EDUCATION
FOR HEALTH AND PERFORMANCE

Proceedings of ICU 2022

The 8th International Conference of the Universitaria Consortium

October, 2022
Cluj-Napoca, Romania

Editors:
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Presa Universitară Clujeană

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Assessment and Management of Stress in Juniors' Sports Activity – Preliminary Study

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Abstract
Introduction. This preliminary study is oriented towards identifying different means of assessing and managing junior sports related stress, which according to the specialized literature, is more and more prevalent. Objectives. Our goal is to better understand the perception of stress by junior tennis players and test the methodological steps which are necessary to elaborate strategies for addressing this matter. Methods. In this paper, the method of studying the specialized literature was used to collect relevant information published in international databases. Also, a questionnaire for evaluating competition related stress was applied to several junior tennis players (N=5) which are involved in national tennis tournaments. Results. The study suggests that if it is not well addressed, competition related stress can limit the performance of junior tennis players, affect their wellbeing, and can also lead to sports abandonment. The applied questionnaire identifies some of the sources of competitional stress for junior players. Conclusions. Sports specialists should be aware of the feelings junior tennis players have related to competitions. Questionnaires are a feasible mean of evaluating competition related stress and can be the foundation of addressing it. This pilot study can be further developed by improving its methodology and by involving more subjects.

Keywords: *sports, stress, assessment, management, juniors.*

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1. Introduction

1.1. Adolescence and sports competitions

Adolescence is a critical period in the development of elite athletes (Vealey, 2007). For some sports, this society provides a window for the development of physical and psychological skills considered essential for achieving optimal performance (Lauer, Zakjarsek, & Lauer, 2017). For others (e.g., gymnastics), it corresponds to reaching the physical and psychological maturity considered optimal for performance. At the same time, adolescence is a very important period for identity development (Erikson, 1959). Teenagers are faced with greater responsibilities and must take it upon themselves to transition to adulthood by making decisive choices for their future. Thus, an important scientific literature has developed around the sports experience of junior athletes since the late 1990s.

This literature falls into two main areas of interest. The first area concerns the development of talent in sport, while the second concerns the positive development of young people through sport. The first area of research is guided by the philosophy that developing excellence is important because the success of professional and Olympic athletes contributes to the economic prosperity and political power of provinces and countries (e.g., Martindale, Collins, & Abraham, 2007). In the second area of research, sport is a vehicle that helps adolescents develop positively, maintain health, and adapt effectively to life transitions (e.g., Fraser-Thomas, Côté, & Deakin, 2005). Despite debates regarding the importance of performance versus positive development, it is important to study the experience of young athletes in competition to better understand what contributes to their success and well-being (Fraser-Thomas & Côté, 2009).

High-level competition is particularly demanding for adolescent athletes (Nicholls, Hemmings, & Clough, 2010). Indeed, competitive athletes spend many hours training and competing. They have to manage their studies around their sport and sometimes have to move away from their families to join training centers. Thus, these young people often face additional challenges at the social, family and school levels to meet the demands of competitive sport. Furthermore, they are exposed to pressure to perform and high expectations from those around them (Ommundsen, Klasson-Heggebø, & Anderssen, 2006). Thus, these athletes must learn to manage their emotions and the pressure they feel (Lauer et al., 2017). For these reasons, researchers are interested in the experience of elite athletes in competition as well as the effectiveness of certain interventions to optimize their well-being and performance.

1.2. Assessing stress in juniors' sport activity: the internal speech

One research path to better understand athletes' experience in competition is to focus on their automatic internal speech. In a sports context, automatic internal speech reflects the emotion experienced by the athlete and provides information about how they manage their thoughts, emotions, and behaviors (Latinjak, Zourbanos, Lopez-Ros & Hatzigeorgiadis, 2014; Van Raalte, Vincent, & Brewer, 2016). Thus, by questioning athletes about their automatic internal speech during a competition, it is possible to better understand their experience. Furthermore, given its influence on emotions and behaviors, internal speech is a target for intervention to improve the performance and psychological well-being of athletes (Andersen, 2009). To contribute to the advancement of knowledge of automatic internal speech and the experience of athletes in competition, this study focuses on the automatic internal speech of junior tennis players.

2. Objectives

Our goal is to better understand the perception of stress by junior tennis players and test the methodological steps which are necessary to elaborate strategies for addressing this matter.

The objectives of this study are to learn more about competition related stress, self-talk, and also about the strategies of better managing the psychological dimension of sports training in junior tennis players.

3. Methods

In this paper, the method of studying the specialized literature was used, to collect relevant information published in international databases. Also, a questionnaire for evaluating competition related stress and self-talk was applied to several junior tennis players (n=5) which are involved in national tennis tournaments.

3.1. Subjects

The subjects were 5 boys aged between 17 and 18 years old from the Transylvania region of Romania that participate in national level tennis tournaments.

3.2. Instruments

After receiving the written consent of their tutors, we explained that the subjects would participate in this study by filling in an online form shortly after their participation in a tennis tournament.

The online form included an introduction about the purpose of this study, questions about their personal identification data, and questions related to 5 significant events that took place during their most recent tennis competition experience, in order to find out which were the emotional trigger events, and what was their self-talk, emotion perception and coping mechanism or reaction related to the events.

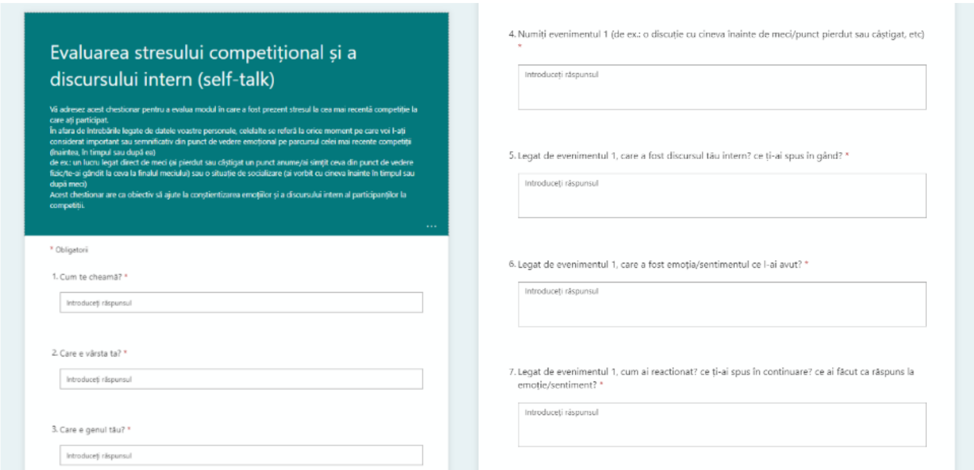

Figure 1. Self-talk assessment questionnaire

After receiving their answers, we used a table to centralize the answers for future analisys, as seen below, in table 1:

Table 1. Internal speech centralizing grid*

Event	Self-talk	Emotion	Behavior
1) e.g.: I talked to my coach before the match	I told myself I have to stay focused during the match	Confidence	I held my chin up and my muscles tense
2)			
3)			
4)			
5)			

* Adapted from Williams et. al. (2014)

4. Results

The subjects' responses were analyzed, and the self-talk recorded was categorized in eight main categories of self-talk used: positive emotion, motivational, instructional, worry, rumination, performance pressure, disengagement, and emotional control. Motivational and rumination self-talk were found to be the most present categories as seen below:

Table 2. The categorized self-talk used by the subjects during competition

	Self-talk categories							
	Positive emotion	**Motivational**	**Instructional**	**Worry**	**Rumination**	**Performance Pressure**	**Disengagement**	**Emotional Control**
Player								
1	"I have been encouraged"	"Keep playing like this" I encouraged myself to carry on like this"	"I must change something in my game"		"I was upset on the referee because his call was wrong. I felt wronged."			
2		"I still have a say in this match. This is not my last word. I am not satisfied!" I must find success despite my bad day!"			"I can't believe it! How did this happen? Why? How? What could I have done better? What did I do wrong?"	"I disappointed them. Why wasn't I better than this?"	"In other circumstances it would be better. This is it."	"It's getting from bad to worse, but I still believe in my chances, I can still try."
3		"I tried to self-motivate."	"I tried to arm myself with patience"	"I started doubting my abilities, but I tried not to let that lost point affect me."	"I started self-criticizing"			"I tried not to think too much at that lost point and carry on."

	Self-talk categories							
	Positive emotion	Motivational	Instructional	Worry	Rumination	Performance Pressure	Disen-gagement	Emotional Control
4	" Oh! Appar-ently, it's not that bad I told my father about my emotions." " It's good that he con-firmed my tactical idea was good"	" If I got this far, I might as well give my best, even if it means dying on court"			"Why is this happening now. Why couldn't the referee be focused the entire match and not make wrong calls?"			"At first I tried to explain my oppo-nent that he was wrong with what he said."
5	"I'm proud of myself"	"Bravo! Carry on like this!"		"No wor-ries!"		" I have to win this match" " I have to win the next match"		

The main events recalled by the players to have triggered self-talk were mainly situations like a social interaction before, during or after the match, a lost or won point, allegedly wrong calls by the referee or physical fatigue.

These methodological actions employed allowed the investigation of these junior athletes' experiences in a competitive setting, letting us better understand self-talk in relation to emotions. The recorded answers could show hints to the sports specialists on how to better prepare the emotional reaction to frequently encountered self-talk triggers.

5. Discussions

Certain members of the athlete's entourage also play a key role in the quality of the adolescent-athlete experience. In particular, the coach and parents are important people in the support and supervision of young athletes (Harwood & Knight, 2015; Thelwell & Hill, 2017). Given their role and the influence they have on athletes, it is important that entourage members contribute to improving the athlete's experience. Thus, it is important to study the quality of the experience of the people involved with the athlete.

Specifically, regarding the experience of junior athletes, parents are recognized as playing a key role in their children's participation in sports (Wiese-Bjornstal, LaVoi, & Omli, 2009). They are recognized as the main source of influence for their children's involvement in sports. In addition, support and encouragement received from parents is associated with a child's perception of competence, enjoyment, and involvement in sport (Knight, Berrow, & Harwood, 2017).

On the other hand, unrealistic parental expectations and a critical attitude are associated with less enjoyment and motivation, a lower perception of competence and a higher level of anxiety. Thus, to better understand what determines the nature of the influence that parents have on elite junior athletes' experience in sport, researchers focused more specifically on their experience. The results of these studies demonstrate that the nature and quality of parents' competition experience influences their child's (Knight et al., 2017). For example, the stress experienced by parents during their children's competitions influences their behaviors and interactions with their children (Burgess, Knight, & Mellalieu, 2016; Harwood & Knight, 2015). The results also testify to the extent of the emotional investment of some parents during their children's competitions. For example, authors who have studied the emotions experienced by tennis players and their parents have observed that some parents experience emotions similar to those of their child (Dorsch, Smith, & McDonough, 2009). The complexity of the relationship between athletes and parents in the context of competition invites researchers to continue research focusing on the experience of junior athletes in competition alongside that of their parents.

The results of one of our previous articles (Baciu et.al., 2015) shows that parents play a critical role in the development of junior tennis players, help their children succeed but coaches believe that many parents significantly interfere with the development of their child, and cause damage to the parent-child relationship. This is not surprising, given that parents do not receive information about how to help their child develop in tennis.

6. Conclusions

Sports specialists should be aware of the feelings junior tennis players have related to competitions. Questionnaires are a feasible mean of evaluating competition related stress and can be the foundation of addressing it.

The limitations of this study are, firstly, that the study participants were not representative of all tennis players. Second, the results are based on the participants' reports during interviews, and the participants may have had self-talk other than those reported. Third, there was a potential for social desirability bias, whereby the participants may have wanted their responses to be viewed favorably.

The study suggests that if it is not addressed, competition related stress can limit the performance of junior tennis players, affect their wellbeing, and can also lead to sports abandonment. The applied questionnaire identifies some of the sources of competitional stress for junior players.

This pilot study can be further developed by improving its methodology and by involving more subjects.

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Effects of a Mindfulness-Based Intervention on the Physical and Psychological Well-Being in Teenagers

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Abstract
As an evidence-based practice for stress reduction, with positive outcomes on mental and physical health, mindfulness proved its effectiveness on behaviors, cognitive abilities, emotional well-being in various populations. One of the many conceptualizations of mindfulness, Baer's five facets mindfulness model, includes five key components of the mindfulness practice: observing, describing, acting with awareness, non-judgement, and non-reactivity to inner experience. These were included in the "In This Moment" program, by Strosahl and Robinson (2015), an effective intervention for distress management. Our research tested the effectiveness of the program on a sample of 431 teenagers from various high-schools in Romania.
164 high school students (93 females, mean age 16.46) had weekly meetings with the trainer, who presented them the exercises, which they subsequently practiced on their own, for one week. The implemented program entailed 9 weeks of practice. Our control group consisted of 217 high school students (112 females, mean age 16.01)
The participants completed measures of psychological flexibility, level of mindfulness, satisfaction with life, depression, anxiety, and stress screening, test anxiety, shyness, and degree of somatic complaints before and after implementation of the program. A three month follow up assessment was also performed.

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We found that mindfulness practice has a positive effect on psychological flexibility, slightly contributing to the decrease of the test anxiety, and to the improvement of somatic well-being, with some of the positive changes maintained also at follow-up. The results will be presented in the light of evidence by other authors and several possible implications will be further discussed on the effects of mindfulness-based practice on physical activity and performance in sports.

Keywords: *mindfulness; psychological flexibility; somatic well-being; stress management; performance in sports.*

1. Introduction

Strosahl and Robinson (2015), the authors of the "In This Moment" program believe that if we do not control stress, neurochemical reactions related to physiological arousal will result in the brain and in internal organs, that can harm physical and mental health. Comprehensive mindfulness strategies activate those parts of the nervous system that counteract and control the effects of stress. Applying these strategies and practicing them regularly will help to strengthen the neural networks in the brain, thus allowing the person to act as flexible and adapted to daily stressful situations as possible. As a result of the exercises, benefits are particularly found in the areas of positive mental health, healthy relationships and increased cognitive efficiency, even though it was previously believed that change could only be achieved through years of practice. Adolescents are seen as a distinct group due to their developmental stage and special problems, and special attention is given to them. (Mohapatra, Panigrahi & Rath, 2012) Several studies have shown that chronic stress interacts with developing brain structures and can cause significant changes that favor the development of psychiatric disorders. During his experiments and research, Kandel (2005) discovered neuroplasticity: structural changes in the brain occur/can occur during practice. (Sheth, McGlade & Yurgelun-Todd, 2017) Papa and Epstein (2018) draw attention to the fact that emotion regulation disorders are currently the biggest and most serious problem. Most emotional process specialists agree that emotions are multidimensionally interconnected response channels, including physiological, expressive, cognitive, and motivational changes. As protective factors for the promotion and development of social and emotional flexibility, we mention stability and favorable relationships with adults, it is extremely important for the young person to feel that he belongs to a community, which trusts him and positively evaluates his performance. (Chadwick, 2014) Baumeister and Leary, then Newton, highlight the stressors, that occur in connection with motives and goals, which mostly appears in the field of social relations: the need for social interaction, evaluation, appreciation by others, and performance concerns. (Sarafino & Smith, 2011)

In connection with influencing depression, anxiety, and psychological flexibility, Acceptance and Commitment (ACT) programs, with growing evidence regarding transdiagnostic effects are considered contextual behavioral change methods that focus on facilitating psychological processes (Lundgren, Reinebo & Fröjmark, 2021). Psychological flexibility, the central theoretical construct of ACT, has six items. Four of these were also identified as elements of total awareness (present moment, acceptance, defusion, and the self as context). The other two components (values and committed action) can be classified as behavior change processes. (Ciarrochi et al., see Baer, 2018). In a meta-analysis conducted in investigating the effectiveness of acceptance and commitment therapy was demonstrated, that increased psychological flexibility was associated with decreased levels of depression and anxiety (French, Golijani-Moghaddam & Schröder, 2017). In the same time, mindfulness practices predicts long-term reduction in neuroticism in subjects with recurrent depression by labeling the feelings, which is a very effective emotional control procedure and prevents the development of depressive symptoms (Jeffcoat & Hays, 2012; Spinhoven et al., 2017); significantly positive correlation of mindfulness with self-awareness and both with psychological well-being (Harrington, Loffredo & Perz, 2014), less stress and anxiety (Jeffcoat & Hays, 2012; Bullis et al., 2014), level of life satisfaction (Taylor et al., 2014), positive effect of mindfulness training on self-esteem (Pepping, O'Donovan & Davis, 2013). Aldao and Plate (2018) draw attention to the flexibility of emotion regulation, which results a more effective adaptation for the individuals to constantly changing circumstances.

2. Methods

2.1. Study Procedure

2.1.1. Participants

Our sample of 431 participants consisted of clinically healthy teenagers who were selected from various schools in Transylvania, Romania. The participants were 15- and 20-years old students, their average age was 17.11 years (SD = 1.22), 46.8% were boys and 53.2% girls.

44.1% of the total sample made up the study group (N=190), the other 241 participants took part in the study as a control group and were put on a waiting list. The test and control group filled out the questionnaires in printed form, under the supervision of the form-master and the trainer.

2.1.2. Intervention

In the research we measured the influence of the mindfulness based "In This Moment" stress management program, introduced by Strosahl and Robinson (2015), on psychological flexibility, life satisfaction, the five basic components of mindfulness, as well as the level of depression, stress, anxiety and the presenting somatic symptoms.

During the training sessions, the study group received the description of the relevant step, as well as the related exercises, both in print and online version. We created a group on a social media site, where we could send the descriptions online and discuss any questions they might have. At the same time, their feedback about the exercises was sent on an internet interface. The "In This Moment" training program based on total awareness has five steps, during which we develop different skills (observation, description, detachment, compassion and full awareness) with the help of exercises, in order to apply them in different areas of our lives: in relationships, at work, at school, in any area of our daily life. (Strosahl and Robinson, 2015) The steps of stress management training based on total awareness are presented in table. 1

Table 1. The structure of "In This Moment" stress management training

The steps of "In this Moment" stress-management training program	Exercises
First step: Observing	7 exercises
Second step: Describing	5 exercises
Third step: Defusion	8 exercises
Fourth step: Self-compassion	9 exercises
Fifth step: Act mindfully	8 exercises
First application: Get to know your everyday helpers and your worries, your annoyances	5 exercises
Second application: The calm and efficient worker	6 exercises
Third Application: Fully Conscious and Balanced daily routines	6 exercises
Fourth Application: Developing Fully Conscious Relationships	7 Exercises

In the research, we compared the study and control groups based on the pre- and post-test results of the questionnaires, as well as the results of the follow-up test of the study group, illustrated in Figure 1

Figure 1. Study design

2.1.3. Measures

The study and the control group completed a pre- and post-test. In the case of the study group, a 3-month follow-up was carried out using the same test packages. We put a test package at their disposal, which consisted of the following questionnaires:

2.1.3.1. *Acceptance and Action Questionnaire-II (AAQ-II),* which measured the psychological flexibility and experiential avoidance along 7 statements. The subjects evaluated the statements on a seven-point Likert scale according to the extent to which the given statement applies to them personally. (Bond et al., 2011). Based on the results of Karekla and Panayiotou (2011), it can be concluded, that experiential avoidance and coping proved to be predictive for determining psychological distress and well-being.

2.1.3.2. *Satisfaction with life scale (SWLS)* contains five statements and the persons had to rate their level of agreement on a seven-point Likert scale. (Diener et.al., 1985)

2.1.3.3. *Depression, Anxiety and Stress Scale-21 (DASS-21)* is a quantitative measure of distress, which measures the level of depression, anxiety and stress. Based on the results, people can be classified into five categories for all three subscales: normal, mild, moderate, severe and extremely severe levels of depression, anxiety and stress. The questionnaire contains 21 items, during which the persons have to evaluate the statements regarding the last week (0= did not happen to me at all; 3= happened to a great extent or most of the time) (Henry & Crawford, 2005)

2.1.3.4. *The Five Facet Mindfulness Questionnaire (FFMQ)* was developed by Baer et al. (2006) and contains 39 items related to five conceptualized elements of total awareness, during which we evaluate: observation, description, conscious action, and lack of judgments and reactivity to internal experiences.

2.1.3.5. By completing the *Ghent Multidimensional Somatic Complaints Scale (GMSCS),* subjects must rate 18 symptoms in the past four weeks in terms of frequency and intensity on a scale from 0 to 7 (Frequency rating: 0=never, 7=constantly; Rating of strength: 0=not at all, 7=unbearable) Contains five subscales: Pain in the head, shoulders, Stomach, Cold-hot sensation, Feelings in the heart, and Fatigue perception (Beirens & Fontaine, 2009)

2.1.3.6. *Cheek and Buss Shyness Scale* contains 14 items, during which the students determine how typical the respective statement is of their emotions or behavior on a 5-point Likert scale. (Cheek & Melchior, 1990)

2.1.3.7. The *Spielberg Test Anxiety Scale* contains 20 statements that children use to describe themselves and they must rate the statements according to frequency. (1=almost never, 2=sometimes, 3=often, 4=always) (Vargha & Szabó, 2011)

2.2. Results

The data were analyzed using SPSS 22.0, parametric tests were chosen to compare the differences in scores (Student's t test) and Pearson's r correlations were computed for the association of variables.

2.2.1. Correlations

A lower level of psychological flexibility and satisfaction with life strongly correlate with a precarious psychological health, assessed in our investigation (depression, anxiety, stress, somatization, shyness), whereas the level of mindfulness is negatively associated with psychopathology and positively associated with both flexibility and satisfaction with life, as presented in table 2.

Table 2. Correlations at pretest

	1	2	3	4	5	6	7	8	9
1. AAQII									
2. SWLS	.478**								
3. Depression	.734**	.461**							
4. Anxiety	.531**	.308**	.637**						
5. Stress	.642**	.375**	.695**	.643**					
6. DASS21	.731**	.438**	.895**	.862**	.878**			.	
7. Mindfulness	-.586**	-.360**	-.581**	-.391**	-.486**	-.556**			
8. Somatization	.568**	.340**	.641**	.655**	.664**	.742**	-.409**		
9. STAI	.644**	.335**	.536**	.504**	.541**	.600**	-.486**	.548**	
10. Shyness	.470**	.296**	.437**	.290**	.376**	.426**	-.495**	.357**	.459**

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

2.2.2. Comparisons

2.2.2.1. Comparison of differences in measures between experimental and control samples

The mean of differences in scores between pre and post-test proved to be significantly different for depression, mindfulness and somatic symptoms after the implementation of the intervention program. Thus, the average level of depression and the subscales of Fatigue, Cold-Hot Feeling and Somatization decreased after the intervention for participants in the experimental sample. Also, the average level of mindfulness increased compared to the levels of these characteristics in the control sample, which results we summarized in table 3. Though not statistically significant, all the differences in scores proved to be modified by the intervention in the post-test assessment phase in the case of the experimental sample, compared to the control sample.

Table 3. Differences in measures between participants and control sample

		Mean	Std.dev.	t	p	*
DASS21 Depression subscale	Experimental group	-.5745	3.72680	-2.134	.034	*
	Control group	.3100	3.79948			
FFMQ	Experimental group	1.8444	11.28654	2.763	.006	**
	Control group	-1.5619	10.79622			
FFMQ Describing subscale	Experimental group	1.1986	4.36417	2.711	.007	**
	Control group	-.1741	4.77227			
GMSCS Fatigue subscale	Experimental group	-1.0347	5.60396	-2.062	.040	*
	Control group	.0974	4.49693			
GMSCS Hot-cold subscale	Experimental group	-1.4583	3.99103	-2.865	.004	**
	Control group	-.3077	3.38701			

* p<.05, ** p<.01.

2.2.2.2. Comparison of pre- and post-test in the experimental sample

Some of the characteristics significantly improved after the intervention in the experimental sample. A significantly higher level of psychological flexibility was reported by the participants after the intervention and a slight improvement of their level of mindfulness, presented in table 4. Examining the pre- and post-measurement of the study group, we conclude that the significant difference can be attributed to the intervention.

Table 4. Pre- and post-test measurements of the participants

			Mean	Std.dev.	t	p	*
AAQII	Experimental group	pretest	21.028	8.5142	3.099	.002	**
		posttest	19.168	8.1802			
FFMQ describing subscale	Experimental group	pretest	24.7589	6.61373	-3.261	.001	**
		posttest	25.9574	6.43081			

* p<.05, ** p<.01.

