level of the different disciplines – biathlon, ice hockey, figure skating, speed skating, cross-country skiing.

Staffing and salaries are regulated by legislation, which is actually a matter between employees and functional managers, in fact a global concept of „leadership and training of human resources done by ISJ Harghita."

The managerial research sector requires "knowledge of the institutional sources of the organization in accordance with its objectives" (Nicolescu, Verbancu, 1996), as well as interdisciplinary knowledge of sports performance.

Management activity also presupposes sport marketing, (Mulin, 1993), given that in Harghita the marketing of sport services and of sport products and competitions has been promoted, in which local organizations, the Mayor's Office, the Local Council, etc. also have been involved.

The strategy of psychological marketing with reference to CSS M-Ciuc Harghita county had the competitive advantage thanks to the leading position in competitions and the quality of results in the performance of the component sections of CSS M-Ciuc, Harghita County.

Management Analysis Methods

Two methods were used in the overall analysis of the organization represented by CSS M-Ciuc, Harghita County:

1. **PEST analysis** (political, economic, social, technological).

The PEST analysis in the sports performance education system focuses on a **policy** of relations between the employer ISJ Harghita and employees - teachers, salary, reward, and motivation.

Economic: it influences the activity of CSS M-Ciuc, Harghita County due to the fact that profit is made, mirrored in the results and performance of the separately funded component departments.

Social factor: meets the needs of the current generation of athletes and motivates the possibility of meeting the needs of future generations.

Technology, is concerned with communication networks, information in the media, organizationally supports economic development (Bondoc-Ionescu, 2005).

2. **SWOT analysis**, meaning **Strengths, Weaknesses, Opportunities, Threats** (Frîncu, Larion, 2007).

The strong points are the competitive advantages of the winter sport departments favored by the climate of the area with a lengthened cold season where biathlon, ice hockey, figure skating, speed skating and cross-country skiing benefit from snow-frozen tracks until the spring.

The strong points were achieved according to the rate of progress obtained by Cohen's formula, applied to an Olympic cycle completed in 2022, according to national championship titles.

In the formula, the number of titles in the first year of the Olympic cycle for Ti and the number of titles in the last year of the Olympic cycle for Tf were applied to obtain the progress expressed as a percentage.

Strong points have been registered at biathlon with 150% progress rate and figure skating 300%, cross-country skiing 66.7%.

The weak points were registered at ice hockey with a regress of - 33% and speed skating – 62.5%.

Opportunities are those aspects that can offer CSS M-Ciuc, Harghita County an advantage: sponsorships, sport facilities, support from local organizations.

Threats are represented by external factors which influence the results and performance, especially given that in the period of the pandemic ice hockey and speed skating had breaks in the training process.

We attach the results by Olympic cycle to show the evolution or regression of the titles obtained in each sport.

Bellow we present Cohen's progress rate formula, which was applied according to national performance data in the Olympic cycle.

$$\frac{(Tf - Ti) \times 100}{Ti} = \%$$

It will be applied to all parameters apart and then the calculation of percentage is done.

Table 1. Evolution of the Biathlon performance of CSS M-Ciuc section

Biathlon

Sport	Institution of education	Competition	National performance 2017-1018 school year			National performance 2018-2019 school year			National performance 2019-2020 school year			National performance 2020-2021 school year		
			1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place
Biathlon	CSS M-Ciuc	Junior National Championship	4	5	5	9	16	9	11	12	5	10	12	12
	Total		4	5	5	9	16	9	11	12	5	10	12	12

According to data supplied by ISJ Harghita

Following the SWOT analysis and the table showing the participation in competitions in the Olympic cycle and the yearly-obtained titles, the progress rate was calculated at 150%, which is a strong point.

Given that there was planned training and there was a managerial strategy in selection there was assistance also in the period of the pandemic and there were training conditions created in an isolated space, given that training was done on natural paths and on the shooting range.

Table 2. Evolution on the ice Hockey Performance of CSS M-Ciuc section

Ice Hockey

Sport	Institution of education	Competition	National performance 2017-1018 school year			National performance 2018-2019 school year			National performance 2019-2020 school year			National performance 2020-2021 school year		
			1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place
Ice hockey	CSS M-Ciuc	U14 National Championship	1					1	1				1	
		U16 National Championship	1			1								1
		U18 National Championship	1			1			1			1		
	Total		3	0	0	2	0	1	2	0	0	1	1	1
	CSS Gheorgheni	U14 National Championship												
		U16 National Championship								1				
		U18 National Championship		1				1						1
	Total		0	1	0	0	0	1	0	1	0	0	0	1
General total			3	1	0	2	0	2	2	1	0	1	1	2

According to data supplied by ISJ Harghita

Following the SWOT analysis and the table showing the participation at competitions in the Olympic cycle and the titles obtained per year the progress rate was calculated at 33%, which is a weak point.