2.2.2.3. Comparisons of post-test and the follow-up in the experimental sample

97 students from the experimental group participated in the follow-up study. We used Student's T-test, which allows us to conclude on the changes that took place within the group between the two measurements: in our case, between the post-test and the three-month follow-up. If a significant difference was found between the averages of the post- and follow-up test in the study group, then this is most likely due to the persistence of the changes that appear because of the intervention.

Looking at the results, we can say that the positive change in almost all variables was maintained, and in many cases reached the level of significance during the follow-up: psychological flexibility increased significantly, vulnerability to depression, anxiety and stress decreased, the overall level of awareness increased, and the level of test anxiety also decreased. A study conducted by Bullis et al. (2014) explores the effect of mindfulness as a trait on emotional regulation, and they conclude, that factors related to the full awareness trait are associated with less distress and anxiety.

The comparison and significant change of the post and follow-up test scores of the Acceptance and Action Questionnaire, DASS21 integrally and the Stress subscale, FFMQ Non-judgement subscale, GMSCS Fatigue and Hot-cold subscales and Spielberg Test Anxiety Scale is illustrated in table 5.

Table 5. Results of follow-up study

		Mean	Std.dev.	t	p	*
AAQII	Post-test	19.729	8.5045	3.666	.000	**
	Follow-up	17.865	7.1534			
DASS21	Posttest	20.785	12.5055	2.316	.023	*
	Follow-up	18.914	10.9352			
DASS21 Stress subscale	Post-test	7.9175	4.26876	2.956	.004	**
	Follow-up	6.9794	3.71085			
FFMQ Nonjudgement subscale	Post-test	26.3333	7.19600	2.124	.036	*
	Follow-up	27.3646	7.02345			
GMSCS Fatigue subscale	Post-test	7.9381	6.20117	2.499	.014	*
	Follow-up	6.8247	5.71002			
GMSCS Hot-cold subscale	Post-test	6.1649	4.54991	2.527	.013	*
	Follow-up	5.1959	3.92545			
Spielberg Test Anxiety	Post-test	45.194	11.6731	2.164	.033	*
	Follow-up	43.112	11.7569			

* $p<.05$, ** $p<.01$.

3. Discussions

The results of the study show that a mindfulness-based stress management intervention, namely the "In This Moment" program positively affects vulnerability to depression, stress, test anxiety, psychological flexibility, conscious action, and the frequency and strength of the experienced somatic symptoms. Our first hypothesis, according to which a significant difference can be shown between the experimental and control group in relation to the pre- and post-results of the questionnaires and scales: DASS-21 Depression subscale, the FFMQ scale, and especially the

Description subscale, as well as the two subscales of the GMSCS seems to be confirmed.

The measurement results treated as dependent variables has changed in a positive direction: vulnerability to depression, anxiety, and somatization decreased and the consolidation of the basic components of total awareness, seems to be confirmed. The three-month follow-up study demonstrated the durability of the changes: the positive influence of the stress management program continued to show an increasing trend in psychological flexibility, and mindfulness and a decreasing trend in depression, anxiety, stress, somatic symptoms, exam anxiety, and even in terms of some subscales of stress and somatization. Our assumption was not confirmed in the case of satisfaction with life and the shyness scale.

4. Conclusions and future research

The present study shows that mindfulness stress-management programs have significant positive effects on psychological flexibility, stress, anxiety and somatic symptoms. The encouraging results with mindfulness and ACT based training programs focusing on stress-management and nomophobia reduction (Barabási-Madár, Costea-Bărluțiu & Vargha 2019) suggest that it is worth considering expanding similar research programs also in the sport area with objective performance measurements.

The results of research in the area of the enhancement of performance and the prevention of performance anxiety for athletes and the presented data provide some initial promise for mindfulness and ACT based programs as potential strategies for the athlete's well-being and performance.

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Body Mass Index in eSports: A Systematic Literature Review

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Abstract
The purpose of this review is to synthesize all the observational studies that studied the effects of eSports on Body Mass Index (BMI). In addition, it has systematically brought together all peer-reviewed observational studies related to the BMI of eSports gamers to draw the attention of field academicians and researchers to the issue related to eSports and promote observational studies on future in the field of sports sciences. Playing eSports games or competing in these games can have significant consequences for players' health. As the popularity of eSports continues to grow rapidly around the world, studies focusing on understanding the health risks and benefits associated with eSports competition and participation have been delayed. Sufficient attention has not been paid to the development and evaluation of preventive interventions which address the harms that video games interrelating with eSports can cause. Similarly, there are gaps in the evidence on ways to encourage safe and healthy digital gaming among the ever-growing eSports gamers population. In order to develop evidence-based guidelines and intervention strategies that contain body composition, body fat, and BMI, these gaps should be filled in with systematic scientific research.

Keywords: *BMI, eSports, Body Composition, Body Fat.*

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1. Introduction

Electronic sports (eSports) are defined as a professional sports competition played online between two or more people by Scholz & Barlow (2019), and high-level playing and watching of digital gaming by Hamilton et al. (2012). eSports are sports that are facilitated by electronic systems, and in which players and teams interact through human-computer interfaces (Hamari & Sjöblom, 2017). In addition, eSports (eSports, electronic sports, competitive games, professional gaming, etc.) can be defined as a new field that is being launched as a new form of sports and is being played with various game modes individually and teamwise by competing on Computer-console-mobile platforms. In 2020, the global revenue of the eSports industry is estimated to be up to $1.1 billion, attracting the attention of 500 million people worldwide (Newzoo, 2017). These forecasts emphasize the rapid evolution and growth of the eSports industry, even if they are not accepted by everyone. This growth is attributed to the growing popularity of digital communication, which increases the consumption of eSports, gives opportunities for potential investment, and paves the way for sponsorships (Lee & Schoenstedt, 2011). With the transformation of many sports branches into eSports, the commercialization of the sector has made rapid progress. While individuals are initially engaged in video games for fun, they are then confronted with competitive games within the gaming communities (Jin, 2010). The playing of these competitive tournaments at the national and international levels has accelerated the sponsorship of teams and the professionalization of eSports (Scholz & Barlow. 2019).

In 2020, the negative effects of the economic, educational, and social repercussions of the global pandemic, Covid 19, on the world have been revealed. In the same way, it has also led to the disruption of traditional sports, negatively affecting the billion-dollar sports industry (Goldman & Hedlund, 2020). With the postponement of traditional sports, there has been a rapid increase in spectators who turn towards digitally presented sports. In particular, eSports has been seen as a potential way to fill the void of traditional sports (Ke & Wagner, 2020).

Health problems related to gaming are highlighted by the American Psychiatric Association (APA) and the World Health Organization (WHO), which recognize online gaming disorder as a part of the diagnosis within the scope of the 11th revision of the international classification of diseases (Jo et al. 2019). Compared to traditional sports environments, eSports lacks the educational nature of healthy lifestyle choices. Since eSports, by its very nature, require a long period of sedentary screen time, there is a need to maintain and improve the health of athletes (Rudolf et al. 2020). It is believed that eSports will pose great risks for a large number of chronic diseases due to prolonged inactivity (Bailey et al. 2019; Patterson et al. 2018). Prolonged screen time, accompanied by prolonged sedentary behavior are considered to be risk factors for numerous chronic diseases (Bailey et al. 2019) and deaths due to these chronic diseases (Biswas et al. 2015). Weight gain caused by inactivity is among the documented negative health problems of eSports to date (Vandewater et al. 2004; Bayrakdar et al. 2020). It has been noted that more than 40% of eSports players do not do any physical activity (DiFrancisco-Donoghue et al. 2019). But with regard to energy expenditure, there is some evidence that active video gamers (e.g., exercise games) tend to increase energy expenditure or physical activity levels (Anderson&Bushman, 2001; Prescott et al. 2018). And this suggests that active video gamers who focus on fitness or exercise can participate to health-promoting physical activities. But it is reported that children with a higher weight play video games more often (Marshall et al. 2004; Vandewater et al. 2004). In some studies, however, inconsistent results have been reported between playing video games and obesity in children (Rey-Lopez et al. 2008). For example, a recent systematic review of 40 studies published from 2010 to 2017 showed that 85% of the studies had a positive relationship between adiposity and screen time in children and adolescents. However, this review did not specifically study video games isolated from other screen activities and did not specify the effects of rising-generation games on obesity (Tripathi & Mishra, 2020). This study will demonstrate an updated review of the relationship between eSports and BMI, combined with advances in eSports in recent years with the prevalence of obesity.

Therefore, the purpose of the study is to decisively review the potential relationships between eSports and BMI by examining recently published observational studies and interventions. Accordingly, the answer to the following main question will be sought:

1. What is the current status of observational evidence (cross-sectional data published between 2016 and 2021) of the relationship between eSports and BMI?

2. Methodology

Therefore, the purpose of the study is to decisively review the potential relationships between eSports and obesity by examining recently published observational studies and interventions. Surveys have been made starting from 2016, given that competitive games began to appear after video games were played online against other people. The data includes all the studies published between January 2016 and December 2021. The literature review was conducted in the Google Scholar, Science&Direct, PubMed, and Web of Knowledge databases. The following keywords were used in the relevant search engines. eSport+BMI, eSport+nutrition, eSport+health, eSport+physical activity, eSport+sleep. Observational studies evaluating the relationship between obesity and eSports are also included. Studies examining the relationship between a predictor variable (obesity-related behaviors such as sleep or nutrition) and BMI are also included (Turel et al. 2017; Cameron et al. 2016; Kracht et al. 2020). Each and all reviews have been conducted not only in the titles of articles but also in abstracts -in cases where this option is available- for the following reasons: (1) titles can sometimes be limited and may not include the words eSports and BMI; (2) authors may use a variety of different terms or synonyms corresponding to the concept of eSports and BMI. Studies conducted on individuals with a chronic disorder (autism) or used a non-observational study design (such as case intervention, qualitative or systematic studies) are not included in this review.

Two authors (AB and PA) independently reviewed the abstracts taken from the first review. The full-text articles of the selected abstracts were evaluated independently by the same authors. Any disagreement on the issue of eligibility after the abstract or full-text process has been resolved by the third and fourth authors (GK and IB). The reference lists of the included articles have been scanned for eligibility. The data were extracted into a form in terms of study type, population characteristics (age, race, environment, and country), study methodology, eSports, and BMI.

3. Results

The selection of the studies is described in detail in Figure 1. 364 articles were identified, including 361 articles from the initial review and 3 articles through the reference lists of the included articles. After 125 articles were removed, 239 original articles were scanned. 123 articles were not included in the review since they include chronic disorders (n=23), are interventions or qualitative studies (n=53) and systematic reviews or meta-analyses (n=47). The 47 abstracts excluded from the scope include assessments that are out of scope (n=9), include a summary of opinion (n=8), and do not include the BMI concept (n=19), eSports and BMI assessment (n=11).

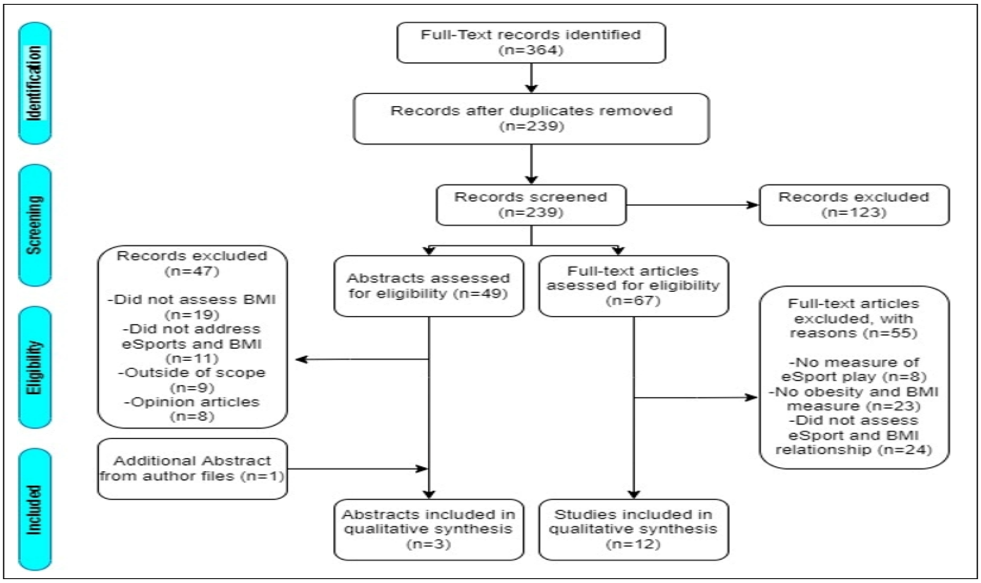

Figure 1. Selection of included research

The articles excluded from the scope (n=55) include assessments without eSports measurement (n=8), obesity and BMI measurement (n=23), and the relationship between eSports and BMI (n=24).

Sixty-seven articles are left for full-text scanning. Since most articles (n=24) were evaluated without specifically reporting on the relationship between eSports and obesity, fifty-five articles were not included in the full-text scanning. As a result, the data of 15 articles determined in accordance with the purpose of the study were evaluated (Trotter et al. 2020; DiFrancisco-Donoghue et al. 2020; Andre et al. 2020; Lee et al. 2021; Rudolf et al. 2020; Tartar et al. 2019; Schmidt et al. 2020; ValladÃo et al. 2020; Cox, 2019; Alexander et al. 2020; Bayrakdar et al. 2020; Giakoni-Ramírez et al. 2021; Bahrilli et al. 2020; Paramitha et al. 2021; Dykstra et al. 2021).

The descriptive characteristics of the included articles are given in Table 1. The sample sizes of the included studies range from 6 to 1772. The vast majority of the studies were conducted in the United States of America (n=6). The sample age range in the studies ranges from 17 to 30. The age range was not specified in three studies (Trotter et al. 2020; Schmidt et al. 2020; ValladÃo et al. 2020).

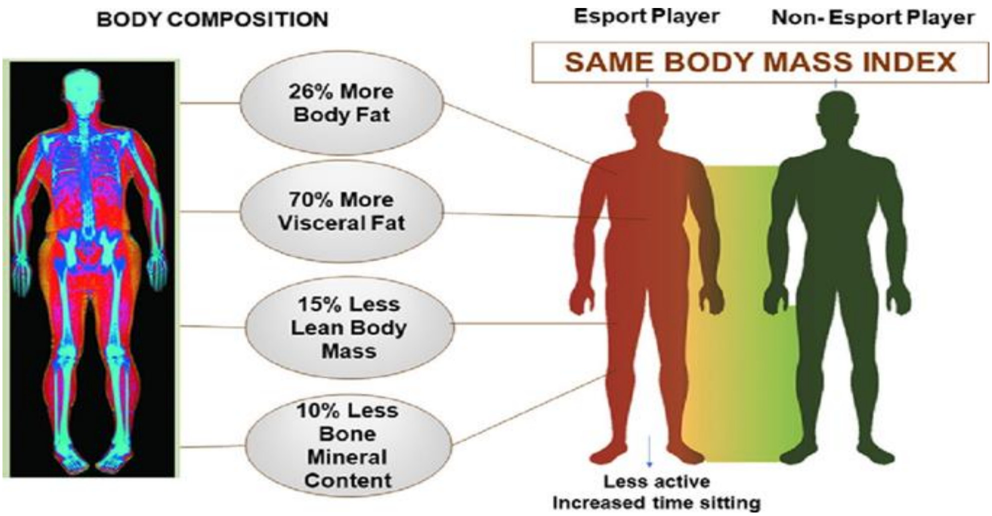

Figure 2. Body Composition (DiFrancisco-Donoghue et al. 2020)

Figure 2 shows that the body fat of the athletes is more than 26%, the visceral fat is more than 70%, the fat-free mass is less than 15%, and the bone mineral content is less than 10%. In addition, it has been reported that there is no difference in BMI between eSports athletes and athletes engaged in traditional sports, but eSports athletes have higher body fat ratios (DiFrancisco-Donoghue et al. 2020).

It is also reported that in eSports, an average athlete's BMI can be classified as normal (Rudolf et al. 2020). On the other hand, the evidence in studies examining the relationship between eSports and BMI is unclear. For example, it has been noted that the BMI level of the gamers who play video games or eSports is higher than that of non-gamers (Weaver et al. 2009). Nevertheless, it has been reported that eSports are less harmful to participants' BMI compared to computer games or other sedentary activities (Trotter et al. 2020).

The next studies: Descriptive characteristics of included studies (*n = 15*), highlight in following: Author and Year, Country, Sample and Participant, Measurements Findings:

1.Trotter et al. 2020
Australia
-N=1772
-eSports athletes from 65 different countries-SF-1 General Health, Physical activity level, BMI: kg/height2. There is a negative relationship between PA and BMI. There is no relationship between the frequency of eSports and BMI. BMI is inversely proportional to in-game ranking (better gamers have a lower BMI level)

2.DiFrancisco-Donoghue et al. 2020
United States of America
-experimental group n=13
-control group n=11, age range 18-30
-College Esports players

All measurements were taken during the peak season. Exercise (min/session/day/week), Body fat (%) Number of steps (2 weeks). There is no difference between the groups in terms of BMI p=0.35

-BMI of the experimental group=23.7, BMI of the control group=24.9.

-The total body fat percentage of eSports players was significantly higher (p=0.05). The control group performed significantly more physical exercises p=0.001

-daily screen time is approximately 2.5 times higher in the experimental group p=0.001

3.Andre et al. 2020

United States of America

-N=18, age range 18-22

-College Esports players, Weekly eSports duration

-Weekly exercise duration

-BMI was identified as 24.1

-The weekly esports duration was identified as 18.9. The weekly exercise duration was identified as 3.9.

4.Lee et al. 2021

-N=17, age mean 20, data was collected from 3 different countries

-Professional Esports players, daily training duration, BMI was identified as 24.1

-The average daily training duration was identified as 9.21.

-The relationship between BMI and daily esports was not examined in the study.

5.Rudolf et al. 2020

Germany

-N=1066, age mean 23

-Former professional eSports athletes, and Amateur Esports players

-Sedentary behavior, Health status

-Physical activity

-BMI was identified as 24.6 However, the BMI level of the players who are older or have quit eSports has been identified as 26.0.

-Weekly physical activity is between 2.5 and 5 hours.

-It has been found that professional eSports athletes are more active than amateur and former eSports players.

6.Tartar et al. 2019

United States of America

-experimental group n=30, control group n=30, age mean 28.6

-Pulse rate per minute

-5 or more video games were played per week for 6 months.

-BMI of the experimental group=26.87, BMI of the control group=27.72.

-Experimental group Pulse=77.7, control group pulse=78.9

7. Schmidt et al. 2020

-N=23

-winner and loser Esports players. Cortisol, Anxiety. Winner players BMI=22.6, loser players BMI=26.5, p=0.03

8.ValladÃo et al. 2020

United States of America

-N=21

-Students of the University Esports Club

-Weekly exercise duration, BMI was identified as 25.7

-Weekly Esports duration = 13

-A significant relationship was stated between BMI and eSports duration

9.Cox, 2019

United States of America

-N=23, age mean 20.7

-Those who play eSports -BMI

-Heart Rate -BMI=25.8

-During the eSport, the heart rate average per minute is 119.8

-During resting, an average of 75.6

-It has been found that playing eSports for a long time creates physiological stress

10.Alexander et al. 2020-N=6, age mean 24

-Professional eSports Athletes

-Blood pressure, Heart Rate

-BMI=28.8 (range 22.9-34 kg/m2)

-Systolic blood pressure=130 mmHg, Diastolic blood pressure=75 mmHg

11.Bayrakdar et al. 2020

Turkey

-N=137, age mean 19.92

-Professional eSports Athletes, Level of Physical Activity

-Daily eSports duration

-BMI=26.03

-Daily Esports duration is 9.34

-There is a negative relationship between BMI and the level of physical activity

-There is a positive relationship between BMI and daily eSports duration

12.Giakoni-Ramírez et al. 2021

Spain

-N=53, age mean 21.01, Professional eSports Athletes

-Esports experience

-BMI=26.03

-The BMI of those who are new to eSports is higher, and as the experience increases the BMI rate decreases

-There is a negative relationship between BMI and eSports experience

13.Bahrilli et al. 2020
Turkey
-N=47, age mean 20.98
-Professional and semi-professional Esports players
-Daily screen time
-Pain, Fatigue
-BMI=24.47
- Daily screen time=8.1 hours.
-There is a positive relationship between pain and screen time.

14.Paramitha et al. 2021
Endenosia
-N=50, Age =21.5
-Professional eSports Athletes
-Level of Physical Activity
-Sleep duration, Gaming duration
-BMI=22.4
-Sleep duration=420.5 minutes
-Gaming duration=183.9 minutes
-It is reported that the level of physical activity is high

15.Dykstra et al. 2021
United States of America
-N=27, Age =21.5
-Athletes of the esports club
-VO2Max
-BMI=25.6
-It is reported that by increasing the aerobic capacity, eSports players will be more alive and kicking, and their performance will increase.

Compared to players who do not play eSports; College eSports players are stated to be less physically active, have low fat-free mass, and have a high body fat percentage (DiFarancisco-Donoghue et al. 2020). Although the body fat percentage is high, it has been reported that eSports players are in the normal weight ad fat class compared to international references. It has also been reported that although eSports players look healthy in general, a small group is significantly fat (Trotter et al. 2020). Average BMI was in the overweight range for South Korean players, while Australian and US participants were reported to be at the limit of the overweight and generally to be at the limit of fattiness (Lee et al. 2021). It has been reported that the BMI mean of players who are older and have quit eSports is to be fat, and the BMI level of professional eSports players is in the normal range compared to amateur and former players (Rudolf et al. 2020). It has been reported that there are no significant differences in the BMI variable in the two articles with experimental and control groups. The BMI values of the experimental groups were reported to be lower than control groups. (DiFrancisco-Donoghue et al. 2020; Tattar et al. 2019). In addition, it has been stated in an article that the BMI of those who play eSports increases as they get older (Rudolf et al. 2020). In the BMI assessment conducted on the winner and loser eSports players, it was reported that the winner players had a normal BMI and the loser players were fat (Schmidt et al. 2020).

Concisely, it is reported that the BMI levels of those who are new to eSports are high, but the BMI decreases positively as the experience increases (Giakoni-Ramirez et al. 2021), and as the in-game ranking increases, eSports players have better BMI (Trotter et al. 2020), active eSports players have better BMI compared to former eSports (Rudolf et al. 2020), those who have been playing eSports for six months have a better BMI than those who have not (Tartar et al. 2019), winner players have better BMI levels than loser players (Schmidt et al. 2020), and the BMI level of beginner eSports players is higher and the BMI rate decreases as the experience increases (Giakoni-Ramirez et al. 2021).

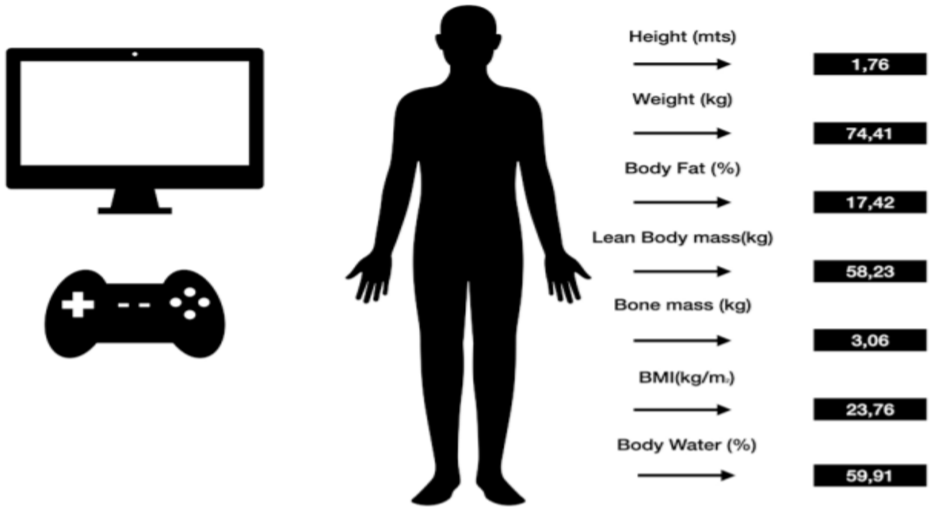

Figure 3. Representation of the body composition profile of the group of professional esports players (Giakoni-Ramirez et al. 2021).

Figure 3 shows the body composition profile of the analyzed athletes. Height (m), weight (kg), fat mass (%), fat-free mass (kg), bone mass (kg), BMI (weight/height^2) and values such as total body water (%) are displayed. According to the article, it is reported that the BMI levels of professional ESPORTS players are at the normal ranges. In addition, it has been reported that eSports practiced for a long period of time do not have any negative effect on the body composition of professional athletes (Giakoni-Ramirez et al. 2021).

In the studies reporting the eSports duration on a weekly basis, the BMI level of college eSports players who play eSports for over 15 hours per week is normal (Andre et al. 2020), and those who play less than 15 hours per week have a BMI level of fat (ValladAo et al. 2020). There are differences in the data of studies examining those who play Esports for over 8 hours daily. It has been reported that the BMI level of professional athletes who play eSports for an average of 9.21 hours per day is normal (Lee et al. 2021), and the BMI level of professional athletes with a daily average of 8.21 is normal (Bahrilli et al. 2020), the BMI level of professional athletes with 3.01 gaming duration is normal (Paramitha et al. 2021). But in an article, the BMI value of athletes with a daily eSports time of 9.34 was reported as fat (Bayrakdar et al. 2020).

In studies indicating physical activity on a daily or weekly basis, a relationship has been reported between physical activity and BMI (Trotter et al. 2020; Bayrakdar et al. 2020). In the studies with 3.9 hours of weekly training time (Andre et al. 2020) and 2.5-5 hours of weekly training time (Rudolf et al. 2020), it was reported that the BMI was within normal ranges. In addition, it is stated that athletes increasing their aerobic capacity will maintain their BMI and improve their performance (Dykstra et al. 2021).

4. Discussion

This review aimed to review all observational studies examining the effects of eSports on BMI. In addition, it has systematically collected all published peer-reviewed observational studies on the BMI of eSports players in order to draw the attention of scholars and researchers on the subject of eSports and to encourage future empirical studies in the field of sports sciences. However, as demonstrated via a systematic literature search, few studies exist focusing on the BMI aspects of esports. Findings of the review demonstrated that one main topic has been investigated in the health literature: (i) The effects of eSports on BMI Some of the studies in the review show that becoming an eSports player is similar to the process of becoming a professional athlete in any sport (Giakoni-Ramirez et al. 2021; Bahrilli et al. 2020; Paramitha et al. 2021; DiFrancisco-Donoghue et al. 2020; Lee et al. 2021; Rudolf et al. 2020; Schmidt et al. 2020). There are many similarities between players who play eSports professionally and players who are defined as traditional athletes (Suits, 2007). But academicians have different views on regard eSports as a sport. In general, it is argued that eSports have a negative impact on people and society (Caillois, 2001). Despite the growing popularity of eSports, research on health problems among gamers has recently begun to appear. Despite the long hours and intense screen time required to reach the professional level in eSports (Garcia-Lanzo & Chamarro, 2018; Huang et al. 2017), research is limited in understanding the impact of such activities on the health of gamers. Current research suggests that eSports are comparable to traditional sports (Freeman & Wohn, 2017a; Freeman & Wohn, 2017b).

Due to the popularity, eSports players have begun to spend quite a long time before electronic devices (dota2.com, 2016). This situation causes a negative effect on physical inactivity and BMI in eSports players. The most fundamental difference between eSports and traditional sports is physical activity. The most worrying thing about eSports is that players have sedentary activities for hours (Rudolf et al. 2019). Increased screen time is called sedentary lifestyle by academicians and experts. There are negative health effects as part of a sedentary lifestyle. One of these negative health effects is obesity (Choi et al. 2018; Cunningham et al. 2018; Polman et al. 2018).

Despite the different opinions about eSports in the literature, Polman et al. (2018) tried to take a different perspective on eSports, noting that it was discussed whether golf should be a sport and that academicians began to work through Tiger Woods' physical body conditions especially in the 1990s. Just as in traditional sports, in order to be the best in eSports, professional eSports players need to be physically healthy so that they can make quick decisions under time pressure and focus on the game process (Happonen & Minshkina, 2019). It is stated that today most golf players do sportive training with personal fitness trainers and eSports players also take care of physical activities in order to protect their health and to be more successful (Polman et al. 2018).

To date, among the common documented negative health problems of eSports, weight gain due to inactivity has been reported (Vandewater et al. 2004). While the BMI level of eSports players who have been sitting motionless by the screen for a long time is indicated as fat (Bayrakdar et al. 2020), another study stated that the BMI levels of professional eSports players sitting by the screen for more than 8 hours daily are normal (Lee et al. 2021; Bahrilli et al. 2020). Sedentary lifestyle and physical inactivity affect BMI (Ekelund et al. 2014). The current results have shown that the BMI level of adult eSports players is at the upper limit of the normal level (Andre et al. 2020; Lee et al. 2021; Rudolf et al. 2020; Bahrilli et al. 2020). The BMI values of athletes ranging between 16.79 and 40.4 kg/m^2 indicate that body compositions are extremely variable. Last but not least, it is reported that this change in the BMI of eSports players may be caused by factors such as age, nutrition, physical activity, stress, sleep patterns, socio-economic status, amateurism, professionalism, and experience (Ball & Crawford, 2005; Dunton et al. 2009; Grandner et al. 2014; Bahrilli et al. 2020).

5. Conclusion

In the articles examined, different results are noticeable in relation to BMI. But it is seen that the BMI of eSports athletes who do eSports professionally is in the normal BMI range, as is the case with healthy people or athletes in traditional sports. However, it is stated that BMI is within the obesity limit/obesity range in non-professional, new to eSports, and players who have quit eSports. As a result, it can be said that athletes who play eSports professionally or do physical activity have a normal BMI, just like athletes who play traditional sports. It is also believed that athletes who engage in physical activity can keep their BMI under control and further improve their performance.

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Comparative Study on Speed Running among Children Aged 11-12

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Abstract
The purpose of this study was to compare the results obtained in 50-sqm speed running by children aged 11-12 residing in urban or rural areas. Furthermore, the study compared the values obtained ten years prior in the same trial (by subjects of the same age). The sample comprised 155 children aged 11-12 ± 0.5 (from Iași, Romania): 74 children from a rural school and 81 from an urban school. The assessment of the 50-sqm speed running was performed by gender (boys and girls separately). The findings have proven the differences among the children: the rural boys obtained X+S=8.64±0.7 seconds compared to X+S=10.02±1.51 seconds scored by the urban boys. The results obtained by the rural girls were X+S=9.22±0.77 seconds, while the urban girls scored X+S=10.7±1.44 seconds. Upon comparing the values obtained in speed running in 2012 with those of 2022, we have concluded that, in 2012, the boys recorded better values by 0.04´´ compared to the rural boys and 1.33´´ compared to urban boys. Concerning the girls, in 2012, they scored better by 0.04´´ compared to rural girls and by 1.52´´ compared to urban girls. Consequently, it may be suggested that the results obtained by children aged 11-12 have had a descending trend, which means an insufficient development of the motor quality of "speed" over the past ten years.

K***eywords***: *physical education, motor qualities, speed running.*

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1. Introduction

Physical education and sport represent a mandatory subject of the standard curriculum, targeting the development of motor skills and the integration into society of middle schoolers (European Commission/ EACEA/Eurydice, 2013).

The PES Curriculum has been widely used and is related to the positive psychological outcomes obtained by students, such as the development of skills and the increase in the motivation to practice exercising (Hastie et al., 2011; Wallhead & O'Sullivan, 2005). Exercising may lead to educational benefits regarding social development, aptitudes, trust, and behavioural consistency (Ntoumanis and Standage, 2009; Van den Berghe et al., 2014).

Physical education and sport discipline are based on an educational curriculum and the analysis of school documents. The syllabus for the Physical education and sport discipline contributes to developing the formation profile of middle school graduates. It is a competence-based flexible school document (MEN, 2017).

The philosophy of Physical education and sport provides students with opportunities to practise sporting activities, increasing the students' chances of practising performance sports (van der Mars and Tannehill, 2015).

Siedentop designed the student-centred curriculum in 1994 to increase students' motivation in Physical education and sport class by accomplishing the essential requirements and depending on their acquisitions (Wallhead et al., 2014).

The contents of instruction concern fields related to the organisation of motor activities, well-balanced physical development, motor capacity, the sports disciplines, individual hygiene and protection, behaviours and attitudes – through a specific approach, they contribute to the progressive acquisition of skills by enhancing the age-specific experience (MEN, 2017).

The Physical education and sports program generally promotes an optimal climate of self-control and student perception through autonomy, competence, and connecting (Chu & Zhang, 2018).

The literature has provided well-grounded evidence concerning the relationship between Physical education and sports class and motor skills (Figueroa & An, 2017).

In addition, various studies have reported that extracurricular activities and leisure physical activities carried out by children may develop their motor skills, which may constitute an alternative to the practice of Physical education and sport (Barnett et al., 2016; Bonvin et al., 2013).

The individual differences concerning motor competence are considered the outcome of motor experiences during childhood; subsequently, they reach high levels of specific competencies. Therefore, Physical Education classes are a significant factor in developing motor skills and qualities (Robinson et al., 2015).

The insight into the motor capabilities of children aged 11-12 is directly related to the effects of physical education practice and the development of various motor skills. For a teacher, it is highly relevant to grasp the motor capabilities of students, as it facilitates the planning process for the classes of Physical education and sports by choosing the manifestation methods and forms and selecting the physical exercises to develop those competencies (Batez, Krsmanovic, Dmitrić & Pantović, 2011).

Iivonen and Sääkslahti (2014) have reported that further research is necessary to understand the characteristics of physical activities that are relevant through their organisation level and structure (Berry, Abernethy, & Côté, 2008; Mota & Esculcas, 2002).

While the Physical education and sports classes take place in a systematic and organised setting under the direct supervision of teachers, the nonformal activities are free, and they contribute to both improving motor performance and enhancing the pleasure of exercising (Coutinho, Mesquita, Davids, Fonseca and Côté, 2016).

Many studies that have investigated the comparison between the motor capacity of urban and rural students have found that rural students tend to have better results than urban ones (Özdirenç, Özcan, Akin & Gelecek, 2005; Tinazci & Emiroglu, 2010; Badrić & Petračić, 2007; Cetinić, Petric & Vidakovic-SamarĎija, 2011; Karkera, Swaminathan, Pais, Vishal & Rai, 2014; Adamo et al., 2011; Tanovic, Kurtalić, Bojic, Mijatović și Azapagić, 2013; Albarwani et al., 2009). In addition, students' development and physical activity make the subject of other research studies (Simeonova & Pavlov, 2012; Yukako et a., 2010; Galov, 1996).

Motor capacity is determined by developing the motor qualities of speed, power, resistance, and flexibility (Slanchev, 1992).

To teach them to students ages 11-12, we use one of the athletics races, i.e., the 50 sqm speed running. The event comprises several phases: start, acceleration, peak speed, and deceleration, which involve, to a smaller or larger extent, the other motor qualities, too (Plisk, 2008). The decisive factor in short-distance running is represented by the level of motor aptitudes – power, speed, and acceleration (Dewanti & Lumintuarso, 2018).

Speed running is defined as a movement executed with maximum speed; it is genetically conditioned. The early detection of genetic resources may help to create an athlete with superior qualities. The maximum race speed is expressed by the structure of kinematic and dynamic parameters (Azuma & Matsui, 2021).

Maximum velocity (Vmax) is characterised by a gradual increase in speed, represented as a relatively flat section between speed and distance, almost 100% of the highest possible value (Healy et al., 2022).

Various methods and means of education speed and power are used to develop maximum acceleration, which helps maintain the acceleration level on the entire distance. Running is a part of most sports, but it has different representations depending on the objective to attain. Competence regarding running skills is significant and necessary in Physical education and sports, and it develops with age (Kato Miyamaru, 2006; Kato et al., 1985, 1987, 1992).

In athletics, an essential factor is to obtain maximum speed as quickly as possible. Short-distance running may be assessed concerning various aspects of speed quality through four phases (i.e., reaction time and reaction speed, acceleration, deceleration, and sprint speed and speed resistance). Speed is influenced by muscle power, anaerobic running, movement coordination, technical abilities, and the type of muscle fibres specific to the athlete (Nossek, 1995).

The comparative studies concerning the biomotor programs conducted around ten years apart aim to assess the health state, mean values of height evolution, youth weight, and the level of motor qualities determined by the biological and functional substrate (National Research Institute for Sport, 2012).

The interested parties involved in the field – mostly the Physical education and Sports teachers – were notified regarding data interpretation for each edition and the conclusions of each work. New findings have been outlined regularly regarding the evolution of biomotor potential, and the causes for justifying outcome decreases regarding some tests have been analysed (resulting in alterations to the syllabus).

After 1990, we noted the regression of the students' biomotor potential. In this respect, investigations have been carried out on other samples of students, thus recording a new battery of measurements and motor tests.

2. Material and method

2.1. The purpose of this study was to compare the results obtained in the 50 sqm speed running by rural and urban children aged 11-1, as well as the comparison of the results acquired decades ago in this test by subjects of the same age.

2.2. The subjects

The sample comprised 155 children aged 11-12 from Iași, Romania, 74 children from a rural area: 38 boys, 36 girls and 81 children from an urban area: 42 boys, 39 girls. We assessed the 50 sqm speed running on distinct groups and by gender.

2.3. Procedure

The test was applied in 2021 – 2022 to all students aged 11-12 during the Physical education and sports classes. The performance of the 50 sqm speed running was assessed according to the National Evaluation System for Physical education and sports benchmarks.

In this study, the statistical analysis compared the results of the 50 sqm speed running of rural students with the results of urban students, as well as the results of the assessment of the biomotor potentials from 2012 with the values obtained in 2022. To make the statistical calculations and graphical representations, the IBM SPSS Statistics 20 software was used, and the following indicators were calculated: Independent-Samples T Test and regression.

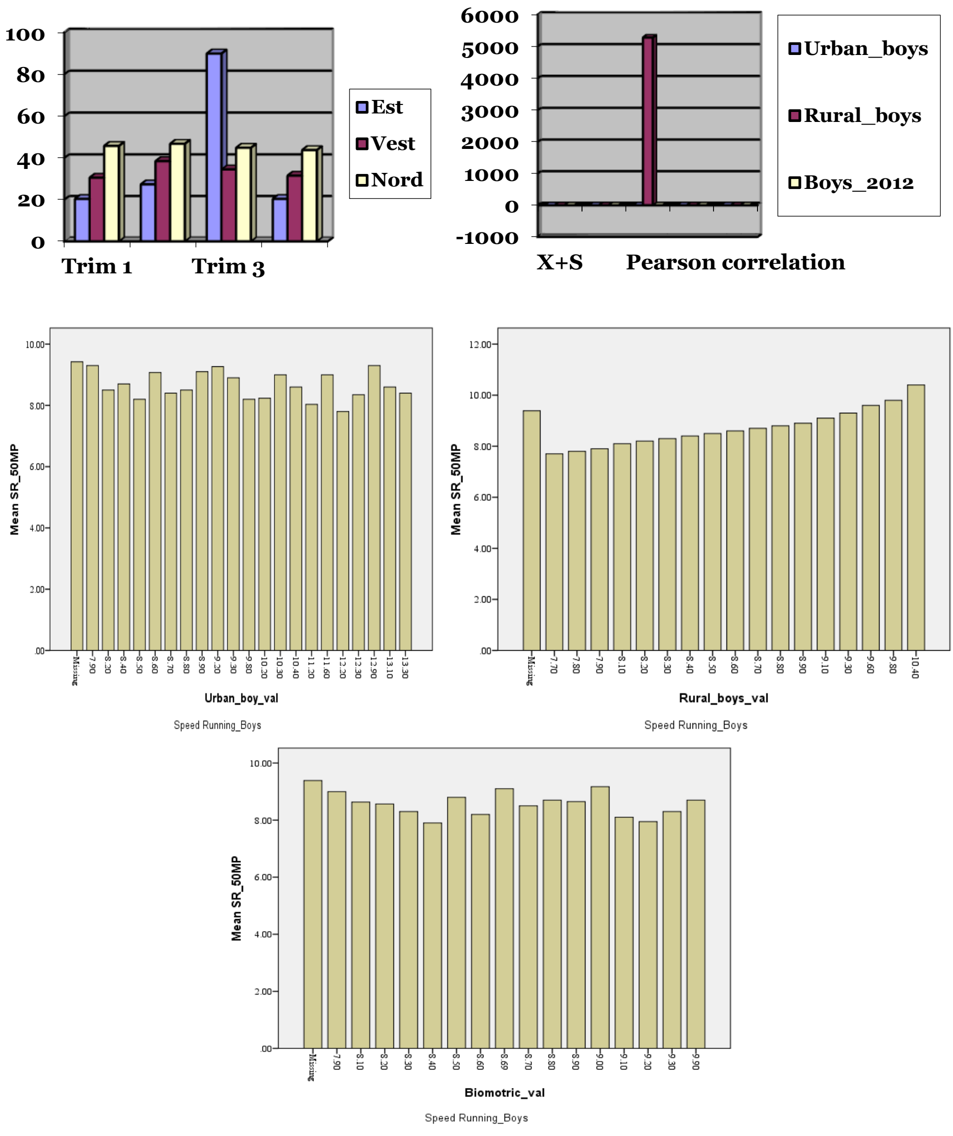
3. Results and Discussion

In this study, we assessed the potential differences between groups of urban and rural students, the differences between the results obtained by urban students in 2022 and the results obtained by students in the biomotor program of 2012, the results obtained by rural students in 2022 and those obtained by students in the biomotor program of 2012.

Table 1. Speed Running (SR) values among the research **Boys**

SR	Urban 2022 – Rural 2022	U. 2022 – Biomotor 2012	Rural 2022 – Biomotor 2012
X+S	10.02±1.51 – 8.64±0.70	10.02±1.51 – 8.69±0.43	8.64±0.70 – 8.69±0.43
D	1.38±0.81	1.33±1.08	0.04±-0.73
T Test	t = - 4.249;	t = 5.284;	t = -0.373
Sig	P<000	P<000	P = 0.711

Statistical calculations have shown that in the 50 sqm speed running, the difference between the mean of the results of urban students was higher by 1.38±0.81 compared to that of rural boys and by 1.33±1.08 compared to that of biomotor 2012. Among rural students, the results obtained in 2022 feature a lower difference by 0.04±-0.73 compared to the mean of the results obtained by boys in 2012. Hence, it may be concluded that between the results obtained by urban and rural boys, there is a perfect significance P<000. In addition, the results obtained by urban boys in 2022 and those obtained in 2012 were significant, P<000. Comparing the results of rural boys in 2022 and those obtained in 2012 indicates a significance threshold of P=0.711, showing that the difference between means is insignificant. (Table 1, Figure 1).



Graph 1. The results obtained by urban and rural boys
and the values obtained in the biomotor program of 2012

Table 2. Regression of results – Boys

Regression	Sum of Squares	Sig.	MIN	MAX
Urban 2022 – Rural 2022	3.130	P = 0.155	8.99	10.10
Urban 2022 – Biomotor 2012	3.916	P = 0.110	9.12	10.62
Rural 2022 – Biomotor 2012	0.04	P = 0.933	8.62	8.66

Between the values obtained by the group of urban boys in 2022 and those obtained by rural boys in 2022, there is a positive regression of 3.130. The values obtained by urban boys in 2022 and those obtained by boys in 2012, there is a positive regression of 3.916. The results of rural boys in 2022 and those obtained by boys in 2012 indicate a positive regression of 0.04 (Table 2, Figure 2).

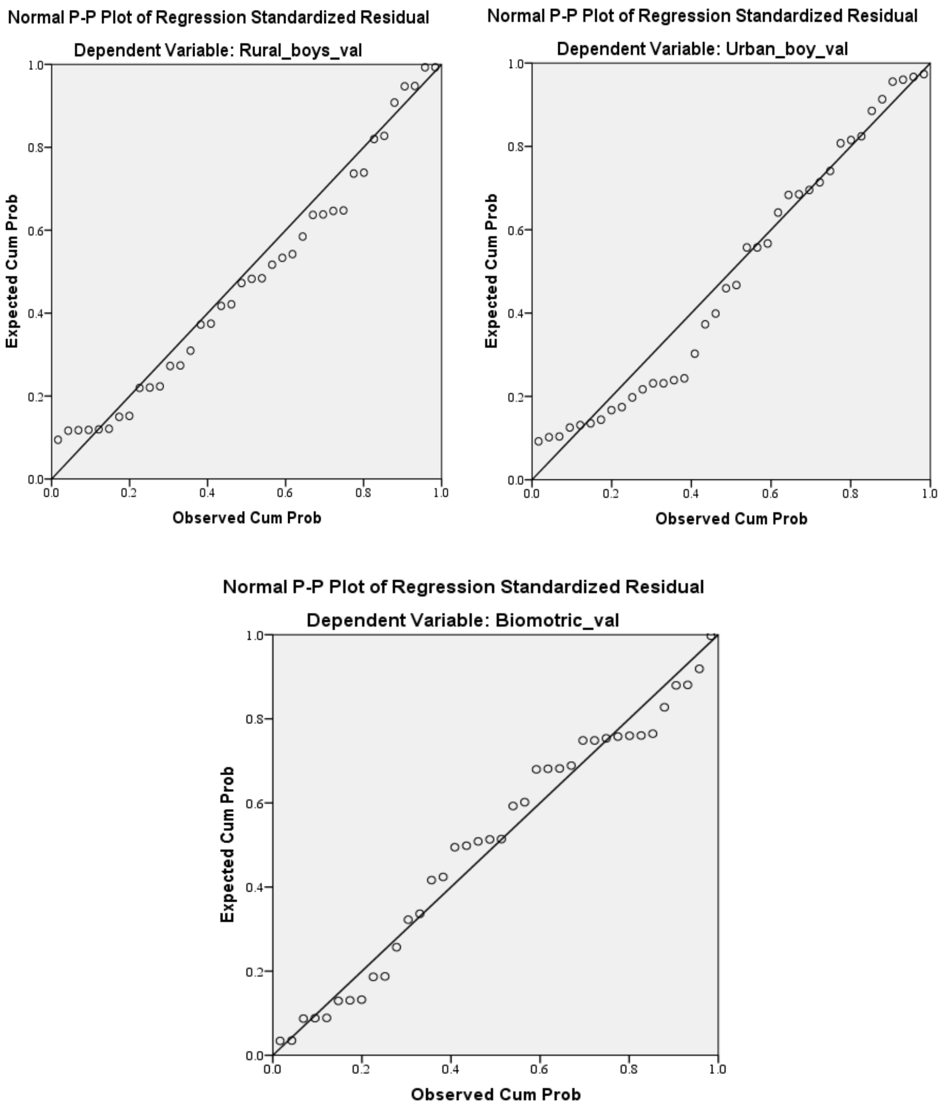


Figure 2. The regression between the three groups of subjects

Table 3. Speed Running (SR) values between the research studies – **Girls**

	Urban-Rural	**Urban -Girls 2012**	**Rural – Girls 2012**
X+S	10.78±1.44 – 9.22±0.77	10.78±1.44 – 9.18±0.66	9.22±0.77 – 9.18±0.66
D	1.56±0.67	1.6±0.78	0.04±-0.11
T Test	t = - 5.746	t = 0.277;	t = 6.086
Sig	P<000	P<000 P = 0.783	P = 0.783
Pearson correlation	-0.046	-0.140	0.036

The results obtained by the rural girls in the 50 sqm speed running in 2022 have shown a difference of 1.56±0.67 compared to the values obtained by the urban girls. The values obtained by girls in the biomotor program of 2012 recorded differences of 0.04±-0.11 compared to the results obtained by the rural girls in 2022 and 1.6±0.78 compared to the values obtained by the urban girls in 2022. The significance threshold is p<000 between the urban-rural groups and urban groups – the biomotor program of 2012, which proves that the differences between means are significant. The differences between the results obtained by the rural girls in 2022 and those obtained by girls in 2012 are insignificant, underlined by the value of P = 0.783. (Table 3, Figure 3).