The ice hockey department faced problems due to absences caused by the pandemic and given that it is a team sport, there have been shortcomings in the training of the entire team, which has been negatively reflected in national competitions that took place in the periods with restrictions, both in training and at school.

Table 3. Performance evolution of the figure skating section CSS M-Ciuc

Figure skating

Sport	Institution of education	Competition	National performance 2017-1018 school year			National performance 2018-2019 school year			National performance 2019-2020 school year			National performance 2020-2021 school year		
			1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place
Figure skating	CSS M-Ciuc	Romanian Cup/FRP/Junior National Championship	1	0	1	0	0	1	4	3	0	3	2	1
	Total		1	0	1	0	0	1	4	3	0	3	2	1

According to data supplied by ISJ Harghita

Following the SWOT analysis and of the table showing the participation at competitions in the Olympic cycle and the titles obtained per year, progress was observed following the application of the formula mirrored in the percentage obtained 300% according to the Cohen formula result, which is a strong point.

Given the organizational management of training in isolated places and sometimes in spots halls in the period of the pandemic, the figure skating department has seen continuity in training. This aspect has been shown especially in the final year of the Olympic cycle through the four titles obtained by the young competitors of the team.

Table 4. Performance evolution of speed skating CSS M-Ciuc

Speed skating

Sport	Institution of education	Competition	National performance 2017-1018 school year			National performance 2018-2019 school year			National performance 2019-2020 school year			National performance 2020-2021 school year		
			1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place
Speed skating	CSS M-Ciuc	Junior National Championship	8	7	4	7	4	1		...		3	2	1
Total			8	7	4	7	4	1	0	0	0	3	2	1

According to data supplied by ISJ Harghita

The SWOT analysis applied for the speed skating department has evidenced a weak point upon applying the Cohen formula, registering a percentage of 62.5%, which means regress.

Results shown by the titles obtained in the last year of the Olympic cycle were inferior to the results of prior years due to the fact that in the period of the pandemic training had its shortcomings, there were many cases of absence of the students whose health was weak, requiring analysis with an opportunity to improve the situation in competitions.

Table 5. Performance evolution of cross-country section of CSS M-Ciuc

Cross-country skiing

Sport	Institution of education	Competition	National performance 2017-1018 school year			National performance 2018-2019 school year			National performance 2019-2020 school year			National performance 2020-2021 school year		
			1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place	1st place	2nd place	3rd place
Cross-country skiing	CSS M-Ciuc	Junior National Championship	0	0	1	6	8	6	6	8	6	7	12	6
	CSS Gheorgheni	Junior National Championship	6	7	3	7	5	1	1	4	0	3	2	1
	CSS Toplita	Junior National Championship	0	0	5	0	0	0	1	0	0	0	0	0
Total			6	7	9	13	13	7	8	12	6	10	14	7

According to data supplied by ISJ Harghita

Following the SWOT analysis and the table showing the participation at competitions in the Olympic cycle and the titles obtained per year, following the calculation of the progress rate there was seen a regress upon applying the formula reflected in the percentage obtained, a progress rate of 66.7% according to the results of the Cohen formula, which means a strong point.

In the period of the pandemic, the management organization focused on the training of students to be done on routes in nature without any contact with the large public. They faced no problems with training and competitions, this meaning an opportunity within our analysis.

Conclusion

Organizing school sport management, with adequate selection and training may achieve a future of high performance at junior level, who will be the seniors of tomorrow.

As a strong point in the SWOT analysis of the management activity of the CSS M-Ciuc, Harghita county, many junior athletes have been promoted to senior teams and clubs.

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DIDACTIC ESCAPE ROOM, APPLIED AT UNIVERSITY, IN ONLINE TEACHING

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ABSTRACT. The use of active teaching techniques combined with ludic aspects and game-based learning is a current field of investigation in higher education. "The use of escape rooms is also being considered as an educational tool in many schools. Using a variety of scenarios and challenges, the escape rooms create an experience that is simultaneously motivational and educational for the participants" (Manzano et al., 2021, p. 1). Our Didactic Escape Room was applied in the 2020-2021 academic year, at the end of the first semester, during the Covid-19 pandemic period, with online teaching, on a group of students from the Faculty of Physical Education and Sport (FEFS), enrolled at the psycho-pedagogical specialization within the Teacher Training Department, and on a group of students from the Faculty of Psychology and Educational Sciences, specializing in Pedagogy of Primary and Preschool Education (PIPP), within Babeş-Bolyai University, Cluj-Napoca. Through this intervention, we measured the general attractiveness, stimulation and novelty of a didactic Escape Room applied online, and we found that the degree of attractiveness for a didactic Escape Room, applied online, was high. Also, it was stimulating enough to generate engagement at the group level. We believe that the specificity of the group involved in the Escape Room is very important, and that each didactic activity of this kind be properly adapted for the class to which it is applied.

Keywords*: didactic, escape room, class, university, education, online*

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Introduction

The use of active teaching techniques combined with ludic aspects and game-based learning is a current field of investigation in higher education. The use of escape rooms is also being considered as an educational tool in many schools. Manzano et al. (2021, p. 1) declare that "Escape rooms are immersive games played by small groups of three to eight people, in which participants are required to solve puzzles to escape from a room or, in the case of breakout, open a final chest".

Most escape rooms include narrative-based challenges that use puzzles, tasks, and a time limit. Other varieties include puzzle hunts, breakout boxes, escape books, augmented reality escape rooms, and portable escape rooms in boxes, which allow players to enjoy the same immersive and difficult experience in the comfort of their homes (Fotaris & Mastoras, 2019).

The escape rooms provide an experience that is both motivating and educative for the participants by using a variety of scenarios and difficulties. Within an escape room, all problems, challenges or activities are called puzzles. To escape the room, players must solve different puzzles in a certain period, determined by the creator of the room (Nicholson, 2015). Moreover, the thematic experience and the knowledge about the topic, plays a crucial role in the puzzle design process. For a successful experience and for players to be drawn into the game environment, the chosen theme must be consistent with the narrative part of the theme (Clare, 2016).

It shouldn't come as a surprise that educational institutions have begun to include these projects into their curriculum by using escape rooms as teaching tools. Some instructors have taken one step further and created educational escape rooms, which are defined by López-Pernas (2019, p. 1) as "escape rooms that include part of the course materials within their puzzles in such a way that students are required to master these materials in order to solve the puzzles and succeed in the escape room".

Even though the majority of escape rooms are just for entertainment, educational escape rooms are growing in popularity with professional programs as a way to include students in their learning environment and foster teamwork and the development of social skills (Brown, 2019). Complexity is essential to the success of educational escape rooms since overly simple puzzles can quickly bore children while excessively difficult ones may cause frustration or even worry (Hermanns et al., 2018). A resulting design criterion for educational escape rooms is to ensure active participation within teams.

According to the findings of recent studies, games and the utilization of escape rooms have been successful in immersing students in the learning process and aiding in their memory of what they've learned (Veach, 2019).

Also the research called "Escape Rooms for Learning: a Systematic Review", presents a systematic literature review of 68 studies focused on educational escape rooms. Study results indicate that escape rooms help students to understand problems in another ways and were found to promote teamwork and collaboration. The activity of the escape room developed and improved social interactions, which was another shared benefit. Improved analytical skills such as critical thinking, problem-solving and creativity were also signalled as a major advantage (Fotaris & Mastoras, 2019).

Another study demonstrates that an escape game in the classroom encourages students to discover scientific concepts in a group setting and in a playful way. It also offers opportunities for students to develop adaptive and receptive skills, to compete with and against their peers, to display their individual skills, interact with one another, and experience moments of discovery and success (Dietrich, 2018).

Wiemker & Clare (2015, p. 2) says that, "to solve the puzzles, players require skills such as searching, observation, correlation, memorization, (logic) reasoning, mathematics, reading and pattern recognition". Among the abilities that can be developed with the usage of escape rooms in the classroom are problem solving and critical thinking. The various activities and challenges that the escape rooms present encourage participants to consider, assess, and solve problems. According to studies, the majority of participants get motivation and commitment from playful learning experiences (Whitton, 2018).

Another notable finding of one of these studies is that educational escape rooms can aid students in learning from their classmates and gaining a unique outlook on the course topics. The type of riddles employed in educational escape rooms must be extremely dependent on the subject area in light of their prior experiences (Eukel, 2017).

Objectives

1. The level of attractiveness for a didactic Escape Room applied in an online university course.

2. The degree of stimulation and novelty perceived by students of a didactic Escape Room applied in an online university course.

3. The difference in perception, on a didactic Escape Room applied in an online university course, between the moment before and after participating in the Escape Room, for two groups of students from different specializations.

4. The difference in perception, on a didactic Escape Room applied in an online university course, between the moment before and after participating in the Escape Room, between the two groups.

Material and methods

Didactic Escape Room was applied in the 2020-2021 academic year, at the end of the first semester, during the Covid-19 pandemic period, with online teaching, on a group of students from the Faculty of Physical Education and Sport (FEFS), enrolled at the psycho-pedagogical specialization within the Teacher Training Department, and on a group of students from the Faculty of Psychology and Educational Sciences, specializing in Pedagogy of Primary and Preschool Education (PIPP), within Babeș-Bolyai University Cluj-Napoca. None of the students had participated, prior to this class, in any didactic Escape Room, online or onsite.

In order to fulfil the research objectives, the UEQ (User Experience Questionnaire (UEQ), n.d.) was applied, built online with the help of Google Forms.