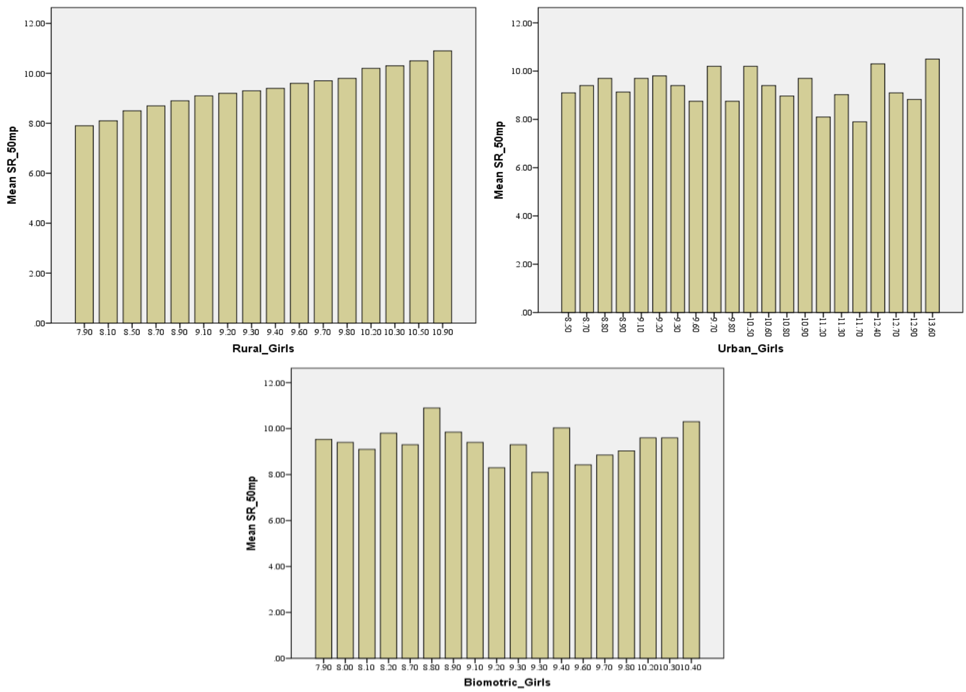


Figure 3. The results of girls in the 50 sqm speed running

Table 4. Regression results – Girls

Regression	Sum of Squares	Sig.	MIN	MAX
Urban- Rural	0.145	P = 0.788	10.80	11.05
Urban -Girls 2012	0.087	P = 0.836	10.84	11.03
Rural – Girls 2012	0.412	P = 0.415	9.02	9.43

Statistical calculations prove a positive regression of 0.145 between the results obtained by the urban girls in 2022 and the results obtained by the rural girls in 2022. The values obtained by the urban girls in 2022 and those obtained by girls in 2012 show a positive regression of 0.087. In addition, the values obtained by the rural girls in 2022 recorded a positive regression of 0.412 compared to those obtained by the rural girls in 2012 (Table 4, Figure 4).

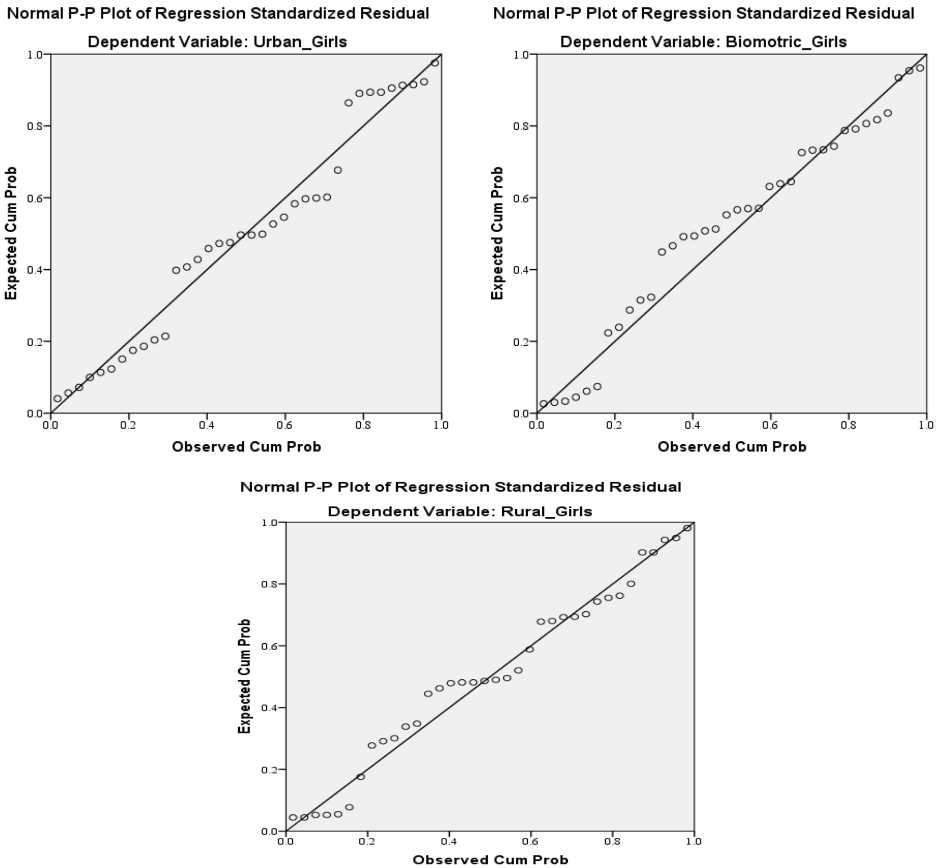


Figure 4. Regression between values in the 50 sqm speed running

A study carried out on 150 children within a primary school in Vidikorac, Croatia, has mentioned that the reaction time in the 50 sqm speed running is, on average, 15.3% higher for boys than for girls and that boys run 4.8% faster than girls (Blažević et al., 2011). Another study conducted in Croatia on a sample comprising 2431 students aged between 11.3 +/- 6.1 have shown that the differences between the exercise capacity of the rural and urban children have been calculated using a series of univariant analysis of variance, the results for speed running demonstrating that urban students have scored almost equal values compared to rural students (Ujević et al., 2013). Another study was conducted on students aged 10-12 and included 85 students, 61 from urban and 24 from rural areas (from various geographical zones). The urban students came from the school Kebangsaan Sungai Besi 2, Kuala Lumpur, and the rural students came from the school Sekolah Kebangsaan Sungai Rasau, Dalat. The results have proven that rural students scored higher by 33.3% compared to urban students, who obtained 19.7% (Hian et al., 2013).

4. Conclusions

This study aimed to compare the results of students aged 11-12 from rural and urban areas and the results obtained by students in 2022 with those within the biomotor program of 2012 in the 50 sqm speed running.

The study results have proven that rural boys scored higher than urban students and boys. In addition, the values obtained by rural boys in 2022 were better compared to the results obtained in the biomotor program of 2012.

The values obtained by girls in the biomotor program of 2012 were better compared to the results obtained by the rural girls in 2022 and the results obtained by the urban girls in 2022.

Consequently, the results prove that rural boys featured constant values concerning speed running, while urban boys scored lower on this test. Furthermore, the urban girls recorded lower scores compared to rural boys and the values obtained by girls in the biomotor program of 2012.

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Physiotherapist's Activity in the Clinical Intensive Care Unit and Acute Medical Wards

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Abstract
The purpose of the research is based on the activity of the physiotherapist, who, according to international standards, must have knowledge of the specialized equipment of the intensive care unit, from which the morphofunctional data of the patients in accordance with the diagnosis approached result.
The working hypothesis starts from the premise that on the basis of a physiotherapeutic assessment and a good collaboration with the multidisciplinary team, an interdependent relationship can be established, by setting out the tasks of the medical team and developing a well-established and individualized program, with therapeutic rehabilitation exercises appropriate to the pathology approached, whether acute or chronic respiratory pathologies.
A survey of physiotherapists' work was used, using the questionnaire interview method conducted through the online application Survio.com, which includes items that collect data from the responses of the interviewed subjects on the therapy applied in respiratory recovery in the UK and Romania.
The validity of the developed questionnaire was achieved using the Alpha L.J. Cronbach coefficient on the subjects, using the statistical interpretation program IBM SPSS Statistics 25, which attests both the consistency of the items listed and the validity of the questionnaire as a whole.

Keywords: *Physiotherapist, ontensive therapy unit, multidisciplinary clinical team, questionnaire interview method, therapeutic recovery program.*

1. Introduction

The physiotherapist's work is based on a good knowledge of the resulting parameters, both on specialized equipment and on the morpho-functional data of the patients in accordance with the presented diagnosis, which is one of the **topical aspects of the research topic**.

Within this interdependent relationship, the physiotherapist uses practical training recommendations for the remedial exercise programme, which can become a guideline applicable on intensive care units. It can be optimised and adapted following acceptable results on each targeted pathology and, of course, individualised on each subject (Brassington et al., 2002).

In addition to these observations, there are also the premises of experimental research results of internal specialists and international publications, with similarity in recovery on Anaesthesia and Intensive care Unit even on pathologies that have a current social impact, such as SARS-COV2 (Auwal, 2020), or research on Bestall et al. (2003).

2. Questionnaire survey method

The questionnaire survey aims to “study the opinions, motives, attitudes, habits, decision-making and behavioural patterns of the interviewed subjects” (Epuran, 1995), especially those who are respondents in our survey in the field of health and physiotherapy work of individuals or specific groups.

In the case of the questionnaire survey applied by us independently it had the particularity that it referred to the real conditions and experience of the subjects in respiratory therapy.

The conditions of application of the questions was the professional specialized training of the observer, the observer's level of practicing attention in discovering details.

Our survey methods sought to provide explanations regarding the opinions and objectivity of the responses in order to formulate scientifically conclusions, and succeeded in providing the researcher with explanations regarding the mechanisms of opinion formation and the prediction of patients' behaviours in the physiotherapy recovery process.

The questions received recorded responses in standardised form conducted in a limited time focused on the research topic. Recommendations were made within the survey methods where the questions had a single interpretation or also interpretation variants with certain progression and rationality.

On the objectivity of the subjects' narrative, the answers to the questionnaires depend the formulation of scientifically based conclusions on respiratory therapy and the work of specialized physiotherapists.

Within the research we considered it necessary to prepare a questionnaire through the online application Survio (Survio.com) and to have the answers automatically processed by the application in real time.

We mention that this questionnaire is structured in two parts:

In the first part the questions aim to collect data referring to the activity of the physiotherapist specialized in respiratory therapy within a team, activity materialized by applying a recovery program with specific physical and respiratory exercises, correlated with the field of medical gymnastics, with a program corresponding to a chronic or permanent respiratory pathology taking into account age, gender and other morpho-functional characteristics of the patient.

The second part includes items through which data are collected from the responses of the interviewed subjects on the therapy applied in respiratory recovery.

The survey was carried out by questionnaire to 14 respiratory therapy specialists in the United Kingdom (UK) and Romania during March-April 2021 first stage, second stage June-July 2021, applying the evaluation texts.

Graphing method and interpretation of respondents' answers.

5 representative responses of the respondents were selected.

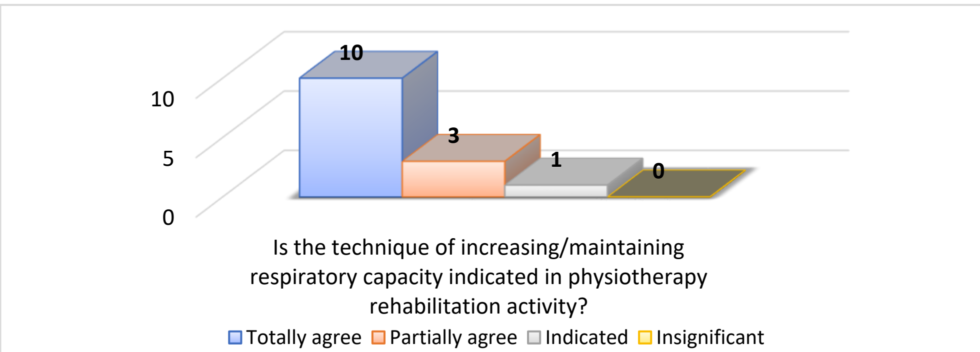

Figure 1. Graphical representation of the recovery activity by respiratory physiotherapy means, specific to increasing or maintaining respiratory capacity

In the graph above Figure 1 can be observed and interpreted that 10 out of the 14 interviewed subjects represent the majority, who consider that they totally agree, that specific physiotherapy techniques are necessary to increase or maintain respiratory capacity, while 3 out of 14 partially agreed with this statement, considering that only certain techniques are effective, and one subject considered that it is indicated to apply any specific physical exercise oriented on the respiratory apparatus.

As a confirmation of the importance of respiratory physiotherapy recovery activity, none of the interviewed subjects responded with "not significant".

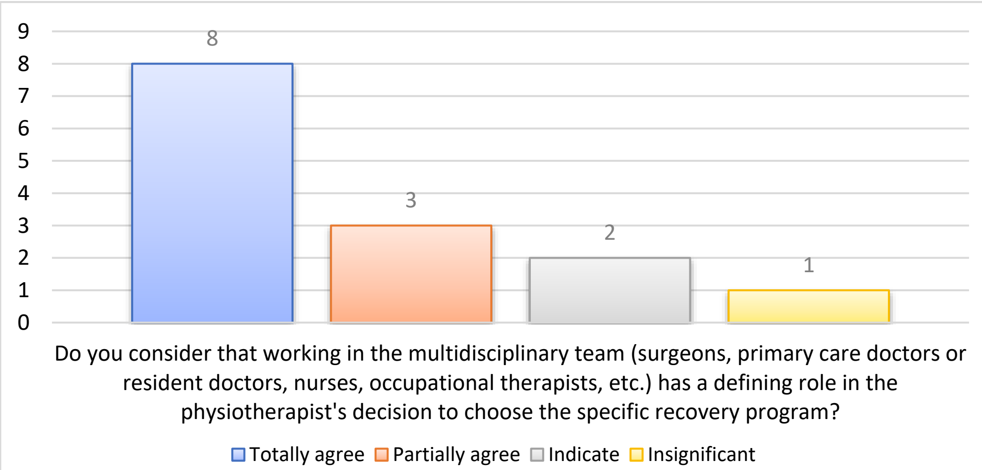

Figure 2. Graphical representation of multidisciplinary team work

From the graphical representation above Figure 2, we can observe a differentiation of opinions regarding the role of the physiotherapist, from the point of view of a professional team, in which the share of opinions of the team members is divided according to the activity and place of performance.

Out of 14 interviewed subjects 8 totally agreed with the above, forming the majority, in the appreciation that an interdisciplinary collaboration and consultation contributes to the defining role in the choice of the specific optimal rehabilitation program by the physiotherapist.

Three subjects partially agreed, and 2 others opted for indicating that the work of the specialised physiotherapist in the multidisciplinary team has a decision-making role. Only one subject considered that working in a professional team is insignificant for the specialist physiotherapist by making decisions regarding the choice of the specific rehabilitation programme.

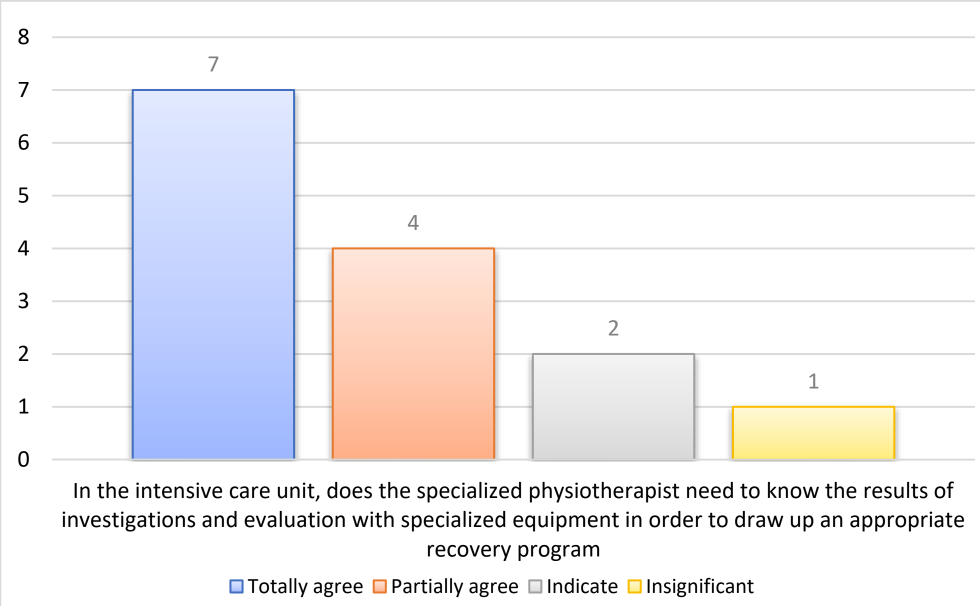

Figure 3. Graphical representation of assessment with specialist equipment in the intensive care unit (After Collins et al., 2014)

According to Figure 3, in the field of general physiotherapy, but especially in the intensive care unit, there is the opportunity to use specialised equipment for the correct application of a recovery exercise programme as optimal as possible, such as the motomed (auxiliary device for maintaining and increasing muscle strength, but also for maintaining range of motion, through passive, passive-active, active and resistance movements) and the therapeutic incentive spirometer coach 2 or with balls in-situ. In addition to these, internationally respiratory physiotherapists use a range of specialised aids to improve, maintain and treat respiratory diseases, including SARS-CoV-2 (COVID-19) (Garrod et al., 2000).

This aspect of knowledge of modern equipment, of intervention in the application of a recuperative exercise programme in the physiotherapy treatment schemes, gave rise to a series of varied responses, as can be seen in the graph above, where 7 out of 14 interviewed subjects totally agreed with this statement, 4 partially agreed, 2 admitted that it is advisable to use these technological means, and 1 assumed that this need is significant.

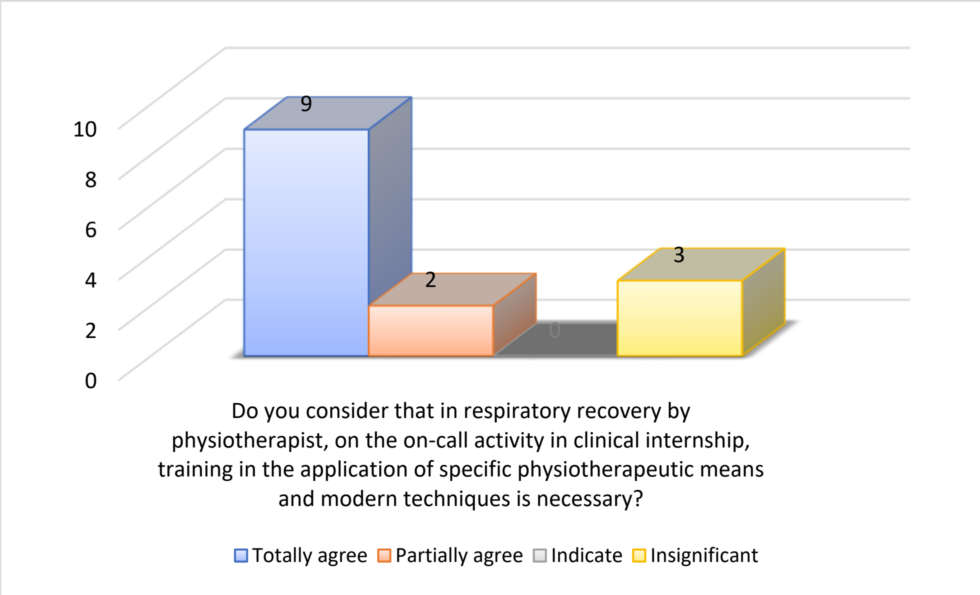

Figure 4. Graphical representation of the physiotherapist's activity during the clinical on-call period in clinical internship (After Mahler et al., 2003)

According to the international literature, the respiratory physiotherapist has also on-call duties, where they demonstrate specific and applied knowledge using modern means and techniques. Even in the Romanian national health and emergency system, interventions are used to manage certain respiratory pathologies.

In the comparative graph above, Figure 4, it can be noted that this activity is topical at international level, which is also confirmed by the recommendations of the interviewed subjects, 9 answered totally agreeing, 2 only partially agreeing, and 3 considered that this activity is insignificant in the Romanian health system. For this reason, there is no affirmative answer to the fact that a complementary training through the training of respiratory physiotherapists would be indicated.

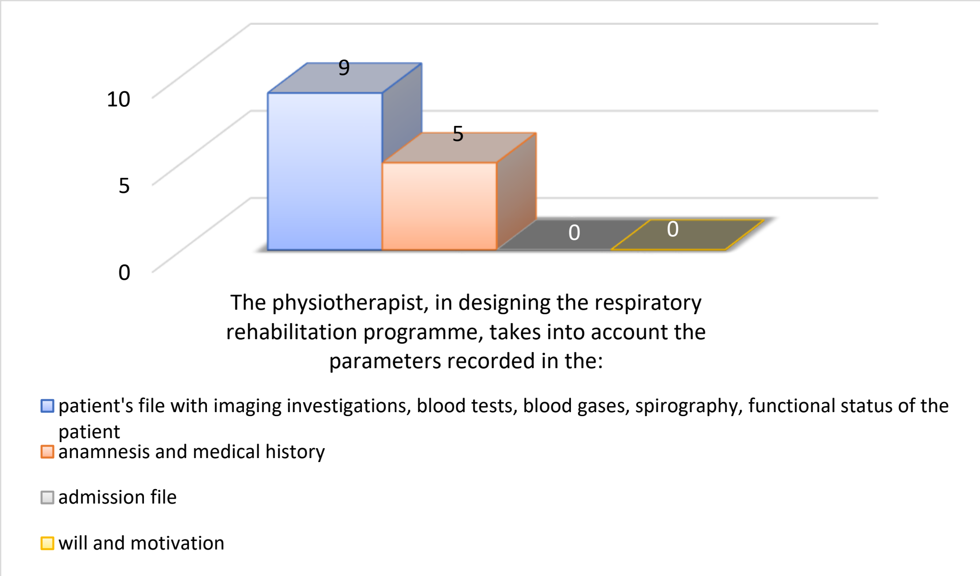

Figure 5. Graphical representation of the creation of the recovery programme based on the documentation

From the above graph, Figure 5, it can be noted that the answers are oriented on the pathological conditions records according to the patients' personalized records, which address the results obtained by imaging, laboratory samples, viscosity and colour of secretions (sputum), spirography, EKG, etc., as well as the medical history and admission records.

Knowing and interpreting data from blood/blood gas analysis results can help to avoid malpractice on different pathologies, and based on the imaging study, the physiotherapist can select a variation of recovery techniques and a set of physical exercises in order to draw up an optimal recovery program, considering the clinical diagnosis with indications and contraindications of the MDT team. Monitoring and assessment of the patient's functional status using specialist equipment, e.g., non-invasive measuring devices, mechanical ventilators, even injectors (where appropriate to know the medication used and the timing of therapy with it) on the intensive care unit helps to guide the physiotherapist during the implementation of the remedial exercise programme.

The answers are eloquent with reference to the data collected after consulting the above documents and parameters, 9 subjects agree with this statement and 5 agree with the second statement, as they are conclusive in the functional assessment of the patient.

The admission file and the patient's motivation are not significant enough for the composition of an adequate recovery programme. As a result, none of the interviewed subjects took into consideration these last two answers.

3. Statistical-mathematical method for data processing and interpretation

The questionnaire received a total of 168 responses from 14 interviewed subjects.

Different types of items are used in the questionnaire:

- With one answer
- Multiple choice

In phase I, the questionnaire was addressed to a sample of respiratory therapy health professionals, made out of medical specialists, specialist nurses, physiotherapists specialising in respiratory rehabilitation, occupational therapists aged between 27 and 60.

The sample of respondents was evaluated according to profession, seniority, experience and professional competence in parallel to those in the United Kingdom (UK) vis-à-vis Romania.

In Phase II, an analysis of the responses showed that there was some difference in terms of the way of working in a team, as well as the way of kinesiological recuperative intervention depending on the way of assessing the pathology and applying appropriate exercise respiratory recovery programmes.

Alpha Cronbach coefficient, identification of the indicator of analysis in the 12 questions, sum of variable items in the questions with final total score of variable responses are mentioned.

4. Results

For the analysis of some of the items in the questionnaire, a Likert-type scale was used with values ranging from 1-4, where value 1 = “totally agree", which represents the highest level of appreciation, and value 4 = "not significant" is rated with the lowest level of appreciation, the mean score values "partially agree", "indicated", falling within the range of appreciation represented by graphical interpretations.