The research was carried out on the following steps (identical for both groups of students - FEFS and PIPP):

- A presentation was made regarding what an Escape Room and a didactic Escape Room entails;
- An analysis of a didactic Escape Room tutorial, very similar to the one the students were going to participate in, was carried out;
- UEQ was applied, before participating in the Escape Room (UEQ1-FEFS and UEQ1-PIPP);
- The didactic Escape Room took place (FEFS – 10 students, PIPP – 37 students);
- UEQ was applied, after participating in the Escape Room (UEQ2-FEFS and UEQ2-PIPP).

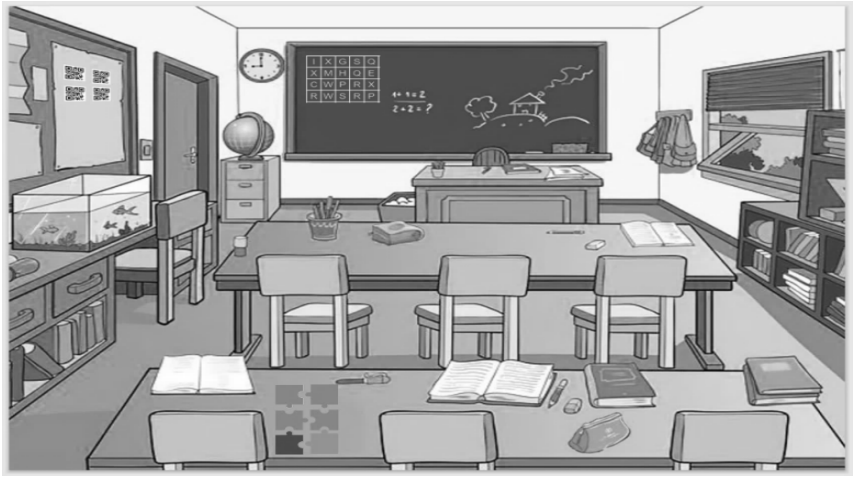

Fig. 1. *Didactic class (Escape Room) with clues*

The structure used for Didactic Escape Room:

- Students received a link that led them to a riddle;
- Solving the riddle opened the "didactic class" in which the clues were located.
- The first 6 clues (key terms from the didactic content) had to be found in a square with letters;
- Each clue was the password for one piece of a puzzle;
- Solving the puzzle offered a mathematical map which, solving it, offered a final number;
- The correct number was linked to a QR code that opened two text fields from the didactic content, which needed to be processed;
- The other QR codes offered an image in which the password for story cubes was hidden.