The assessment of the answers revealed information and data that the respondents' interest in the training activity of the physiotherapist specialized in respiratory recovery is materialized by the exercise program applied as optimized as possible.

The values of the average score obtained and interpreted through graphs show a high interest in the therapy activity according to the answers in the graphs below.

One of the objectives of the **research** was to find out the professional opinion of the members of the multidisciplinary team regarding the orientation towards the use of an adapted questionnaire.

After the information was centralized, it was **concluded** that "an instrument is reliable and consistent when the items of which it is composed, correlate both with each other and with the additive result of all the items (Likert scale - psychometric, global score)".

In order to know the validity of the developed questionnaire, a pre-testing was carried out using the Alpha L.J. Cronbach's coefficient on a number of 14 subjects, the aim being to establish their reliability.

The IBM SPSS Statistics 25 statistical interpretation program was used to detect the value of this coefficient.

The IBM SPSS Statistics 25 statistical interpretation program was used to detect the value of this coefficient.

Tab. 1. The mathematical equation of Alpha L.J. Cronbach coefficient

$$\rho_T = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k}\sigma_i^2}{\sigma_X^2}\right)$$

Tab. 2. Interpretation of values of Alpha J.L. Cronbach's coefficient

Coefficient's value	Consistence
Superior to 0.9	Excellent
Between 0.7 and 0.9	Good

Coefficient's value	**Consistence**
Between 0.6 and 0.7	Acceptable
Between 0.5 and 0.6	week
Inferior to 0.5	It is not accepted

Tab. 3. Case processing summary

		Number	%
Cases	Validity	14	100.0
	Exclusion	0	.0
	Total	14	100.0

Tab. 4. The value of Alpha L.J. Cronbach's coefficient for the 7 statistically interpreted items

Reliability	
Cronbach's Alpha	N of Items
.909	7

Tab. 5. The values of the items introduced in the IBM SPSS software

	Item1	item2	item3	item4	item5	item6	item8	item9	item10	Item11	item12
1	1	1	1	1	1	1	1	7	5	1	10
2	1	1	1	1	1	1	1	7	9	1	6
3	2	1	1	2	1	1	2	6	10	3	3
4	2	1	1	2	2	1	2	9	6	3	4
5	2	1	2	2	1	1	7	6	7	1	10
6	3	2	2	2	1	1	7	6	7	1	10
7	3	3	3	3	4	1	8	5	6	4	4
8	3	2	3	3	4	1	8	6	9	4	5
9	1	1	1	1	1	1	3	10	10	1	10
10	1	1	1	1	1	1	3	10	10	1	10
11	1	1	1	2	1	1	4	7	7	3	6
12	1	1	1	2	1	1	4	10	7	3	6
13	1	1	2	2	2	2	5	9	10	1	10
14	2	2	4	4	4	3	6	6	4	4	1
15											

After the data were centralized and collected, the internal consistency of the questionnaire was obtained using the Alpha L.J. Cronbach's coefficient. Thus, the coefficient has a value of 0.909 (for the 7 items out of 12 that can be statistically interpreted), falls above the limits set as threshold according to Figure 14, having an excellent consistency.

5. Conclusion

The resulting coefficient attests to both the consistency of the items listed and the validity of the questionnaire as a whole. The 5 items that could not be statistically interpreted will be descriptively analysed.

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Monitoring the Effects of a Postural Re-education Program Through Biofeedback

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Abstract

Background. The use of the Global Postural System GPS 600 device to optimize the posture of athletes has been the subject of our research since 2019. **Aim.** Through this study we want to investigate the preservation over time, namely at 6 months, of the effects obtained through the postural re-education program with the help of biofeedback. **Subjects.** The study included 12 athletes between the ages of 15 and 28 that practice contact sports. **Methods.** The methods used were posturography, made using the GPS 600 system, the statistical method, the screening method. The analysed parameters were the head position, the centre of gravity position, the weight loading on both legs and the orientation of the transverse axis of the trunk. **Results.** The results of this study indicate that the measured variables maintained the values recorded immediately after the program for six months after the completion of the program. **Conclusion**. The improvements of posture obtained with a biofeedback re-education training with the GPS 600 device are maintained at least for six months after the programme.

Keywords: *biofeedback, athletes, posture, program.*

1. Introduction

Postural balance is considered a related parameter of gross motor performance. It is acquired in early childhood and perfected by adolescence, but it can also be influenced by various conditions. A simplified clinical

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assessment of balance and posture could be useful in monitoring motor development or therapy (Heidt 2021).

Postural control or balance can be defined statically as the ability to maintain a base of support with minimal movement and dynamically as the ability to perform a task while maintaining a stable posture. Factors influencing balance include sensory information obtained from the somatosensory, visual, and vestibular systems and motor responses that affect coordination, joint range of motion and strength. Superior balance is the result of training experiences that influence a person's ability to attend to relevant proprioceptive and visual cues (Bressel 2007).

Postural control involves an organized network of interacting systems. Muscle activity is controlled by the central nervous system to maintain balance by integrating inputs from the musculoskeletal, visual, and vestibular systems. Proprioception, which comes from muscles and skin receptors, provide information about the body's position in the environment, as well as the relative position of body segments. The visual system provides information about the external environment. Cerebellar control provides feedback-feedforward control of muscle activation. Finally, the vestibular system generates information, using specialized organs located in the inner ear, which allow tracking of angular acceleration based on the semicircular canals and linear acceleration based on the sac and utricle. Redundancy of related information from the musculoskeletal and vestibular and visual systems is essential to allow the central nervous system to generate correct responses when these systems receive conflicting stimuli (MariaRubega 2021).

A balanced posture allows sports movements to be carried out with optimal energy consumption and minimal strain on the musculoskeletal system. The existence of a dysfunction in the musculoskeletal system leads to compensations that require high energy consumption and, over time, can cause damage and wear. Overall, the movements performed by the athlete do not reflect the existence of these offsets and a thorough investigation with advanced technological means is required.

With the technology offered by the posturograph, deviations of the center of gravity can be identified as well as weight support points, load level, weight distribution in the soles, posture anteriorized, posteriorized or compressed, and body asymmetries. Possible compensations or decompensations can be identified in the biomechanical context. (Chelaru, Buldus & Monea 2021).

Postural rebalancing training is a highly effective means of improving balance performance with moderate to large effects on static and dynamic balance in healthy young adults, regardless of age, gender, training status, setting, and test method (Gebel, et al. 2018).

Postural control is essential when carrying out everyday activities or sport and its possible disturbances have a very significant impact on personal autonomy and sport performance (Juande la Torre 2017).

The interaction of the various senses of orientation that contribute to postural control is not well understood. Therefore, Maurer performed experiments in which measured the postural responses of normal subjects and patients with vestibular loss during perturbation of their position. The results suggested that in the sway condition, normal subjects altered their postural strategy by heavily weighting the feedback from the plantar somatosensory force sensors. (Maurer 2003).

The goal of balance is to maintain control of the center of gravity, visual feedback helps improve overall balance control (Lakhani 2015).

Hamaoui (2014) found that increased muscle tension along the trunk induces a more disturbing effect on posture when it is asymmetrical. Maintaining balance requires the integration of vestibular, proprioceptive, and visual information and the translation of this input into appropriate motor responses. Postural stability depends not only on subjects being tested with their eyes open or closed, but also on the presence or absence of visual feedback. Since postural stability is regulated by multiple senses, such as the vestibular system and proprioception, auditory stimuli may play an increasing role if one of the systems involved is impaired (Palm et al. 2009)

Visual biofeedback has the potential to enhance balance training in both seated and bipedal positions. Body sway depends on the type of feedback. The results of different types of feedback conditions help us understand how the brain interprets visual biofeedback. Frequency domain analyzes demonstrated that direct and inverted visual feedback reduced swing amplitude at lower frequencies (Goodworth 2020).

The control of postural influence is based on the evaluation and integration of external sensory stimuli by the central nervous system. Visual biofeedback has become a popular method of improving balance due to supplementing natural visual information with visual cues of the center of pressure. It is also possible to further improve balance by increasing visual biofeedback signals (Chamberlin et al 2021)

2. Aim

The purpose of the study is to monitor the preservation of postural balance acquired through biofeedback treatment using the GPS 600 device accompanied by a physical therapy program.

3. Study design

The study involved 12 subjects, athletes between the ages of 15 and 28. The subjects have an average age of 21 years, are contact sports practitioners, and participate in training at least 3/week. Former research we developed in 2019 studied the influence of a physical therapy program and postural biofeedback training on athletes' postural control. This second phase of the research is a follow up study to monitor the persistence of the postural control improvements after six months.

4. Materials and Methods

The Posturograph or Global Postural System (GPS) is an advanced postural analysis system that uses noninvasively diagnostic and evaluation techniques and methods in the field of medical recovery.

The posturograph includes 2 diagnostic units and a software:

- Podoscope - is used in the analysis of static foot disorders and the position of the centre of gravity; with his help are processed the captured images, determining the exact length of each leg, the existence of static plantar disorders (flat foot, hollow, etc.), as well as possible deviations at the ankle level.

- The unit of postural analysis - is used to determine the deficiencies in the spine, through a system of video cameras that allow the acquisition of high-resolution images, images that are then processed through the software, to analyse all segmental or global deviations of the body.

Postural analysis is performed from the front, back and profile and can diagnose the deficiencies of the spine in the sagittal or frontal plane (scoliosis, kyphosis, hyperlordosis).

The software allows the storage of the patient's medical data, both of those resulting from the posturographic tests, as well as those related to the medical history or the medical treatments that the patient follows. It is useful for monitoring the evolution of patients and the effectiveness of the recommended therapies.

Based on the data obtained from a complete posturography, customized kinetotherapy and medical recovery programs are developed.

We used the following methods:

- the method of bibliographic study - the study of the specialized literature to update the theoretical basis
- observation method - intentional tracking, accurate and systematic recording of manifestations and situational context for each subject
- measurement method - the evaluation of the subjects using the posturograph provides somatometric and functional data
- experimental method - application of the program proposed by the working methodology
- statistical method - data processing and interpretation using SPSS program, descriptive statistical analysis.

The intervention protocols are:

- Postural re-education through visual biofeedback with the GPS 600 device

The subject is positioned on the podoscope in the center of the crystal with bare soles, the screen of the device is positioned in front of the subject so that it has approximately at eye level the parameters that must be followed.

The device shows in real time the movements of the center of gravity in 3 main points (2 points in the middle of the soles and a central point, located in the middle of the two points in the sole). This center point is the point to show us the direction and trajectory of the center of gravity movement.

The first scan is performed, the subject must be still, eyes open, looking straight ahead. The device shows us the movements/oscillations of the center of gravity in real time and the ideal position of the center of gravity. The 3 key points that indicate the ideal position of the center of gravity are marked on the monitor with 3 white dots (the dots are made of white paper, and they are glued to the screen).

The center of gravity ideal position and the postural corrections he must perform are explained to the subject. Postural corrections are performed by very fine movements of the whole body without moving the feet on the podoscope. The purpose of the movements is to position the center of gravity line in the marked position as the ideal one, once the subject has managed to position the center of gravity in the ideal position, they must maintain that position until the 20 seconds are up.

These postural corrections are performed 10 times per session, each session lasts 20 seconds. The sessions were conducted over 2 weeks for 10 days.

- Physical therapy program

After the specific warm-up, a set of 3 fundamental exercises was chosen to be performed in an individual circuit for 30 seconds each, 2 times.

Climbing the balance cushion by stepping and isometrics:

From orthostatism at floor level, the athlete will step on the balance cushion with the non-dominant leg, followed by a slight flexion from hip, knee and dorsiflexion (triple flexion); position to be maintained for 5 seconds. Repeat with the dominant leg. The descent is done backwards, in the reverse order of climbing the balance cushion (the first leg to descend is the dominant one, followed by the non-dominant one). The athlete will perform as many correct repetitions as possible in the given time interval of 30 seconds.

Support on one leg on the balance cushion:

From orthostatism on the balance cushion, perform flexion from the hip and knee of one leg, so that the support is realized by the contralateral limb. The flexed limb can be abducted to help maintain balance throughout execution.

If the athlete falls from the pillow, he should reposition himself and continue to maintain the position for the rest of the time.

Keeping balance on the wobble board:

From orthostatism on the wobble board, maintaining balance for 30 seconds.

5. Results

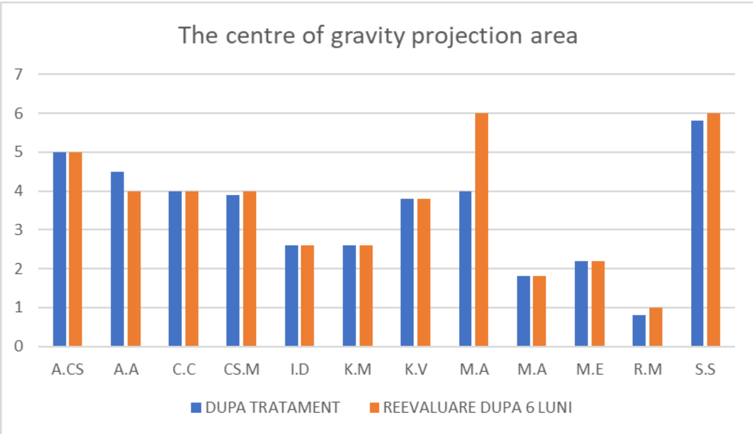

Figure 1. The centre of gravity area projection

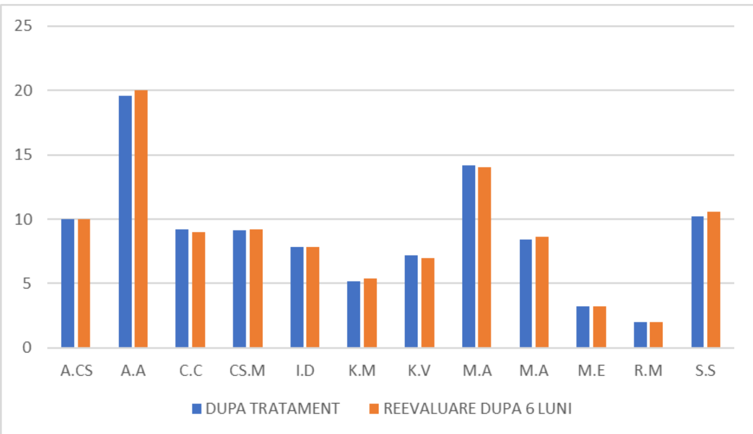

Figure 2. The head anterior posture comparison

The comparative analysis of the results of center of gravity area projection after the intervention and six months after are shown in Figure 1

The head anterior posture comparative analysis is shown in figure no.2

As shown in figure 1, out of 12 subjects, 7 preserved the posture obtained 6 months ago after the postural re-education program, 3 subjects had a minimal, insignificant change and for 1 subject the changes were 0.5 cm. Only one of the subjects presented a greater change of 2 cm.

In figure 2 is shown that out of 12 subjects, 4 mentioned their posture obtained 6 months ago after the postural re-education program, 6 subjects had a minimal, insignificant change and for 2 subjects the changes were 0.4 cm.

The gravity loading on the left foot comparative analysis is shown in figure no.3.

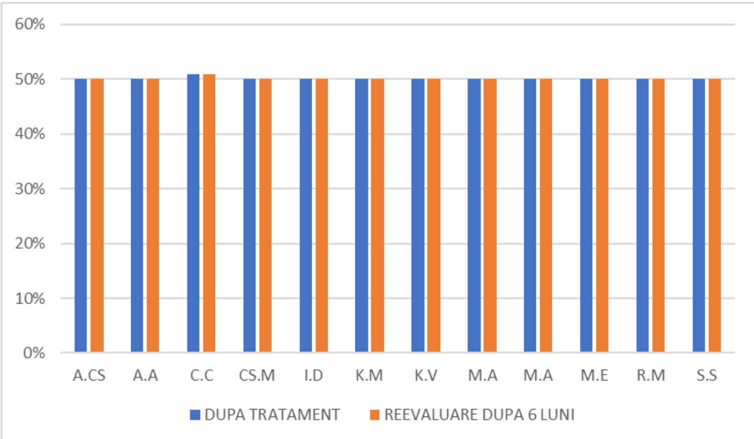

Figure 3. The gravity loading on the left foot

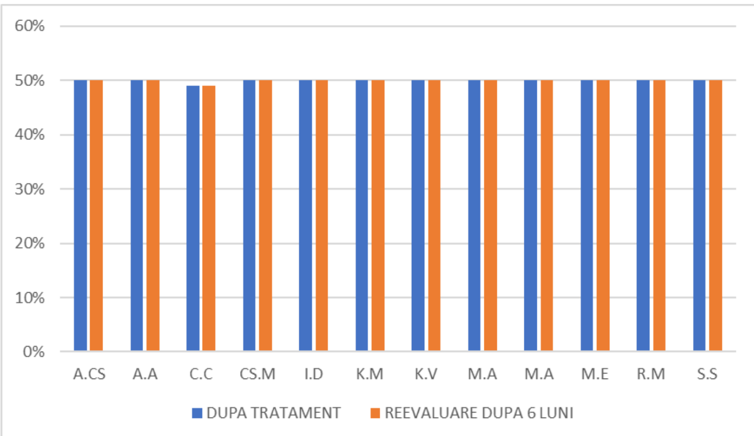

Figure 4. The gravity loading on the right foot

The gravity loading on the right foot comparative analysis is shown in figure no.4.

For all subjects, the weight distribution on the two hemi parts of the body was maintained at the values obtained after the postural re-education program.

The results show that the new posture acquired following the complex treatment of postural re-education through visual biofeedback and a physical therapy program was preserved. We note that at the re-evaluation carried out 6 months after the end of the postural re-education intervention program the results were maintained. It should be noted, however, that all subjects in the study are performance athletes who continued their training at a normal pace.

6. Conclusions

The postural reeducation protocol we used, proved to be a treatment that maintains its effects even 6 months after the intervention. The improved posture was memorized in the muscle fibers and movement memory.

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The Development of Psychomotrical Skills in Judo Practitioners

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Abstract
The continuous development and improvement of psychomotor capabilities, as well as their correlation with the goals of each sports field, is explained by the increasingly widespread use of the new conquests of science, especially those in the field of physiology, biochemistry, biomechanics, hygiene, psychology and pedagogy, these in their turn being stimulated by the universality of the sports phenomenon, by the increase in the competitiveness of athletes.
The study follows the evolution of some psychomotor capacities in a group of judo practitioners between the ages of 16-18. The research is based on an invoked experiment monitored over the course of a year, during which the subjects had as their main objective the accumulation of as much technical baggage as possible. The comparison of the initial and final results, in the tests carried out, confirms the opinion of the specialists according to which the accumulation of various judo techniques, through repetition in different forms, has as its purpose the development of psychomotor capacities. In other words, the practice of judo determines both a harmonious physical development, a development of motor qualities and a superior control of the body and segments in intrinsically relationship but also with the forces and segments of the partner/opponent.

Keywords: coordination, rhythm, balance, judo.

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1. Argument

Most autors (Deliu, 2014; Stefănuț, 1983) claim that training in judo involves the need of control, coordination and restraint, and that they all stand for a method to develop psychomotor skills. The ability to execute deliberate and powerful movements in the decisive moments of a fight is one of the chief factors determining motor efficiency within a fight. Hence, such ability should be improved on ongoing basis, using the broad experience of martial arts, as well as the contemporary knowledge of biomechanics. Unlike the classic endurance training routine, a specific coordination training, directed towards the generation of extra initiation strengths in the execution of specific movements in judo, and, in a quick manner, the precise transfer of these forces, as well, may boost, up to several times, the strength of movements. (Bompa, 2001; Deliu, 2014). These extra initial forces can be knowingly generated in various segments of the musculoskeletal system as a result of a rapid eccentric sequence and concentric muscle work, trunk and hip rotation movements, adequate body, weight centre and work translocation to the feet. (Roșu & allea 2006).

The continuous development and improvement of psychomotor skills, as well as their correlation with the goals of each physical field, is explained by the increasingly wider use of the new findings of science, especially those in the field of physiology, biochemistry, biomechanics, hygiene, psychology and pedagogy, whereas, these, in their turn, being stimulated by the universality of the sports phenomenon, by the increase of the athletes' competitiveness (Mitrache & Tüdöș, 2004).

The multiple rehearsal of a technique from any martial art, does permit the acquisition of the skill and improvement of technical-tactical actions, but, at the same time, it also develops the muscle chains involved in the execution of the movement (Sava & allea, 2014; Stefănuț, 1983). Therefore, a motor quality specific to a martial art develops depending on the manner of execution of a technical procedure, as number of retakes, the intensity of stress, the duration of breaks, etc. (Roșu & allea 2006). We believe that, under such circumstances, we cannot isolate a motor quality, but, on the contrary, the other motor qualities are equally influenced to a greater or lesser extent.

According to Alexe (1993), the coordination (skill)"stands for the ability to abruptly and thoroughly select and perform motor actions specific to a series of unforeseen situations, with increased efficiency".

Galan (2014) defines coordination as: "a psychomotor coordinative quality that develops, to a great extent, with the practice of techniques from combat styles and which it, in turn, it does condition. The acquisition of new techniques, as quickly and correctly as possible, rapidly and efficiently adopting them to the ever-changing and unpredictable conditions during combat, all such things belong to coordination".

In specialty literature, no consensus was reached, neither with regard to its definition nor to its components. The components of exhortation according to Șerbănoiu & Tudor (2007) are:

- the motor learning ability;
- the fast reaction ability;
- the ability to guide and control;
- the rhythm and tempo ability;
- the ability to combine and discriminate movements;
- the spatial and temporal orientation ability;
- the ability to adapt and transform movements;
- the ambilaterality;
- the static or dynamic balance;
- the precision, specific to combat styles.

Coordination is general and specific and combined with all motor qualities. According to Cârstea (2000), determining factors are: the level of coordination of the centres of the nervous system and elasticity of the cerebral cortex, the quality of the transmission of nerve impulses and muscle innervation, the ability of analyzers to capture information and perform the synthesis related to the analysis of the situation, the ability to anticipate the performer, the performer's memory and thinking (especially the creative one), the workload and complexity of the motor skills that the individual masters, the level of development of the other motor qualities. Mobility is an athlete's ability to perform large-amplitude movements with all body segments, via the joints, either actively or passively (Westbrook & Ratti, 2010). Dragnea (1991) claims that "mobility and flexibility are included in the category of intermediate motor skills, placing them amongst the conditional ones (force, speed, endurance – determined by energetic processes) and the coordinating ones (influenced by movement control processes)". The lack of mobility and flexibility results in higher energy consumption with negative impact on remaining qualities, especially in martial arts where a budoka ought to be flexible and mobile.

2. Method and Methodology

In order to test the influence of judo practice on the development of coordination, we conducted an ascertaining experiment throughout the entire length of a school year. The subjects fall within a group of judoka athletes aged from 16 to 18 year-old, having practiced judo for at least four years. Acquisition and consolidation of fighting techniques from standing position and ground fighting were the single variables used. We selected various psychomotricity tests, in order to identify the dynamics of coordination.

Psychomotor tests used:

- Measurement of dynamic balance and orientation -BASS Test (Epuran, 2001);
- Static balance measurement test - "The plank" (Epuran, 2001);
- Coordination and speed measurement test - Commute (Epuran, 2005);
- Test for the checking of the ability to judge timeframes: at 3s and and at 5s (Epuran, 2005).

3. Results and discussions

The data analysis highlights the fact that the experimental group subjects achieved superior results in three of the five tests, whereas, and in the other two such tests, they are significant from one stage to another.

Recorded progresses are equally confirmed from a statistical viewpoint. The results of the "Commute" test record a significant difference amongst the initial testing and the final testing (Figure 1). Having in view that this sample stands for the coordination skill in speed mode, the difference recorded is based on the increase in the coordination skills of movements. Accordingly, we record a significant increase $p<0.01$ in the experimental group. As we have previously stated, we do believe that this difference is based on an increase in coordination, but also on the development of a capacity to perform a speed effort over a longer period, that is in endurance mode.