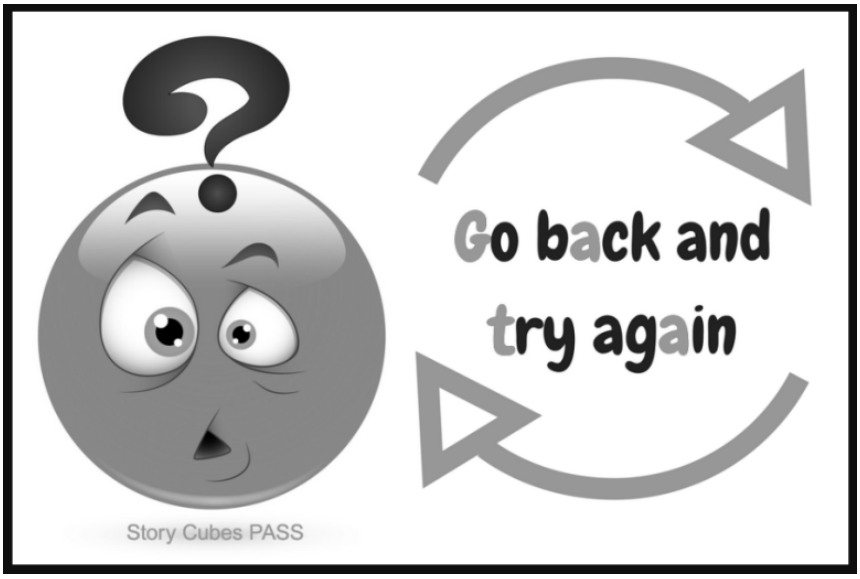

Fig. 2. *QR code for Story Cubes*

Results

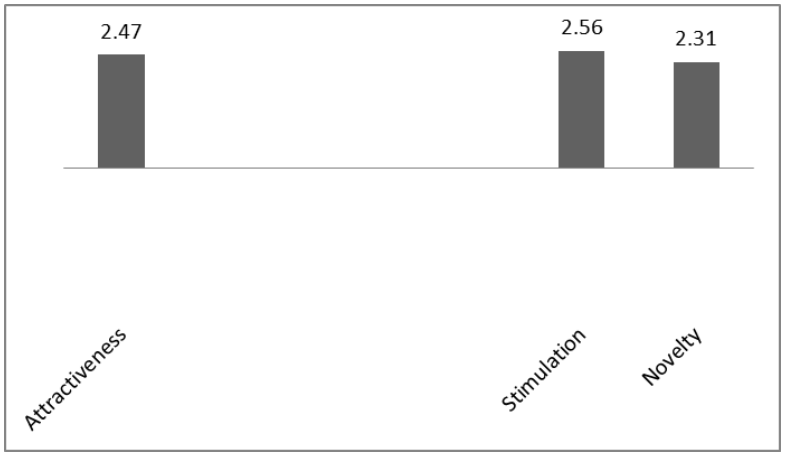

Chart 1. UEQ1-FEFS
Chart 1 shows the initial results for the FEFS group

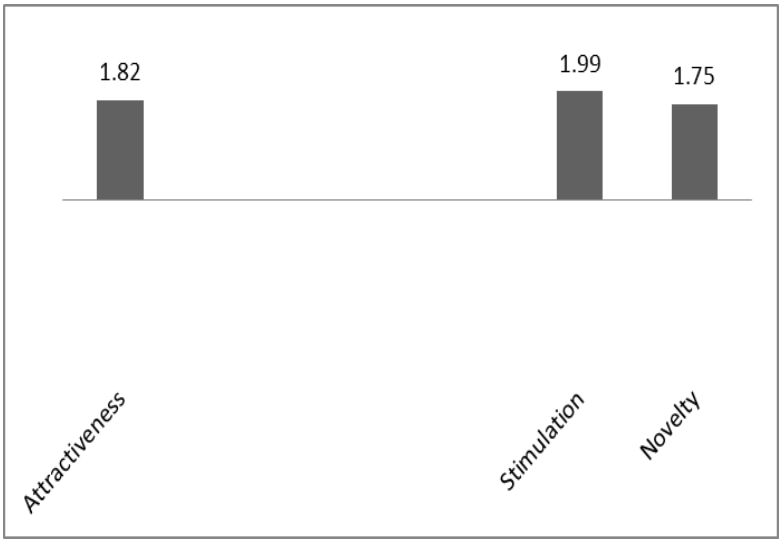

Chart 2. UEQ1-PIPP
Chart 2 shows the initial results for the PIPP group

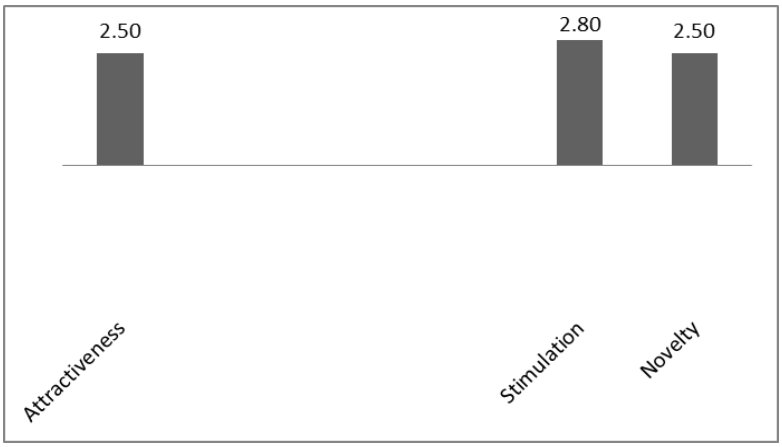

Chart 3. UEQ2-FEFS
Chart 3 shows the final results for the FEFS group

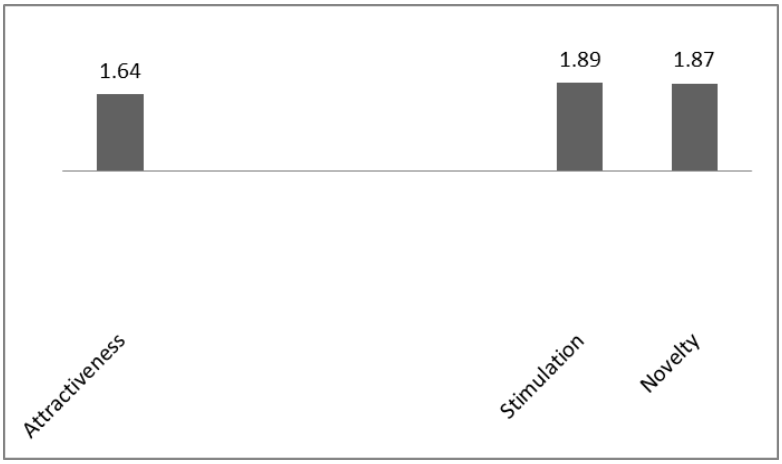

Chart 4. UEQ2-PIPP
Chart 4 shows the final results for the PIPP group

In Table 1 we note that we have no significant differences, p=0.05, before and after Escape Room for the FEFS group.

Table 1. Two sample T-Test UEQ1:UEQ2 (FEFS), Alpha-Level 0.05

Attractiveness	0.6901	No Significant Difference
Stimulation	0.2072	No Significant Difference
Novelty	0.2613	No Significant Difference

In Table 2, we note that we have no significant differences, p=0.05, before and after Escape Room for the PIPP group.