Table 1. Dynamics of Psychomotor Ability Indices

Assessment Means / Indices	Initial Test	Final Test	t	p
"Commute" Test (s)	26,80±0,74	24,20±0,72	3,17	< 0,01
"Bass" Test (points)	91,10±2,58	101,63±2,50	3,67	< 0,01
"Plank" Test (s)	22,90±0,66	26,41±0,60	5,19	<0,01
Judgement of Timeframes (3")	3,85±0,12	3,44±0,10	3,42	< 0,01
Judgement of Timeframes (5")	5,84±0,17	5,26±0,14	3,22	< 0,01

The coordination of movements is also based on the growing process affecting the subjects of the study. In this respect, the diversity of plans and directions in which specific movements are performed in judo stands for a direct and immediate contribution to the development of the coordination skills. As per the description of technical procedures in judo, we can easily become aware that the movements of segments are performed simultaneously in various components and directions, both from one arm to another, as well as from arms to feet.

In the *"Bass test"* the previous situation is repeated, with a significant increase from the initial to the final testing ($p< 0.01$) (Figure 1). Having in view that the test herein judges, as previously analyzed, coordination, but also distributive attention based on speed, according to the author of this test [60, p. 265], subjects fall within the "very good" category. Such difference in ranking is caused by the distributive attention required by the opponent's trunk and segments positions, at various moments of the execution of technical procedures in judo.

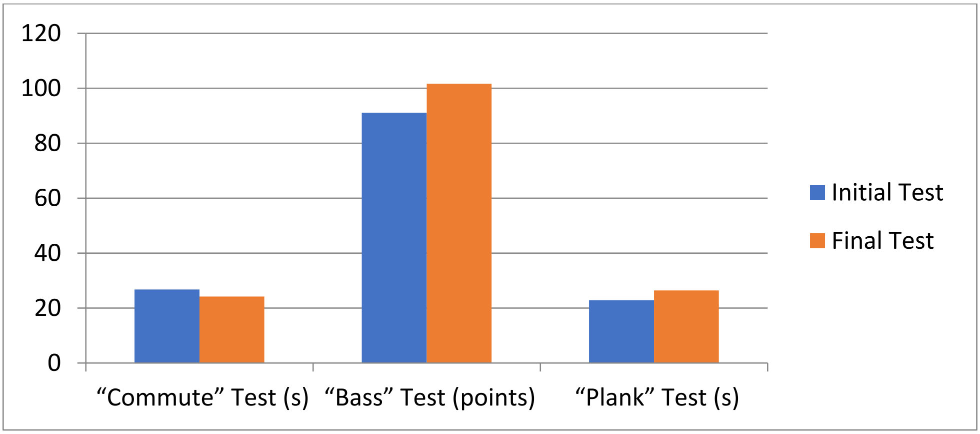

Figure 1. The results obtained in the initial testing and the final testing

In judo procedures, distributive attention is required to the maximum, regardless of the form of execution or stage of motor skills acquisition. Distributive attention does make the difference amongst the two opponents in head-to-head combat, since it requires both overall body observation, as well as details about the position of body segments. These arguments are added to those previously described, on the subjects' growth and development stage.

Static balance evaluated by the *“Plank”* test reinforces the results of the other tests, since the record of higher indices in this test requires coordination, attention and concentration ability (Figure 1). Accordingly, subjects made significant progress $p < 0.01$. The difference recorded is solely due to the evolution from the subjects' initial to final testing. All previously described qualities (coordination, attention and ability to focus) are mentioned, in specialty literature, as falling under the scope of martial arts. Among the martial arts, included in the category of means of action, those that contribute substantially to the development of the mentioned qualities are the skills of judo and aikido. Attention is a peculiarity that develops with the increase of the ability to focus and determines an inclusive development of the speed to react. One of the forms of execution of technical procedures in judo is the demonstrative form (kata) when the performer must imagine his opponent in various postures (attack or defense) and focus on the most rigorous execution. Moreover, another reason to record the identified difference also includes the presence of technical procedures that are performed from the position of standing on one leg.

If in the other tests psychomotor qualities are requested in the test "to appreciate the timeframes of 3s and 5s (Figure 2), the sense of rhythm is particularly requested. As we can notice in Table 1, the difference from initial to final testing, in both tests, is identical for both timeframes (3s and 5s). Hence, both intervals record a significant difference ($p<0.01$). We believe subjects record a progress, as a result of the sequencing of movements in judo and their fragmented execution. The execution of movements in a certain rhythm with each alternate segment can determine the formation of a sense of the rhythm of execution, and, implicitly, of time. We mention that within the planning of the consolidation of technical procedures in judo, there are moments of execution, upon signal, to develop the reaction speed. Therefore, in order to standardize execution, to assure the same number for all subjects, we repeatedly performed the technical procedures, upon order, by counting. Moreover, when one aimed at the development of the execution speed, we set, in most cases, an interval of 10 seconds. This form of execution determined over time the formation of a rhythm, a controlled sequence of movements.

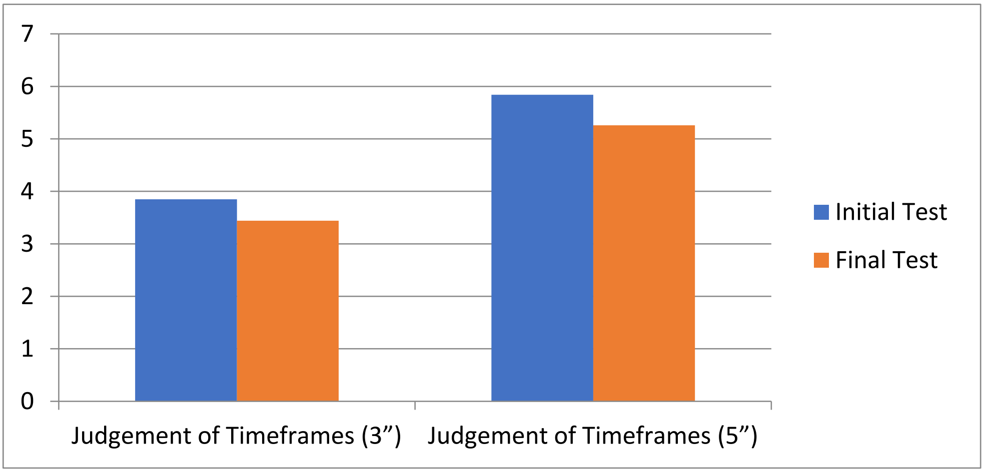

Figure 2. Judgement of Timeframes (3"and 5")

The almost identical results recorded at the two timeframes are due to the relatively short duration of the deployment; nevertheless, a slightly significant difference is recorded in the 3s as compared to the 5s test, which could determine us consider that the subjects have already acquired experience from one test to another. In this respect, we must point out that the tests for both timeframes took place the same day.

4. Conclusion

Psychomotricity tests highlight the influence of the acquisition of judo-specific skills in the formation and development of balance skills, in the Bass and Orientation and coordination test the difference is very significant $P< 0.005$, whereas in the other tests the significance threshold is $P< 0.01$. This was to be expected given the various directions of the segments during the execution of technical procedures, the need to coordinate the segments in relation to one's own trunk, but also in relation to the partner's or opponent's segments. The variables herein are valid both in the case of acquiring technical procedures for demonstrative judo competitions, as well as for combat ones. To conclude with, practicing judo is a safe form of developing coordination and segment control, but equally to develop a sense of rhythm.

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Comparative Study
on the Anthropometric Model of the Bobsledder

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Abstract
Since the 19th century we can talk about "winter sports" in the usual sense of the word. Spending winter holidays in the mountains became intertwined with sports fashion, ascents and skiing becoming an integral part of them, just like evenings or balls.
"Bobsleigh" is a winter sport in which the crew of two or four people compete with a piece of equipment called "sleigh", on ice tracks. This sport was invented in the late 19th century (1870)when a steering mechanism was attached to a sled.
Nowadays, in modern training, the idea that only the technical-tactical component (piloting) is important for the pilot and only physical training for the pusher can no longer be accepted. Without multilateral training, no one is able to achieve high performance today.
From a motor and technical point of view, bobsled belongs to the group of skill sports in high speed conditions. However, it is a sport that puts intense strain on the nervous system, with the psychological factor playing an essential role for the entire crew. From here one can draw the idea that bobsledders must be fast, explosive, dexterous and, last but not least, resistant.
Without continuous activity, carried out from an early age over several years, it is not possible to reach the level of training required by the demands of competitions and sports performances.
The athletic condition of the athletes is the basic requirement, the pilots being selected from sports such as athletics, biathlon or other sports in which the athletic condition is decisive. You can also select and form pilots from among the elite pushers.
At the moment of triggering the start and pushing the bob, the athlete's effort is transmitted along an curve that includes almost all muscle groups, which leads us to think of a dynamic of the qualitative growth of the muscles involved in the effort: biceps, triceps, deltoid, the dorsal muscles of the chest, abdominal muscles, gluteus

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maximus, muscles of both legs. The forearm flexors have a secondary role, but the extensors and the scapulo-humeral muscle groups have a decisive role in two key moments of the start: pulling the bobsled and accelerating before getting in the bobsled.

Keywords: *anthropometry, comparative study, bobsledder, model.*

1. Introduction

From a physiological point of view, sports performance is influenced by a number of factors: the energy produced in the body through the aerobic-anaerobic process, the state of health and the neuro-muscular functional state, physiological factors (sports form, training status), genetic factors, and so on.

Using the classification of efforts according to the most demanded apparatus or system of the body, the scientists found that the bobsled competition is part of the efforts of the neuromuscular type. (Scott, S.H., 2008, pp. 1217-1224)

What does performance in bobsled depend on?

- the production of energy (the result of improving the capacity for aerobic exercise)
- neuromuscular function
- psychological factors (motivation, psyche, will)
- adaptation of the body to effort and recovery capacity

The predominant effort in the bobsled event is of an anaerobic-lactacidic nature (the start under 6s, maximum intensity, during the descent, sequences of anaerobic effort, maximal and submaximal intensity). Well-prepared bobsledders, from the start to the climb into the bob, run with their chest blocked on inspiration (apnea). (Millet, G. 2006, page 103)

The promptness with which the nervous and neuro-muscular system will respond when the start is triggered, the frequency of the running steps and the force of the push made by the muscular system, are the determining physiological factors in achieving great performance.

The problem of the processes of restoring the functional capacity of the organs and restoring the energy substances of the cells are in the attention of the specialists in the field of sports medicine and last but not least condition the achievement of high-level sports results.

The increase in effort capacity, depending on the effort, is directly proportional to the increase in the effort that produced it. The more a training session demands the body, the more its capacity for effort increases after the fatigue disappears.

Nowadays, two on-ice trainings supplemented with a third of specific physical training has become a normal practice. During the period when there is no snow, three training sessions are held daily. Optimal results are obtained when the organs and systems that have been stressed have time to recover and enter the overcompensation phase.

The workouts are accompanied by post-action phases that last several hours, depending on the individual. A great emphasis is placed on restoring the body between heats, competition days and after the competition.

2. Assumption

An optimal physical training program can contribute to an optimal development of anthropometric indices in women's bobsled trials.

3. Logistics

The study was carried out on the athletes of the National Youth Bobsled Team, medalists at the Youth Olympic Games in St. Moritz in 2020. The venue was at the National Institute of Sports Medicine in Bucharest, in March 2021 at the beginning of the training period and in October 2021 at the beginning of the competition stage.

3.1. Tests performed:

- anthropometric measurements: waist (with the wall-mounted thaliometer) and weight (with the electronic scale)
- testing the strength of the palmar flexors for both the left and the right hand. The test was carried out using the digital dynamometer.

– testing the strength of the scapular belt. The test was performed with the dynamometer
– lumbar strength testing. The test was performed with the dynamometer.

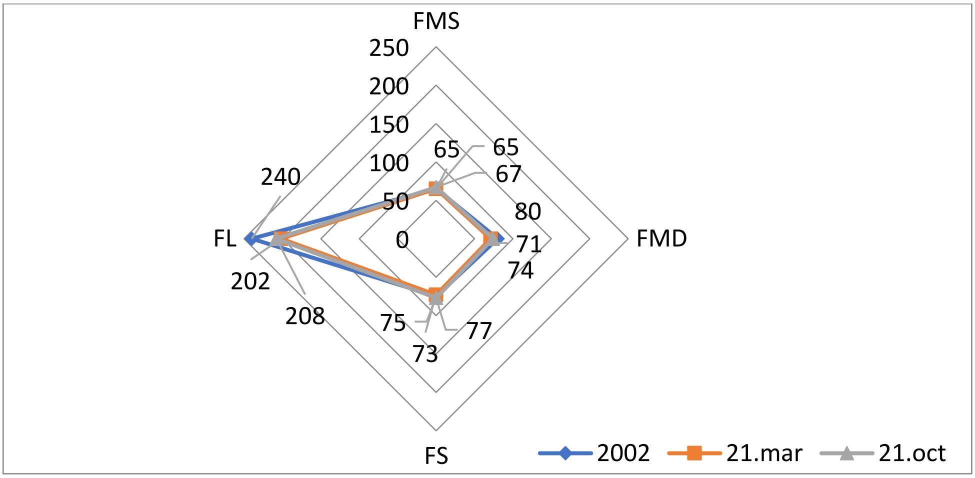
4. Results

Table 1. Anthropometric data (height, weight and body mass index)

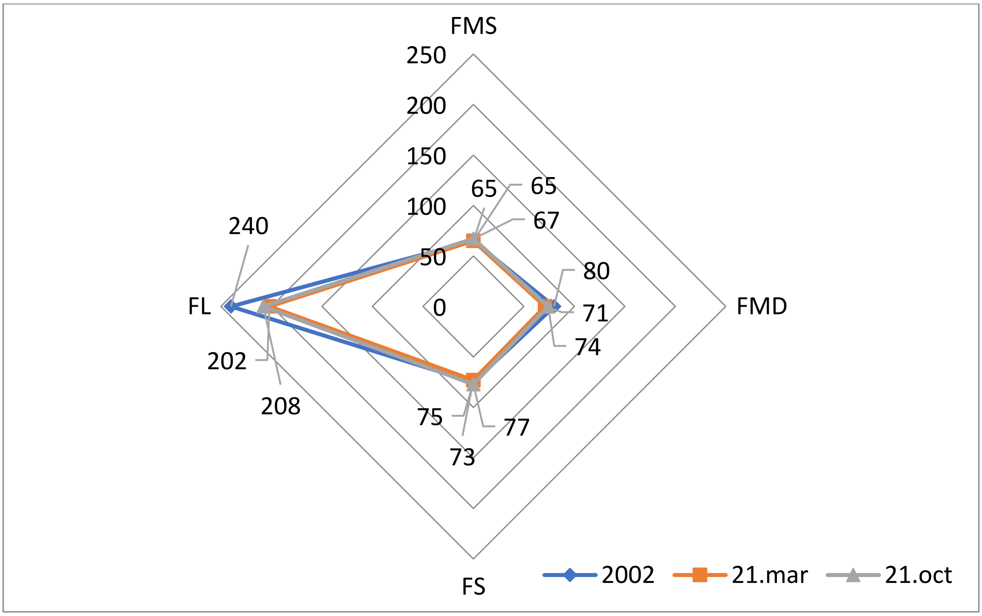
	MODEL FEMALE BOBSLEDDERS AT FIRST COMPETITION (2002)		ANTHROPOMETRIC DATA AT THE BEGINNING OF THE TRAINING PERIOD (MARCH 2021)		ANTHROPOMETRIC DATA AT THE BEGINNING OF THE COMPETITION PERIOD (OCTOBER 2021)	
	Pilot	Pusher	Pilot	Pusher	Pilot	Pusher
HEIGHT (CM)	167	168	167	168	167	168
WEIGHT (KG)	76	79	78	79	76	78,5
BMI(KG/M²)	27.25	27.99	27.97	27.99	27.25	27,64

Table 2. Anthropometric data related to the strength of the flexor muscles in both hands, scapular strength and lumbar strength

	MODEL FEMALE BOBSLEDDERS AT FIRST COMPETITION (2002)		ANTHROPOMETRIC DATA AT THE BEGINNING OF THE TRAINING PERIOD (MARCH 2021)		ANTHROPOMETRIC DATA AT THE BEGINNING OF THE COMPETITION PERIOD (OCTOBER 2021)	
	Pilot	Pusher	Pilot	Pusher	Pilot	Pusher
THE STRENGTH OF THE RIGHT HAND FLEXOR MUSCLES	60	65	61	65	63	67
THE STRENGTH OF THE LEFT HAND FLEXOR MUSCLES	70	71	72	71	74	74
SCAPULAR STRENGTH	70	73	72	73	75	77
LUMBAR STRENGTH	170	190	200	202	205	208



Graph 1. Anthropometric strength data for the pilot



Graph 2. Anthropometric strength data for the pusher

Legend:
– FMS- left hand flexor muscle strength
– FMD- right hand flexor muscle strength
– FS- scapular force
– FL- lumbar strength

In table no. 1 we can see that from the point of view of the body mass index, the pilots at the beginning of the competition period are at the level of the model of the specialized literature, that is, at the level at which the female bobsledders were at the beginning of the competitions intended for women.

Also in table no. 1, we notice that among the pushers, at the beginning of the competition period, the body mass index is 0.35% lower than the model offered by the specialized literature.

In table no. 2 we can see that both in the measurements made at the beginning of the training period and those at the beginning of the competition period, the results are better, the force is higher, and last but not least, the force is higher at the beginning of the competition period compared to the period of training, which means that the applied physical training programs were correct and had the desired effect.

5. Conclusions

This work can be a path breaker in Romania, or at least among the first, as the specialized literature lacks research in this field. Bobsleigh athletes have strong shapes and structures, demonstrated by the measurements taken, and can fall into the endomorph or overweight category.

The analysis of the forces indicates that the bobsledders must be strong in order to push the bobsled at the start close to the maximum.

Strength is greater at the beginning of the competition period compared to the training period, which means that the applied physical training programs were correct and had the desired effect.

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Functional Recovery of the Patient after Surgically Reduced Humerus Fractures

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Abstract

The restrictions imposed on patients diagnosed with a humerus fracture are multiple, so that social, family and professional life is directly affected.
Considering the increased incidence of this type of fracture in terms of traumas located in the upper limb and the variety of surgical treatment options that are required in this case, we considered it necessary to conduct an in-depth study both from a theoretical point of view as well as from a practical point of view regarding the recovery program for patients diagnosed with humerus fracture. Unlike other types of fractures treated orthopedically, humerus fractures need a surgical approach and implicitly the fastest possible implementation of the recovery program in order to positively influence the patient's evolution in terms of regaining joint mobility and muscle strength deficit for to return to pre-injury activities and to self-care.
The research was carried out in a medical recovery clinic, over a period of 6 months. Three subjects diagnosed with surgically treated proximal humerus fracture who followed a functional recovery program were followed.
The results obtained from the conducted research indicate that through early kinetotherapeutic intervention and the use of proprioceptive facilitation techniques, we can obtain an optimal recovery of the functional remainder in the case of humerus post-fracture patients.
According to the results presented in the article, the patients registered an increase in the mobility of the affected upper limb, in all planes of motion, compared to that of the

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initial evaluation. At the final evaluation, a significant increase in strength was observed in all movements of the upper limb.
Using the kinetotherapeutic approach and following the treatment plan, the patients confirmed a decrease in the pain level initially present following the surgery on the humerus fracture, one of them reporting the complete absence of pain, and two of them obtaining a considerably lower pain level.
According to the results obtained and shown in the graphics of the research, we could observe a different recovery of mobility and strength in the patient of the third age compared to the young patients, which demonstrates the fact that the age of the patient is a particularly important factor both in the composition of the treatment plan and and in verifying the results obtained.
The importance of the rehabilitation program was demonstrated by the patients' ability to resume their usual activities in the shortest possible time and their socio-professional reinsertion.

Keywords: *humerus, fracture, rehabilitation, function, mobility.*

1. Introduction

The severity as well as the morphology of the humeral fractures, the concomitant injuries and the general conditions of the patient (age, bone and soft tissue quality, activity level) must be considered for both the surgical approach and the technical procedure.

While nondisplaced or slightly displaced two- or three-part fractures can be approached via a percutaneous or minimally invasive approach depending on the surgeon's preference, four-part or displaced fractures should be managed using the delto-pectoral approach. Especially for complex fracture types, the availability of fracture arthroplasty (anatomic or reverse proximal humeral replacement) should be checked to extend the surgical procedure if necessary. Also, the operative team, operative time (especially in patients with multiple injuries) and the experience of the surgeon should be considered before surgery. Based on the patient's constitution, additional fractures of the shoulder joint (glenoid or clavicle) should be managed surgically in the same operative procedure. (Biberthaler, P., &, Kirchhoff, P., 2015, p. 101)

1.1. Surgical approach to proximal humerus fractures

Functional outcome after surgical treatment of proximal humeral fractures has been evaluated in many studies over the past decade. However, the discussion of the surgical approach with special respect to the delto-pectoral and deltoid approach is still controversial. (Fankhauser, F., et al., 2005; Gardner, MJ., et al., 2005; Laflamme, GY., et al., 2008; Martetschläger, F., et al., 2012; Solberg, BD., et al., 2009; Suedkamp, N., et al., 2009)

Hepp et al. were the only ones to report approach-related outcomes following proximal humeral interventions. In 39 patients with an anterolateral deltoid splitting approach, the authors observed less pain and higher levels of activity of daily living in the immediate postoperative period. On the other hand, the 44 patients treated with a deltopectoral approach achieved consistently higher scores after 12 months of follow-up. Based on their findings, Hepp et al. concluded that the choice of surgical approach can influence the functional outcome of the shoulder. (Hepp, P., et. al., 2008; Biberthaler, P., &, Kirchhoff, P., 2015, p. 102)

1.2. Treatment of proximal humerus fractures

"Kinetotherapy in orthopedic-traumatic diseases of the locomotor system is a complex process conducted depending on the type of disease, the individual morpho-functional characteristics, the degree of tissue damage.

A number of parameters are taken into account in the creation of recovery programs general and local.

The most important general parameters are: The type and specificity of the deficiency, the duration of the illness and recovery, the age of the deficient, the general physical capacity, the profession or the type of daily activity.

The local parameters that must be taken into account are the following:

a) Purpose(s) of recovery

In general, the programs are made for two large groups of deficiencies.

- the first group that includes those deficient who do not remain with definitive injuries and whose goal is to progressively improve function, until returning to normal.

- the second group includes those deficient who remain with permanent organic or functional injuries and whose goal is to favor the creation of compensatory mechanisms to replace, with maximum efficiency, the lost organs or functions.

b) Morpho-functional characteristics of the interested segment

c) Possibilities of perception

d) Type of surgical intervention performed

The duration of a physiotherapy session is 40-45 minutes, of which: 10 minutes warm-up, 20-25 minutes the fundamental part and 10 minutes conclusion.

The programs have an individual character and include exercises adapted to each individual case, according to the antecedents of the deficient, his general and local condition, the likely evolution and the pursued social goal.

The programs must be interspersed with numerous breathing exercises, which train the ample participation of the entire upper body, exhalations being done with force and noise.

The elements of breathing exercises represent breaks that ensure a maximum effect, because, being symmetrical exercises, they become forms of "active rest" (Secenov).

Given the complexity of individual programs and the time required to work with each case, a physiotherapist cannot work with more than 10-12 patients in his daily work schedule. The presence of a larger number of patients causes a decrease both in the quality of the recovery documents and in the time allocated to each case.

The results of the recovery programs are tested weekly, through methods of exploration and evaluation specific to physical therapy or complementary. The most accessible to a physiotherapist are the articular balance and muscle balance methods. Depending on the nature of the injury, the functional diagnosis and the pursued socio-professional reinsertion, it is often necessary to use other methods, as well as global testing of the affected segment within gestures characteristic of the patient's profession or occupations." (Neculăeș, M., Course notes, Physiotherapy in orthopedic-traumatic conditions, p. 28-31)

2. Methods used in the study

In this study, 3 patients, 2 men and 1 woman, aged between 24 and 63 years, were included. All patients underwent clinical diagnosis by performing soft tissue ultrasound, magnetic resonance and X-ray, and functional diagnosis was obtained by carrying out specific tests to identify the presence, location and severity of the fracture. The tests used for functional diagnosis were the joint balance of the shoulder joint, the muscle balance and the VAS scale. (Table no. 1)

Table 1. Centralization of patients included in the study.