Table 2. Two sample T-Test UEQ1:UEQ2 (PIPP), Alpha-Level 0.05

Attractiveness	0.7162	No Significant Difference
Stimulation	0.8359	No Significant Difference
Novelty	0.7895	No Significant Difference

In Table 3, we notice that we have significant differences between the two groups, for Attractiveness and Stimulation, p=0.05, before and after Escape Room.

Table 3. Two sample T-Test FEFS:PIPP (UEQ1), Alpha-Level 0.05

Attractiveness	0.0013	Significant Difference
Stimulation	0.0034	Significant Difference
Novelty	0.0569	No Significant Difference

In Table 4, we notice that we have significant differences between the two groups, for Attractiveness, Stimulation and Novelty, p=0.05, before and after Escape Room.

Table 4. Two sample T-Test FEFS: PIPP (UEQ2), Alpha-Level 0.05

Attractiveness	0.0022	Significant Difference
Stimulation	0.0013	Significant Difference
Novelty	0.0034	Significant Difference

Discussions

Participation in didactic Escape Room, applied in an online class at university, was evaluated with high scores by both groups on all three dimensions evaluated. Higher scores were obtained in the FEFS group compared to the PIPP group.

For the FEFS group, all scores increased after participating in the Escape Room, but for the PIPP group the score increased only for Novelty, while for Attractiveness and Stimulation lower scores were recorded after participating in the Escape Room. Although there were changes in the scores of the evaluated dimensions, they are not statistically significant at p=0.05. It is possible that

the attractiveness and degree of stimulation, in the PIPP group, may have decreased due to the general perception of the complexity of the proposed Escape Room. Unfortunately, we did not measure this aspect, but we can state, from our records, that in the FEFS group all participating teams completed the didactic requirement, while in the PIPP group only one group was close to this target, in the same time frame. One problem we encountered in this research was the difficulty of effectively controlling the interaction between members of the same team during online activity.

On the other hand, the scores recorded between the groups are statistically significant (p=0.05). Before the Escape Room there were differences between the FEFS group and the PIPP group on Attractiveness and Stimulation, and after the Escape Room, we recorded differences on all 3 dimensions between the two groups.

Conclusions

The degree of attractiveness for this didactic Escape Room, applied online, was high. Also, it was stimulating enough to generate engagement at the group level. We believe that the specificity of the group involved in the Escape Room is very important, and that each didactic activity of this kind be properly adapted for the class to which it is applied.

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THE INFLUENCE OF THE VISUAL ANALYZER ON POSTURE AND BALANCE – REVIEW TYPE STUDY

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ABSTRACT. Introduction: The posture of the body in space is influenced by information from outside and inside the human body. The eye has a dual role being both an exteroceptor and an enteroceptor. Exteroception is achieved through peripheral vision and proprioception is related to the activity of the extrinsic muscles of the eyes and the oculo-cephalo-gyrus pathways. Therefore, the visual analyzer can influence the posture through refractive disorders (myopia, hypermetropia or astigmatism) or blindness, but also through convergence disorders and heterophoria. **Purpose:** The present study was carried out with the aim of analyzing the influence of the visual analyzer in maintaining the correct posture of the body **Material and method:** Search engines Google Scholar as well as Frontiers, BioMed and ScienceDirect databases were searched using keywords on the desired topic and 53 articles were found. After inclusion criteria were applied (studies from the last 15 years, full articles, studies using cohorts of subjects or case studies), 20 articles were chosen for analysis. **Results:** In the 20 articles chosen for the study, blind participants were discussed, healthy subjects whose response to different visual stimuli was analyzed or subjects with different visual impairments who were investigated to maintain balance and correct body posture in different conditions. **Conclusions:** After analyzing the 20 articles, we came to the conclusion that the visual analyzer influences balance and can produce changes in body posture in space. Improving the function of the visual analyzer can be achieved through specific exercises, various surgical interventions or balancing performed by specialists such as aophthalmologist doctor, physiotherapist or posturologist.

Keywords: *visual impairment, posture, balance, visual analyzer*

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Introduction

Posturology is the medical science that deals with the global assessment of the body's position in relation to the vertical. The postural system performs many functions in an attempt to keep the body in balance both statically and dynamically. For a normal operation, the postural system depends on the information received from exteroceptors and interoceptors (Bachigeanu, 2018). According to Bricot (2010), in the postural system, the eye has a double role, being exteroceptor and interoceptor. Exteroception is achieved through peripheral vision and proprioception refers to the activity of extrinsic muscles and the oculo-cephalo-gyrus pathways, thus resulting in the subordination of the neck muscles to the eyes (Bricot, 2010). The visual analyzer provides information about the position of the body in space, the color, shape and size of objects as well as the relationships that exist between them. The visual function provides a percentage of 88-92% of the information gathered from the environment and this is an essential function for interacting with the environment, in this way being assimilated information to be processed by the visual analyzer thus determining a self-regulating dynamic process (Baritz, 2016).

The processes of sensation and perception are as complex as a whole that they can be very different from one person to another. The visual analyzer can unbalance the postural system through two specific pathologies: refractive and convergence disorders (Bricot, 2010). Refractive disorders involve exteroception, namely minor disorders such as myopia, astigmatism and hypermetropia, which can be corrected with glasses or contact lenses. Conversely, convergence disorders are less frequently diagnosed and are corrected through interventions performed by a posturologist and an orthoptist in collaboration with an ophthalmologist (Bricot, 2010).

Purpose

Since more and more people are diagnosed with postural deviations and many of them present some disorders of the visual analyzer, we wanted to carry out an analysis of the literature with the aim of observing what is the opinion of the specialists on the influence of the visual analyzer in maintaining the correct posture of the body and balance

Material and method

Searches were conducted on the Google Scholar search engines, as well as the databases of Frontiers, BioMed and ScienceDirect. The search strategy was initially based on the use of keywords: visual impairment, posture, balance,

visual receptor. Then helpful elements were added to narrow the search and find the necessary articles: postural stability in binocular viewing, postural stability in children with strabismus, balance in elderly with visual impairments, baropodometry analysis in visual disorder, blind individuals postural control.

The inclusion criteria were: articles from the last 15 years referring to the visual analyzer, being studies in which one or more subjects were evaluated, articles being able to be read in full text. 53 articles were found of which 7 were review articles and were excluded from the current study, 19 of them were not of interest because they did not meet all inclusion criteria, 7 were duplicates and were excluded and 20 of articles were selected to be studied. These were articles conducted on groups of patients from different geographical areas, with a variety of ages and conditions that influence posture or balance, but there are also a studies conducted on healthy subjects that demonstrates the influence of visual inputs on balance. The way to select the items is presented in Figure 1.

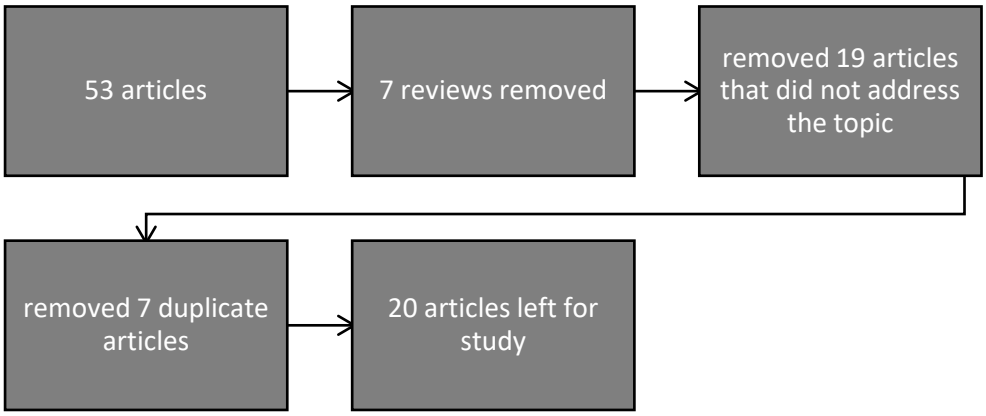

Figure 1. *The process of collecting the sources needed for the current study*

Discussions

Affecting the visual analyzer, as well as how it responds to stimuli, plays an extremely important role in maintaining posture and balance. Of the 20 articles included in this review, 3 of them studied patients with blindness and the influence of this disability in maintaining posture, 7 articles investigated the response of subjects with different impairments of the visual analyzer to stimuli or balance and posture testing, 3 presented studies on the elderly with various eye conditions, 7 articles observed the reaction of healthy subjects to different visual inputs or the reaction to the use of VR headsets.

The researchers made a comparison between congenital and acquired blindness. Castro K.J. et al. (2021), Schwesing R. et al. (2011), Soares A.V. et al. (2011) demonstrated that acquired blindness produces greater balance disturbances as well as higher plantar pressures compared to congenital blindness, which provides greater adaptability of compensatory mechanisms. The researchers highlighted that an important element in the case of people with blindness is also given by the duration of the acquired deficiency. Deficiencies newer than 2 years fail to compensate through other mechanisms, while those older than 10 years are much more adapted to the environment, almost like congenital ones.

Visual impairments developed by the elderly have been studied by Wiszomirska I. et al. (2015), Thomas, N. M et al. (2016), Haibach-Beach P. et al. (2020). They looked at the impact of exercise on improving gait, posture, and balance, and demonstrated that regular exercise can help the postural tonic system respond better to stimuli. Physical exercise increases stability and causes a decrease in the rate of injury in the elderly with various vision deficits. Also, Alex.A Black et al. (2008) and Caldani S. et al. (2019) discuss eye diseases such as glaucoma and Usher syndrome respectively, and their impact on posture. Their studies mainly focus on stability and reach similar conclusions after tests on stable and foam surfaces. Both studies state that a more severe damage to the visual analyzer unbalances the body more strongly, although in the case of Usher syndrome the damage to the vestibular system also intervenes, while in the case of glaucoma in the elderly a strictly ocular approach is needed to restore visual acuity and binocular vision, this causing an improvement in the fall percentage of affected people.