Nr. crt.	Patient initials	Age	Profesion	Diagnosis	Date of entry into treatment	Date of exit from treatment
1.	L.A.	26 years	student	3-part fracture of the proximal humerus of the right shoulder, surgically treated under anesthesia with a titanium anchor and osteosuture	09.11.2020	28.04.2021
2	S.T.	24 years	programmer	Complex fracture upper extremity right humerus, treated surgically under anesthesia with osteosynthesis (SMITH&NEPHEW locked plate)	03.12.2020	07.05.2021
3	M.A.	63 years	pensioner	Complex fracture of the right proximal humerus, operated, with osteosynthesis, complete rupture of the supraspinatus tendon	04.01.2021	10.06.2021

Symptomatology was graded using the visual analogue scale (VAS) and according to a 10-point clinical rating scale. (Table no. 2)

Table 2. Visual analogue pain scale (VAS).

Nr. crt.	Patient initials	Initial pain level	Final painful level
1	L.A.	5	1
2	S.T.	6	0
3	M.A.	9	3

Joint range of the shoulder joint was classified using the joint balance. (Table no. 3)

Table 3. Joint balance at the level of the affected shoulder.

Nr. Crt.	Patient initials	Initial flexion	Final flexion
1	L.A.	80º	120º
2	S.T.	110 º	158º
3	M.A.	95º	120º

The muscle strength of the shoulder movements was classified using the muscle balance. In table shoulder 4, you can see the evolution in terms of the strength of the flexors at the level of the affected shoulder. (Table no. 4)

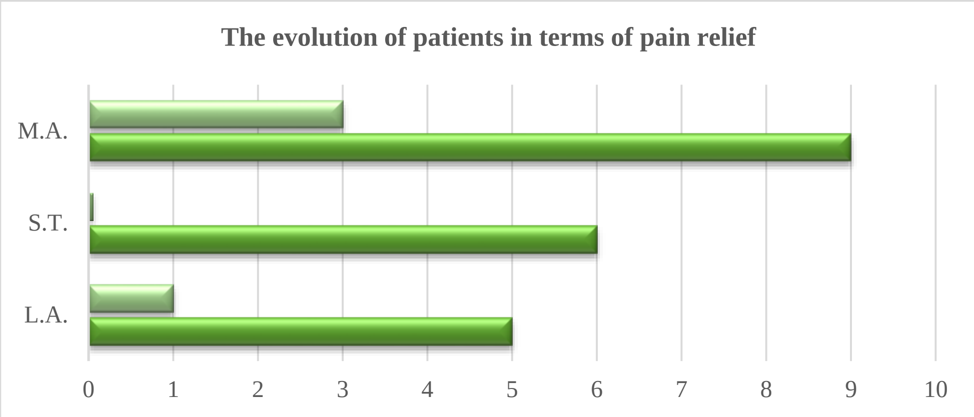
Table 4. Muscle balance at the level of the affected shoulder.

Nr. Crt.	Patient initials	Initial flexor muscle strength	The strength of the end flexor muscles
1	L.A.	3	+4
2	S.T.	-4	5
3	M.A.	4	5

The primary goal of rehabilitation was to restore the patient's pre-injury functional range of motion. However, rehabilitation programs vary greatly among surgeons, institutions, regions, and the patient's personal resources. The recommended duration of immobilization, the timing of the first physiotherapy session, the intensity and frequency of the sessions and the setting of the therapy, whether it is at home or in a hospital / private center, are considered variables that influence the patient's recovery. Furthermore, the level of therapist experience and the treatment modalities provided by therapists create additional heterogeneity.

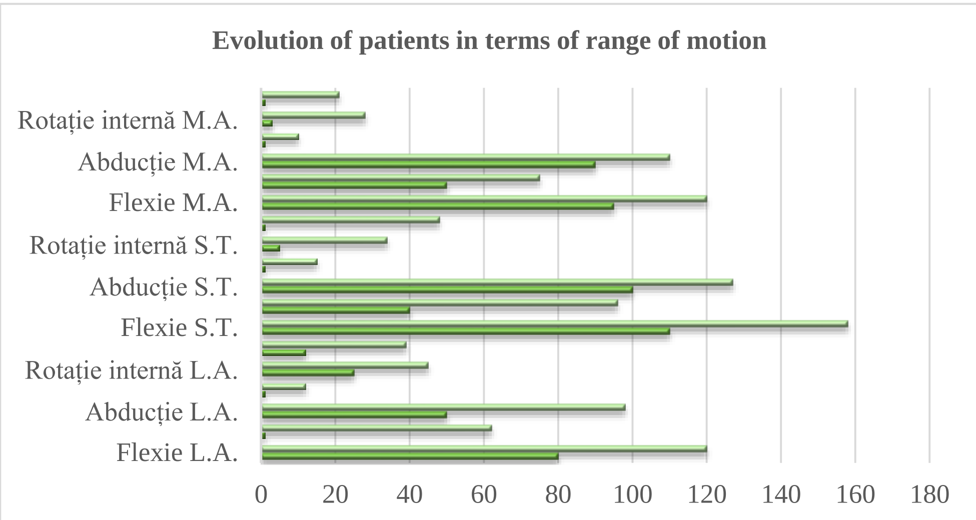
It is generally accepted that prolonged immobilization leads to shoulder stiffness and therefore patients tend to have unsatisfactory outcomes. Early self-performed movement is indicated after a short period of immobilization to ameliorate loss of function. Rehabilitation generally follows two stages. Passive / assisted mobilization with range of motion exercises followed by progressive resistance exercises.

3. Results of the study



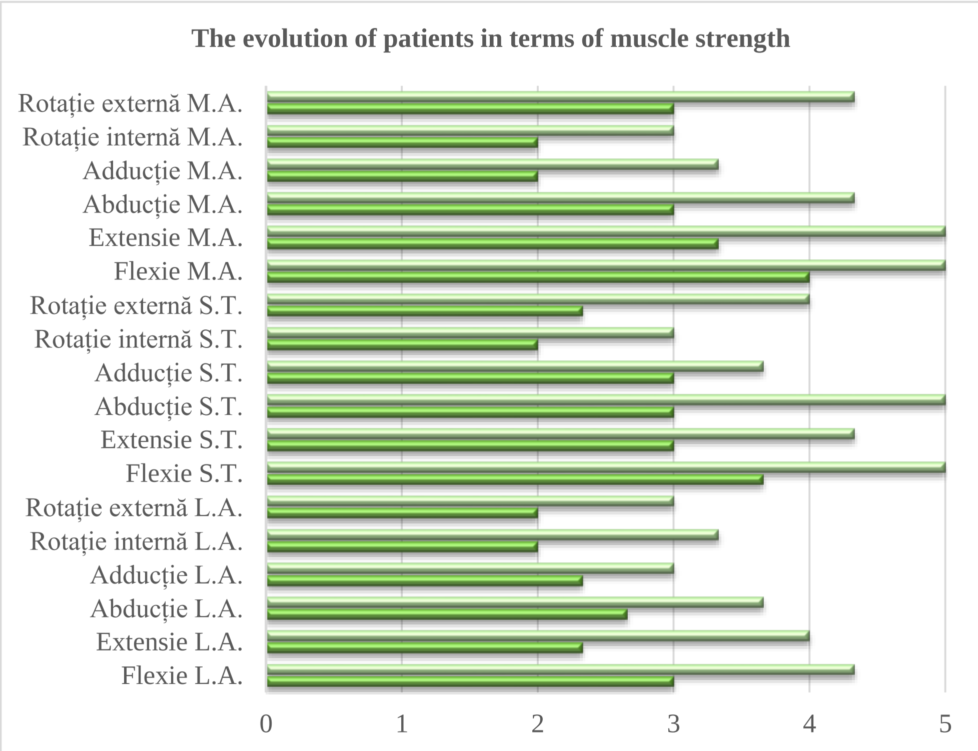
Graph 1. Evolution of patients from the point of view of pain reduction

According to chart no. 1 we can see a significant improvement in terms of pain reduction in all patients. We emphasize the fact that, at the final evaluation in the case of patient S.T., the pain was not only diminished but completely absent.



Graph 2. Evolution of patients in terms of range of motion

The correct use of the means in order to achieve the objectives proposed for the recovery program can be seen in the values returned by the final evaluation, present in graph no. 8 which highlights a significant improvement in terms of the range of motion of the affected upper limb for all patients participating in the study. All movements that were impossible at the initial evaluation benefited from a significant positive evolution in all patients.



Graph 9. Evolution of patients in terms of muscle strength

The effective choice of means in order to achieve the objectives proposed for the recovery program is summarized in the values obtained at the final testing present in graph no. 9, which highlights a significant improvement in terms of muscle strength in the affected upper limb. It should be mentioned that, at the final evaluation, in the case of the muscle strength during the flexion movement, it reached a normal value of the muscle strength in the case of two of the patients participating in the study, and in the case of the muscle strength during the extension movement, respectively flexion a normal muscle strength value was reached in two different patients participating in the study. Overall, all patients experienced significant improvements in muscle strength in the affected upper limb.

4. Conclusions

The results obtained from the conducted research indicate that through early kinetotherapeutic intervention and the use of proprioceptive facilitation techniques, we can obtain an optimal recovery of the functional remainder in the case of humerus post-fracture patients.

According to the results presented in the previous tables and graphs, the patients registered an increase in the mobility of the affected upper limb, in all planes of motion, compared to that of the initial evaluation.

Following the treatment plans, at the patients' final evaluations, a significant increase in strength was observed in all movements of the upper limb.

Using the kinetotherapeutic means and following the treatment plan, the patients confirmed the decrease in the pain level initially present following the surgery on the humerus fracture, one of them reporting the complete absence of pain, and two of them obtaining a considerably lower pain level.

According to the results obtained and shown in the previous graphs, we could observe a different recovery of mobility and strength in the patient of the third age compared to the young patients, which demonstrates the fact that the age of the patient is a particularly important factor both in the composition of the treatment plan and and in verifying the results obtained.

The specific means of physical therapy have an important role in the recovery of patients with postoperative humerus fracture, a fact demonstrated by the patients' ability to resume their usual activities in the shortest possible time and their socio-professional reinsertion.

Correlating all the conclusions presented above, we can support the fact that the hypothesis of the work has been confirmed.

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Supplements as a Method of Influencing Muscle Ratigue in Tennis: A Study Review

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Abstract
The supplements that players use influence muscle fatigue before, during or after tennis and are essential along with other components in the development of a good athlete when talking about performance in sport.
Aim: The aim of this review study is to review the scientific papers on the subject of supplements used in tennis in order to see how they may or may not influence muscle fatigue.
Methods: We used the following databases: Google Scholar, PubMed and Research Gate using the following keywords: supplements in tennis, muscular fatigue and sports performance. Only articles focusing on supplements used by competitive players were selected. We identified 30 articles that met the inclusion criteria: articles published in English, focusing on supplements used by tennis players and available in full text. We excluded articles that did not detail the components of oral suplements and the ingestion protocol, studies available only in abstract form, articles that not targeted professional tennis players.
Results: We selected 20 articles that met the inclusion and exclusion criteria. The results shows that the ingestion of supplements has a positive effect on the prevention of muscle fatigue, as well as during and after exercise in order to facilitate recovery.
Conclusions: The ingestion of supplements by competitive tennis players is a method to reduce the muscular fatigue and improve recoverey after training and sports competitions.

Keywords: *supplements; tennis; muscular fatigue; sports performance.*

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1. Introduction

Tennis is a sport that is increasingly played at all levels. Over the years, the sport has undergone many changes, such as: different biomechanics of movement, increased intensity and duration of matches, more tournaments at performance level. It is one of the recognised sports played on different surfaces with different types of balls, indoors and outdoors. All of the above has an effect on the players' psyche and physique as they adapt to changing conditions from one competition to another in a relatively short time. Tennis is characterised by fast starts, changes of direction, quick breaks and a varied type of effort: maximum intensity effort alternating with long efforts of medium or low intensity, as well as the involvement of different muscle groups (Perry et al., 2004; Fernandez, 2009). The duration of a match is on average about 1h 30 min or more, some matches last even longer atmen's event in Grand Slam tournaments where they are played on the best of 5 sets system.

Pluim B. (2007) mentions this sport as one of the most appreciated and practiced sports worldwide. If practiced as a recreational sport, tennis is an ideal sport for physical improvement at the population level. Bringing numerous benefits, the vast majority keep playing it throughout their lives.

The supplements that players use influence muscle fatigue before, during or after tennis and are essential along with other components in the development of a good athlete when talking about performance in sport. Supplements are important when talking about energy stores, preventing and reducing fatigue (Thomas, Erdman & Burke, 2016). It is a key element in the development of any athlete's performance capacity, especially at junior age where it is a critical time for them (Fleming, Naughton & Harper, 2022). During prolonged exercise, such as tennis matches, carbohydrate ingestion is considered to be the most recommended diet for recovering skeletal muscle and nervous system capacity.

2. Material and methods

2.1. Data collection

Using the following electronic databases: Google Scholar, PubMed, Research Gate, we searched for articles using the following keywords: supplements; tennis; muscular fatigue; sports performance. In the second phase the keywords were used in combination to get the most accurate results. We selected only those articles that aim supplements on influencing fatigue in tennis players.

Eligibility criteria:

To be included in this review, scientific works must fulfill the following criteria: articles published in English, focusing on supplements used by tennis players and available in full text.

There have been excluded from the study: articles that did not detail the components of oral suplements and the ingestion protocol, studies available only in abstract form, articles that not targeted professional tennis players.

There have been excluded from the study: articles that did not detail the components of oral suplements and the ingestion protocol, studies available only in abstract form, articles that not targeted professional tennis players.

3. Results and discussion

3.1. Results

From the diagram above (figure 1), a number of 1281 article were identified. Articles published between 1990-2000 (n=2), 2000-2010 (n=11), 2010-2022 (n=7). There has been more interest in this type of study recently. Some studies have used as supplements: carbohydrates (n=6), sports drinks (n=2), caffeine (n=7), creatine (n=2), bicarbonate (n=2), sodium citrate (n=1). These studies have always had experimental and placebo groups, the subjects being competitive tennis players. The number of participants in the selected studies can be divided into the following categories: 0-10 participants (n= 8) and more than 10 participants (n= 12). Articles that included men in the study group (n= 14), that included only women (n=0), that included both genders (n= 6).

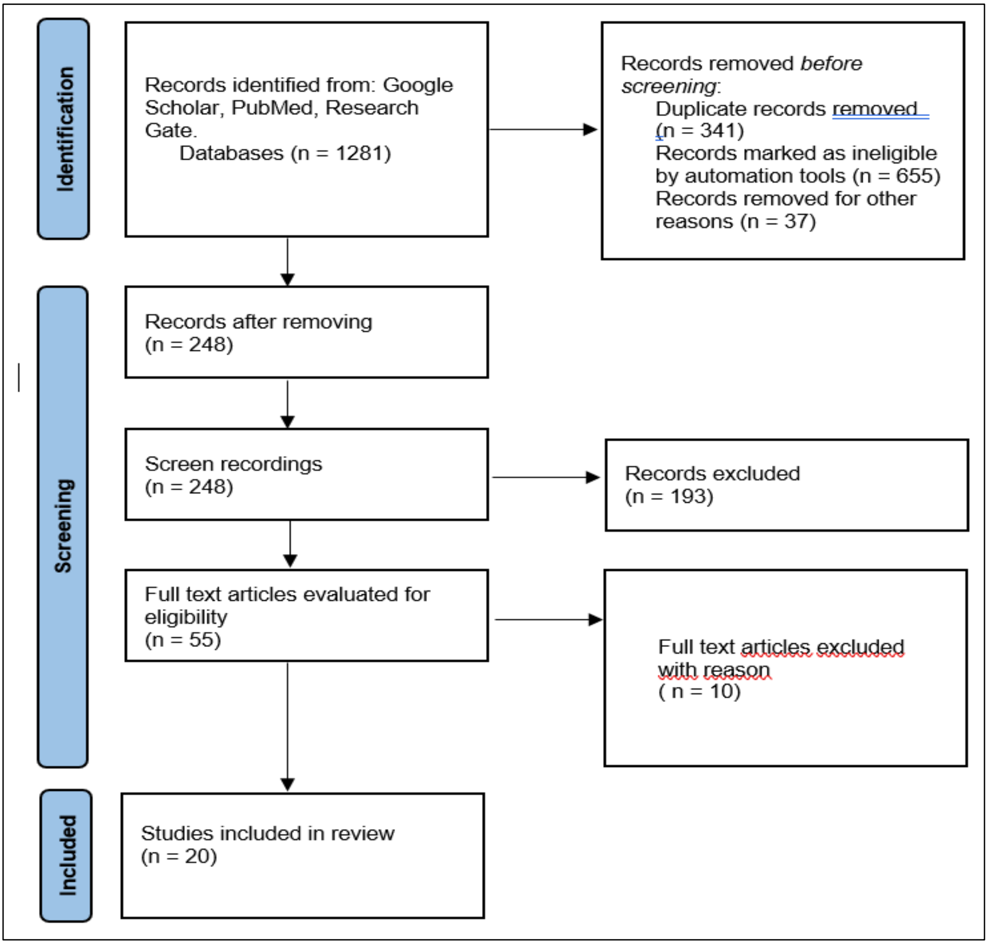

Figure 1. Prisma flow diagram

After the inclusion and exclusion criteria a number of 20 articles were included in review. The results show that ingestion of supplements significantly influences sports performance of tennis players both in competition and in simulated match.

Table 1. Articles used in the review

No. article	Target group	Protocols	Results
1. Peltier et al. (2013)	8 well-trained male tennis players (regional level-French Tennis Federation)	2 groups: ingesting placebo or sport drinks. The players had a dietary protocol before the 2 sessions to minimize variations in pre-exercise glycogen stores.	The group that ingested sports drinks had a better resoinse to perceived general and muscular fatigue than the placebo group.
2. Gomes et al. (2013)	12 male tennis players	5 days trial with 2 matches in 2nd and 4th days. Subjects ingested either a CHO or PLA beverage.	CHO supplementation did not affect players performance during the match. Blood glucose showed a higher trend concentration (p=0.06).
3. Chen et al. (2015)	10 healthy male and 10 healthy female (tennis, soccer, basketball)	Caffeine washouts 7 days prior to the experiment 2 sessions: caffeine session and the placebo session A capsule of 500ml water mixed with 6mg/kg caffeine placebo (diet flour, Sun Right, Taiwan).	Caffeine significantly improved isometric contractions by 5.9%
4. Gallo-Salazar et al. (2015)	14 young and healthy tennis players (10 male and 4 female)	2 experimental trials: First trial: players ingested a powdered caffeine-containing energy drink (Fure, ProEnergetics, Spain) dissolved in 250 mL of tap water = 3 mg caffeine. Second trial: identical drink with no caffeine content.	The preexercise ingestion of the caffeinated energy drink increased handgrip force by 4.0% ± 7.2% in the right hand and by 4.3% ± 7.2% in the left hand.
5. Op 't Eijnde, Vergauwen & Hespel (2001)	8 well-trained, young male tennis players	2 experimental protocols (creatine or placebo supplementation). 20 g of creatine monohydrate powder/day	creatine supplementation might improve performance in tennis. Ingestion of ~ 20±25 g ´ day±1 of creatine monohydrate
6. McRae & Galloway (2012)	22 nationally ranked tennis players (15 male, 7 female	Participants ingested either a 6.4% CHO-E drink (Lucozade Sport, GlaxoSmithKline Nutritional Healthcare, 281 mOsmol/kg) or a 0.0% placeboelectrolyte beverage (Lucozade Sport, GlaxoSmithKline	CHO-E trial had significantly higher success rates on all serves (p < .05; 66% ± 7% success on placebo vs. 68% ± 6% on CHO-E)

No. article	Target group	Protocols	Results
		Nutritional Healthcare, 61 mOsmol/kg).	
7. Brink-Elfegoun et al. (2014)	8 male regionally-ranked tennis players	The diet was standardized as follows: fat 25%, protein 15% and carbohydrate 65%, plus 200 mL of mineral water at each meal. During the match day, participants had to drink a pre-match drink (500 mL of liquid), a drink during the match (750 mL/h) and a drink after the match (250 mL).	playing three simulated tennis matches in a thirty-six-hour period did not significantly decrease any of the physical performance measures 3 h after the last match
8. Vergauwen et al. (1998)	13 well-trained male Belgian tennis players	they ingested two capsules containing an initial bolus of either caffeine or placebo (glucose)	CHO feedings to improve stroke performance at the end of prolonged tennis play. Caffeine intake does not yield an additional beneficial effect to stroke quality.
9. Pluim (2006)	36 male tennis players	2 groups: creatine group and placebo group.	without extra strength training creatine supplementation is not effective at enhancing isometric strength in young male competitive tennis players
10. Wu et al. (2010)	9 male Division I college tennis players	Each participant -> 2 experimental trials: bicarbonate and placebo, in a randomized order. The participants consumed NaHCO3 (0.3 g kg-1 body mass) or placebo (NaCl, 0.209 g kg-1, equal amount of sodium) in 250 ml water.	NaHCO3 supplementation could prevent the decline in skilled tennis performance after a match.
11. Fernnadez-Elias et al. (2020)	11 professional male tennis players	70 mL of concentrated beetroot juice.	The ingestion of a shot of nitrate beetroot juice was ineffective to improve running performance and serve grip.
12. Cunha et al. (2019)	10 Brazilian nationally-ranked young male tennis players	Subjects ingested either sodium citrate (SC - 0.5 g.kg−1 BM in capsules of 500 mg) or a placebo (PLA).	All metabolic parameters increased after the ingestion before and after the match.

No. article	Target group	Protocols	Results
13. Hornery et al. (2007)	12 highly trained male tennis players	3.trials: placebo control and 3 interventions. Trials were separated by 48 hours to 7 days. Participants consumed approximately 14 mL · kg–1 · h–1 of a commercially available carbohydrate-loaded beverage (6%). The participants in the placebo group ingested a powder placebo to mask caffeine and a carbohydrate-free flavored drink.	Carbohydrate drink enhanced blood glucose concentration. Supplementation with a modest amount of caffeine increased serve velocity, specifically during the final stages of the simulated match.
14. Klein et al. (2012)	20 National Collegiate Athletic Association Division I tennis players (10 men; 10 women)	the ingestion of either 6 mg/kg of caffeine/ a placebo	Caffeine significantly improved performance.
15. Strecker et al. (2006)	10 male collegiate level tennis players	Players performed two 90 minute trials of simulated tennis playing against a ball machine. Participants ingested either 3mg/Kg of body weight of caffeine or placebo with 32 oz of carbonated soft drink.	The results of this investigation show a better performance on the forehand shot compared to backhand.
16. Juzwiak et al. (2008)	44 adolescent males aged 10–18 years. The players were placed into two groups based on age (10–13 years, n=17; 14–18 years, n=27)	4-day FD, EE via METS plus estimated BMR, DEXA.	CHO intake decreased recommendations (<5 g.kg.bm−1) in 32% of players. Protein intake increased recommended intakes in 73% of players; >1.5 g.kg.bm−1.
17. Mitchell et al. (1992)	12 tennis players (1o male and 2 female)	In one trial -> subject ingested a CHO solution 7.5 g * 100 mL, in the other trial -> ingested a water placebo artificially flavored.	The ingestion of CHO did not prevent a decrease in performance. Fatigue occured in 3 hours in the match, suggested by service speed and shuttle runs.

No. article	Target group	Protocols	Results
18. Kushwah (2019)	10 university level male tennis players	High Carbohydrate Drink (H-CHO) 17.5 g/ 100 ml of water High Electrolyte Drink (H-ED) 21.8 g/ l of water Carbohydrate-Electrolyte Drink (CHO-E): commercially available Gatorade sports drink. The dose was 100 ml lemon-lime flavored Gatored + 6% carbohydrate.	CHO-E ingestion during the simulated tennis match rises the Na, K+, BGL, and SR and reduces the BLa and BT than other fluid supplement.
19. Strecker (2007)	10 skilled male tennis players ranked between 4.5 and 6.0 on the USTA scale	CHO-E ingestion during the simulated tennis match elevates the Na, K+, BGL, and SR and reduces the BLa and BT than other fluid supplement. The participants ingested a gel capsule with either 3 mg. Kg-1 of body weight (BW) of caffeine or placebo + 32 oz carbonated soft drink was consumed with both caffeine and placebo.	Ingestion of 3 mg/Kg BW of caffeine improves tennis skill performance in the end of a match play.
20. Munson et al. (2020)	12 British nationally-ranked tennis players	Participants consumed a 250 ml sodium-containing beverage (10, 20, 50 mmol/L) or a placebo (0 mmol/L), and continued to consume 1,000 ml of the same beverage at set periods during the 1-h training session.	Consuming 50 mmol/L of sodium before and during a 1-h tennis training session reduced urine osmolality and improved groundstroke performance in nationally-ranked tennis players.