Subjects diagnosed with strabismus were studied by Bucci M.P. et al. (2016) and Legrand A. et. al. (2011). They examined differences in postural control before and after surgery, using tests on pressure platform, with eyes closed and eyes open, and the dominant and non-dominant eye open, respectively. It was found that visual acuity and foot pressure were improved with the eyes closed, but also with the non-dominant eye open, resulting the fact that post surgery the subjects developed better postural stability. Gaertner G. et al. (2013) approached the topic from a different perspective and wanted to observe the differences of the Romberg coefficient in children with divergent and convergent strabismus according to the viewing distance in two conditions, eyes closed and eyes open for binocular vision and monocular. After testing, it was found that the distance does not significantly influence the Romberg coefficient, but a medio-lateral pressure change was noticed for divergent strabismus and an antero-posterior swing in monocular vision with the dominant eye. The study demonstrated that binocular vision improves postural control regardless of

distance or type of strabismus. The same result was reached by Zipori A.B. et al., (2018) and Sánchez-González, M. C., et al. (2020) who investigated balance in subjects with strabismus, with and without amblyopia, but also in healthy subjects. Subjects' Bruininkis-Oseretsky test scores highlighted that there is a disturbance in maintaining balance in subjects with strabismus and those with amblyopia compared to the control group, and these differences are observed even in subjects with mild binocular dysfunction (intermittent strabismus and good stereopsis).

In healthy people, research shows that balance and posture change when the visual analyzer is disabled or disturbed. It seems that the rest of the systems are not able to compensate for the deficit, the period being too short for the adaptation of the other systems (Rodrigues et all, 2015). Hans-Georg Palm et al. (2009), Mohapantara S., et al. (2011) demonstrated that healthy subjects have impaired balance and anticipation if the eyes are closed. Visual stimuli are much more important in maintaining balance than auditory stimuli. Park D.J., (2016) demonstrated that balance training can be achieved by the action of bidirectional peripheral visual stimuli.

As video games using VR headsets are increasingly present in our homes in recent years, Luo H., et al. (2018) and Tychsen L. & Foeller P. (2019) used virtual reality to establish the relationship between eye stimuli and postural changes. These tests showed conflicting results but under different test conditions. It seems that optical stimulation through virtual reality that only requires eye movements to follow the target significantly destabilizes the posture. But if the target is tracked through head and eye movements, then the postural destabilization appears to be extremely small. In the study by Tychsen L. & Foeller P. (2019) conducted on 6-year-old children who participated in 2 sessions of a flight game in which a 3D VR headset was used and head movement was required to control the craft, for 30 minutes, postural destabilization was affected by only 9%. Children manage to adapt more easily to the visual stimuli specific to video games that use VR headsets, in their case maintaining postural stability and adapting the vestibulo-ocular reflex.

There is also a reverse approach. Postural deficits in the frontal plane, namely idiopathic scoliosis, were studied in an attempt to correlate them with eye problems. Scoliosis with a Cobb angle greater than 15 degrees was found to have lower latency characteristics in saccadic movements and decreased reaction speed. A larger Cobb angle means normal vestibular responses but altered oculomotor functions due to cerebellar dysfunction (Lion A., et all in 2013). Unfortunately, the study does not concretely show whether the appearance of eye defects is a factor in the appearance of scoliosis or vice-versa.

Conclusions

The visual analyzer remains one of the main factors influencing the postural tonic system. Any imbalance at this level can affect the musculature at the level of the neck that can change, in time, the musculature at the level of the whole body and can cause a postural instability that affects the balance.

There are many ways to alleviate eye problems: corrections with glasses and lenses, surgical interventions or even exercises that address the extraocular muscles or the muscles of the whole body for sighted or blind people, in order to improve balance and posture. Studies on healthy people demonstrate the importance of this analyzer, observing imbalances when it is non-functional, higher anterior-posterior pressures and differences in pressure between the limbs.

Deficiencies such as strabismus, amblyopia or glaucoma affect balance and body posture. Alignment of the visual axes after surgery provides improved postural stability, suggesting the major role of proper functioning of the visual analyzer for good postural control. Differences were observed related to congenital and acquired blindness and distance in years since vision loss. Congenital blind people manage to compensate and adapt better to the environment through the rest of the systems, while acquired blindness determines adaptation and adequate response to external stimuli only 8-10 years after the incident. The eye is an integral part of the tonic postural system, and its disturbances are reflected in human posture and balance.

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