3.2. Discussion

This study aims to show a link between the ingestion of supplements and the effect it does or does not have on the sports performance of tennis players. Most of the articles were focused on testing subjects during a match or a simulated match using the ball machine in training. Participants in the study being assigned to an experimental group and a placebo group and vice versa (Munson et al., 2020; Juzwik et al., 2008; Hornery et al., 2007). Another author's view on supplementation is thus very important to maintain an optimal level of fluids before, during and after the tennis training or match. High temperature is known to increase the risk of dehydration leading to injury and reduced sports performance (Myers, et al., 2018; Klein et al., 2012; Kovacs, 2006).

Poire et al. (2019) study comparing a group of athletes who took caffeine as a supplement vs. the placebo group found that those who used caffeine performed better in sprints, but experienced stomach discomfort, service accuracy was not affected. Compared to tennis, caffeine ingestion had no effect on the accuracy of free throws and 3-pointers in basketball and football where the shots were not improved after caffeine supplementation (Abian et al., 2015; Krasnanova et al., 2014). Sodium bicarbonate helps prevent a decrease in player performance during a match or training session in a study in which 9 professional players received a diet protocol (Wu et. al., 2010). According to Brink-Elfegoun et al. (2014) after playing 3 simulated-matches did not significantly decrease any of the physical performance of the players. Another supplement that helps increase performance in tennis is sodium citrate. In this study, 10 male tennis players had increased their metabolic parameters after the ingestion (Cunha et al., 2019). Also other studies on female tennis players show that a protein-based diet can be achieved more easily with the help of information on the number of training hours (Gropper et al., 2003).

4. Conclusions

This study shows that supplements can be used as a method to prevent and reduce muscle fatigue after matches or training and to recover from physical activity. An important factor is to choose an appropriate dosage that is specific for the sport and the player and to select the right time to use supplements: before, during and after a match or training session. In addition to preventing fatigue and maintaining performance capacity, the speed of the groundstrokes has also been improved especially when talking about service.

Nutritional supplements such as carbohydrates, caffeine, creatine, bicarbonate and sodium citrate as well as energy sports drinks help athletes in preventing and reducing muscle fatigue. Intervention with supplements adapted to the players is essential when the optimal level of hydration must be maintained, especially at times of high temperature during a tournament.

The ingestion of supplements by competitive tennis players is a method to reduce the muscular fatigue and improve recoverey after training and sports competitions.

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Motion Games for Static Balance on Visually Impaired Children

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Abstract
This paper addresses on multiple therapeutically aspects of visually impaired children, from the adapted physical activities point of wives. The functional life qualities benefits of the motion games over the aspects of psychomotor disorders. The teacher must adapt each game to the possibilities of the child and to the individual disorders and deficiencies, and set the most important targets, as a constant and regular factor of adapted development in life quality of the child.
In terms of physical development, lack of vision does not directly cause disturbances, but the trend towards sedentarism and knowledge of the environment through predominant tactile kinesthetic information are responsible for the occurrence of physical deficiencies and delayed motor development.
This study is outlined as referring to a need to prevent, compensate and complex therapy of the physical and motor development disabilities of the visually impaired schoolchild, by carrying out complex and appropriate assessments with continuity in the development and application of school curricula of physical culture, with a specificity in the psycho-motor integration of the visually impaired pupil, using sport-specific means adapted to the ambulatory pupils' physical therapy. The study was conducted at the School for the Deficiencies of View no. Austrului 33, Bucharest, sector 2, on a group of 27 subjects enrolled in Gymnasium group V-VIII during January 2008 - June 2009. As a research method, I used the pedagogical experiment using initial and final measurements of a test battery. In this paper I present the results of the adapted static balance test, these being statistically processed on the basis of the individual study with the permanent character of the appropriate bibliography. In the physical education and sports adapted lesson physical exercise can be considered the easiest and most appropriate form to capture and motivate the child and to develop abilities in empathy with its playful side with eloquent results in the psychomotor development of children with vision deficit.

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***Keywords**: psychometric; vision deficit; motion games; static balance; motion games, quality of life, adapted development.*

1. Introduction

In terms of physical development, lack of vision does not directly cause disturbances, but the trend towards sedentarism and knowledge of the environment through predominant tactile kinesthetic information are responsible for the occurrence of physical deficiencies and delayed motor development.

These lead to the inevitable slowdown in motor, psychological and intellectual development. This study is outlined as referring to a need to prevent, compensate and complex therapy of the physical and motor development disabilities of the visually impaired schoolchild, by carrying out complex and appropriate assessments with continuity in the development and application of school curricula of physical culture, with a specificity in the psycho-motor integration of the visually impaired pupil, using sport-specific means adapted to the ambulatory pupils' physical therapy.

In terms of physical development, the lack of vision does not directly cause disturbances, but the tendency towards sedentarism and the knowledge of the environment through predominantly tactile-kinesthetic information, are responsible for the appearance of physical deficiencies and of delayed motor development.

Therefore, the need to know and integrate correctly the physical development of the ambliop school, the need to detect, examine and evaluate, to follow the evolution and finally to apply a complex and effective prevention, compensation or therapy decision.

The evaluation process is very important in directing the motor activities, because the effects of the means used immediately or late on the whole organism, and coordinates the operative directing of the physical effort.

The development of the psycho-motility of the amblyopic children, through specific physical exercise programs, games of motion and adapted physical therapy, structured according to the needs of the subjects in the study and applied according to a specific methodology, may be able to optimize the potential of the children with amblyopia;

Physical exercise, a basic means of physical education and physiotherapy, applied in its playful form, adapted movement game, it can optimize the psycho-motor development of amblyopic students.

In the use the complex and adequate evaluation, a real intervention and compensation of the disorders of physical development of the amblyopic student can be ensured, performing a complex therapy of the motor development disorders if we use motor games with technical tactical structures in sports games.

If it is acted through team games associated with physical therapy, the psycho-socio-cultural integration of amblyopic students can be improved.

The psychomotor behaviors of each individual evolve according to his / her aptitude, the degree of physical and intellectual development and the educational influences he was subjected to during his childhood. As a complex function that determines the regulation of human behavior, psychomotor activity includes the participation of different processes and psychic functions, which ensure both the reception of information and the proper execution of response acts. Through its basic components, psychomotricity makes possible the pragmatic adaptation (learning of professional, manual, intellectual techniques), social adaptation (ways of interpersonal communication), aesthetic adaptation (techniques of bodily expression), educational adaptation. (Răcăşan M. 2002)

Bedoin N. (1990) makes the following details: "the body diagram and the self-representation (of the corporeal self) have as a common point of permanent self-meeting. By knowing the body scheme, one reaches the permanent self in space. The image of the body is linked to the permanent in space and to the location in time, and the self-representation is linked to the child's relations with the world.

The body scheme is elaborated by the automatisms and the afferents that work beyond consciousness. The body diagram is a simplified way, not so much of the form, as of the functions and relations of the different parts of the body, constituting a stable landmark for the evolution of posture and mobility. In a broad sense, knowledge of the body diagram implies:

- the child's knowledge of his own body scheme (to know how to name and show the different parts of the body);
- knowledge of another person's body scheme
- correctly positioning objects in space in relation to their own body or other objects;
- orientation in space. (Preda V. 1999)

2. Assumption

The inductive hypothesis of research is outlined as referring to a necessity for the prevention, compensation and complex therapy of the physical and motor development disabilities of the amblyopic school, by carrying out complex and appropriate evaluations, with continuity in the development and implementation of school curricula physical culture, specific in the psycho-socio-cultural integration of the visually impaired individual, using specific means of sporting games adapted to the ambulatory students' physical therapy.

3. Logistics

The study was conducted at the School for the Deficiencies of View no. Austrului 33, Bucharest, sector 2, on a group of 27 subjects enrolled in Gymnasium group V-VIII during January 2008 - June 2009. As a research method, I used the pedagogical experiment and instrument we used a stopwatch, using initial and final measurements of a test battery. In this paper I present the results of the adapted static coordination test, these being statistically processed on the basis of the individual study with the permanent character of the appropriate bibliography.

3.1. Adapted static coordination test

Required material: stopwatch.

Instruction to the subject: Sitting on one foot, the preferred foot with the other foot on the inner face of the opposite leg, hands on the hips, eyes closed, and maintains the position until the stop command, as exemplified.

Examination process: The handwriting examiner starts the timer when the subject has reached the correct position and monitors the position for 60 seconds. Note for recording: 2 attempts are made, noting the best test, in seconds with scoring from 0 to 60.

The timer stops when the subject:

- ✓ open the eyes
- ✓ changes the position of the bent leg
- ✓ raises the arms on his hips
- ✓ bend the support knee
- ✓ hopping on the support leg.

3.2. As working principles, the following aspects were considered:

- ➢ the use of diffuse light for cases of glaucoma and albinism and strong light in other cases
- ➢ the doors of the rooms should be closed in order not to create confusion in the perception
- ➢ work space free of obstacles
- ➢ hazardous areas (pillars, arches, radiators, etc.) insulated with protective materials in eventual contact with them
- ➢ marking the areas where the activities take place through surfaces with different texture and consistency (grass, slag, synthetic, parquet)
- ➢ delimiting the workspace by living colors for amblyopic orientation
- ➢ at the first session, helping children to know their space, materials, equipment, sizes, texture, using valid senses
- ➢ for children wearing glasses or other refraction systems, the use of protective systems, especially in the case of objects handling (knees, sticks, ropes, etc.)
- ➢ working balls varying in consistency, size, weight, color, to provide a wide range of visual and tactile-kinesthetic information
- ➢ use of contact sounding systems such as String balls or electronic contact or motion activated systems
- ➢ the use of a whistle or verbal indicator to mark its beginning the end of a driving action, but also the spatial orientation

- using music for relaxation, motivation and positive attitude
- permanent verbal communication to create a climate of trust, security, encouragement, presence, affection
- use of analytical exercises, games, competitions that provide immediate satisfaction to children and facilitate social contacts with important functional effect
- manually guiding the child's movement to the correct positions needed to train a certain skill
- using a model (another colleague or a mobile-sized doll) so that the child distinguishes how the body segments relate to a movement
- guide the movement or motor activities of the blind child by an ambulatory colleague with remnants of sight
- the use of hearing aids in case of visual impairment
- the use by the teacher of a clear, concise language that refers to landmarks known to the child.

3.3. The didactic method used

The motion game contributes to the solving of several tasks, for example the development of a physical quality or a movement skill, while at the same time contributing to the education of a moral and willful quality.

The teacher must know how to orient himself in choosing the game, stopping only on those who can exert a positive influence from a physical, moral and hygienic point of view, avoiding those with undesirable effects related to: superstition, unnatural movements, non-high-risk, high-risk accidents, games where cruelty or anti-social feelings can manifest. (Dragnea A., 2006)

The organization of games in which children gain skills, learn and adopt the right body posture, develop their sense of balance, coordination, mobility, strength, reaction speed and reflexive response, compensate for deficiencies, combat obesity, cardio-respiratory function, development of tactile-kinesthetic perception and memory, to manifest and develop the creative initiative, to educate collectively, the spirit of comradeship, fair play, organization, observance of rules, empathic spirit and self-confidence, sense of utility, belonging and inclusion.

Once the pedagogical task has been established, it is necessary to consider other factors such as: the game team, the game, age, health, venue, gaming teams, arbitration, explanation and demonstration of the game, discipline and game rules, dosing, results, rewards, or prizes. (Epuran M., 2005)

The children played during their physical education and sport classes and also extra-curricular, the specific special designed applied motion games and also the specific games training together, 3 times a week, 45 minutes a session, during the whole educational year from January 2008 to June 2009.

Examples of games with a technical-tactical content in sports games with corrective valences for amblyopia students, games found in the book "Movement Games for Amblyopia" - by Adina Geambaşu, a book that is part of the Compilation of Motrical Activities Formative - Series of Movement Games - University Card, Bucharest - 2005:

"Turkish looks for the ball"; "In the cottages"; "The Striking Strike Ball"; "The worker and the worker"; "The Traveling Book"; "Creeping Train"; "Rolled Ball"; "Who is wrong"; "Mountain Trail"; "Match action"; "Basket Ball"; "Twine".

Figure 1. Motion games for visually impaired children

4. Results

In the next table I present the dates for initial and final measurements:

Table 1. Initial and final measurements January 2008 - June 2009

Subjects	Initial testing	Final testing
1	32	2
2	5	7
3	10	21
4	4	23
5	15	60
6	4	4
7	4	4
8	12	32
9	4	10
10	4	4
11	10	31
12	15	50
13	4	5
14	4	27
15	5	20
16	10	47
17	4	20
18	4	4
19	30	60
20	30	60
21	15	30
22	12	34
23	10	39
24	4	10
25	4	37
26	4	27
27	4	52

Arithmetic mean - its value in the two tests is 9.47 seconds in initial testing and 28.4 in final testing, indicating an increase in the time the subject cannot maintain balance at final testing compared to testing initial. The median value, which is the value of the half-string of recorded results and is not influenced by the extreme data, also a central trend indicator, has values that are not close to the arithmetic mean value, both at the initial test (5.00 sec) and final testing (27.00 sec), indicating differences between the determined values in the subjects included in the sample.

- The calculated variability coefficient shows values of 87.37 in initial testing and 66.66 in final testing indicating a non-homogeneous sample of equilibrium in both tests (Cv> 20%).
- test (Student) - the value of P calculated is 0.000, resulting in P <= 0.05. Statistically, the results differ significantly. The null hypothesis is rejected.

5. Conclusions

The content of the adapted motor activities must aim at optimizing the bio-motor potential of the individual, as well as the cognitive, affective and social-relational components in order to obtain the quality of life, with specificity focused on the motor being placed in a new perspective that implies the exit from the pattern, the search for spontaneity, the flexible adaptation, the emotion, the communication. (Geambasu A., 2006)

Active involvement of students, teaching staff and parents, as well as the response, usefulness and applicability of tests and programs used for psycho-motor development of amblyopic students, and of enriching the didactic process, given the lack of specialized materials with specific in the field, as well as the formation of a multidisciplinary driving team from which not to miss with pedagogues, the physical therapist, the psychologist, the doctor, with the active involvement of the family. .

The multidimensional value of adapted motor activities recommends them as one of the most efficient means of education of amblyopic children, aiming at influencing personality.

The static balance for the children involved in the research was improved through the practice of a proper training and also adapted motion games.

6. Discussions

According to Preda V. (1995), the elaboration of the spatial-temporal structure is a premise of the psychomotor development. Any phenomenon of objective relationships takes place in space and time. The average space is perceived and constructed in the mental plane, as a result of noticing the positions, directions, movements; it is organized starting from the sensory-motor level, of the perceptions related to the action, based on the knowledge (elaboration):

– own body diagram;
– the body scheme of the partner;
– right-left differentiation;
– elaborating the various positions of the objects between them;
– elaboration of topological notions (closed-open, top-down, etc.)

Static balance and postural control are achieved by contraction of some muscle groups of the trunk, in relation to the position of the head in space. This is achieved through an activity coordinated by the central nervous system and in which the vestibular analyzer, the deep conscious proprioceptive sensitivity and the unconsciousness, the extra pyramidal system and the visual analyzer are involved. (Penefonda G., 1992).

The situation of the child with visual impairment is characterized by establishing relations with the external environment through touch, taste and smell, with the help of the other senses: hearing, touch, taste, smell. These states lead to the inevitable slowing down of mental and intellectual development. The variant of hearing, feeling, tasting requires much more effort than seeing. (Wallon H., 1959) For the blind child it is much harder to discover the external environment, to make the connection between the object and the word. He lacks many stimuli that contribute to his development, stimuli that he receives by means other than the sight.

The blind children, following the direct consequence of the blindness, are characterized by the poverty of the movements, vicious positions, disordered movements, states that influence and the psychic and intellectual development of the child. Thus, the visual impairment induces changes on several planes, namely:

– the neurophysiologic plan
– the physical development plans
– the plan of primary and secondary cognitive processes
– the socio-affective plan
– the motor plans.

In terms of physical development, the lack of vision does not directly cause disturbances, but the tendency towards sedentary and the knowledge of the environment through predominantly tactile-kinesthetic information, are responsible for the appearance of physical deficiencies and of delayed motor development. (Hellen Keller, 1914)

The repercussions presented above are the first and foremost consequence of a process and of an inadequate stimulation, thus evident the need for a qualified, early intervention, in order to prevent and prevent these deficiencies and deficiencies. (Cordun M., 1999)

Thus the physical therapist, through specialized knowledge but also through collaboration with parents and the multidisciplinary education team of which he is part, individually analyzing the amblyopic or blind child will make a kinetic program adapted to his unique needs, starting on the way to his correct and beneficial stimulation. If the adapted physical education and sport have the role to compensate the effects of the visual deficit, through group school activities, having an already well established place in the hierarchy and the school curricula, physical therapy, it comes to meet and fulfill the common objectives, bringing an important contribution to the level by individual and individual needs specific to the human being as a unique and unrepeatable entity, compensating for the deficit at all levels (primary acquisition, refinement, adequacy, improvement) and in all areas (corporeal, spatial, relational). (Mujicicov N. 1966)

Exercise through play can be considered the easiest and most appropriate way to capture and motivate the child, in empathy with his playful side.

The game contributes to solving several tasks, such as developing a physical quality or a movement skill, while contributing to the education of a moral and willful quality.

The teacher must know how to orient him or her in choosing the game, focusing only on those who can exert a positive influence from a physical, moral and hygienic point of view, avoiding those with undesirable effects related to: superstitions, unnatural movements, unhygienic, with increased risk of accidents, games where cruelty or antisocial feelings may occur. (Predoiu R. 2009, Teodorescu S. and co, 2004)

It will follow the organization of games in which the children gain activity skills, develop and adopt a correct body posture, develop their sense of balance, coordination, mobility, strength, speed of reaction and reflexive response, compensating for deficiencies, combating of obesity, training of the cardio-respiratory function, development of tactile-kinesthetic perception and memory, to be able to manifest and develop the creative initiative, to educate the collective feeling, the spirit of camaraderie, the fair play, the organization, the observance of the rules, empathetic spirit and self-confidence, sense of usefulness, belonging and inclusion.

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Evaluation of FSM Testing Before and After 2 Weeks of Physical Leisure Activities Coordinated by a Certified Personal Trainer

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Abstract
Introduction. Functional Movement Screen ™ (FMS ™) is a clinical tool designed to use movement behaviors to identify people at risk of injury. The current evaluator certification programs focus on extensive, individualized training. The screen innovative functional motion model (FMS) system used to evaluate customers or athlete's quality. **Objective**. The main purpose of this study was to determine the reliability of test-retest and FMS components, composite scores in young and healthy service members, when tested by a group of beginner evaluators in real time. Specifically, the agreement was evaluated on FMS component scores, while reliability, response stability, and error threshold measurements were obtained for FMS compound scores. The research hypothesis was FSM testing in the evaluation of subjects before and after 2 weeks of physical activity according to the FSM program adapted to each subject. **Methods.** The 10 subjects of the research were between the ages of 12 and 47, of which 8 were boys and 2 girls. During the research, all the subjects lived in Cluj-Napoca and practiced physical leisure activities in a setting organized under the guidance and coordination of a certified personal trainer. **Results.** The evaluation and centralization of the data was done on a Tablet with IOS operating system, on a platform specially designed by the Functional Movement Screen ™ (FMS ™) where only FMS certified members have access. The data is entered manually in the application, by the FMS Certificate evaluator following the analysis of the subjects. **Conclusions.** In conclusion, FMS ™ grows in popularity and use by fitness and rehabilitation professionals for functional screening of athletes, patients and clients. Total FMS scores ™ seem to be able to be reliably scored among trained assessors, while individual tests vary in their ability to be assessed with reliability.

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Keywords: *Functional Movement Screen; Movement behaviors; motion screen; movement patterns.*

1. Introduction

Functional Movement Screen ™ (FMS ™) is a clinical tool designed to use movement behaviors to identify people at risk of injury. The current evaluator certification programs focus on extensive, individualized training. The screen innovative functional motion model (FMS) system used to evaluate customers or athlete's quality. The beauty of the functional motion screen is that a personal trainer, an athletics coach or a strength coach or sports instructor can learn the system and have a simple and quantifiable method of evaluating basic movement skills. (*Functional Movement Screening*, 2021)

Functional Movement Screen ™ (FMS ™) is a clinical tool designed to use movement behaviors to identify people at risk of injury. The current evaluator certification programs focus on extensive, individualized training. The screen innovative functional motion model (FMS) system used to evaluate customers or athlete's quality. The beauty of the functional motion screen is that a personal trainer, an athletics coach or a strength coach or sports instructor can learn the system and have a simple and quantifiable method of evaluating basic movement skills. FMS only requires the ability to observe the basic movement patterns already familiar to the coach or coach. The key to the functional motion screen is that it consists of a series of simple tests with a simple scoring system. (*Functional Movement Screening*, 2021)

FMS allows a coach or coach to begin the process of evaluating the functional pattern of movement in individuals without recognized pathology. The functional motion screen provides strength and conditioning to the coach or personal trainer with an evaluation option that closely links to what the athlete or client will actually do in training. In a certain sense, the tests are improved by working on variations in the skills tested. FMS enables evaluation with tools and models of movement that easily make sense to both the client and the coach or coach. The test consists of seven fundamental models of movement that require a balance of mobility and stability. These fundamental motion patterns are designed to provide observable performance of the basic locomotor motor, manipulative movements and stabilizers. (*Are You Moving in a Functional Way? | FOUNDATION FITNESS*, 2022)

The tests place the individual in extreme positions where weaknesses and imbalances become visible if the appropriate stability and mobility are not used. It has been observed that many individuals who perform at very high levels during activities are not able to perform these simple movements. These individuals should be considered to use compensatory movement patterns during their activities, sacrificing effective movements for inefficient ones in order to carry out at high levels. If these compensations continue, weak movement patterns will be strengthened, leading to poor biomechanics.

FMS scoring Individual tests have certain criteria that must be met in order to achieve a high score. The score is divided into four basic criteria: a 3 is given if the individual can perform the movement without compensation according to the established criteria, a 2 is given if the individual can perform the movement, but must use weak mechanics and compensatory models to achieve the movement, a 1 is given if the individual cannot perform the pattern of movement even with compensations, and, finally, a 0 is given if the individual has pain during any part of the movement or test. There are five tests that require bilateral testing; this will result in two scores for these tests. The lowest test score is recorded for the overall score; however, for evaluation and data collection, both scores are required

The 7 FMS motion models are listed in order of priority from the most elementary and fundamental to the most complex and functional - the general order of importance in the Functional Movement Screen ™. Each motion model score contains a corresponding symbol that provides the recommended focus on evaluation or the development of exercise programs.

Three tests: Shoulder Mobility, Trunk Stability Push-up and Rotating Stability have compensation test associated with them, which are punctuated as pass/fail. If a person fails this part of the test, then a score of 0 is given as an overall score. FMS is an assessment technique, which seeks to identify imbalances in mobility and stability during fundamental patterns of movement. This assessment tool is believed to aggravate individual compensatory movement problems, allowing for easy identification. These motion deficiencies can lead to rupture of the kinetic binding system, causing inefficiency and micro trauma during activity. FMS should be introduced as part of the physical medical examination to determine deficits that can be overlooked during traditional medical and performance assessments. In many cases, muscle flexibility and strength imbalances along with previous injuries may not be identified. These problems, which have been recognized as significant risk factors for injury, will be identified using FMS. This movement-based assessment will identify functional deficits related to proprioceptive weaknesses, mobility and stability. If these risk factors can be identified and addressed using FMS, then the decrease in injuries and improved performance should follow. (Khaled, 2021) FMS is used by various examiners to assess movement and predict wastes of time in various physical activities of free time and active participants (for example, young people in professional athletes, firefighters, members of military service).

However, the tools that evaluate movement to help predict those with the highest risk of MUSCULOSKELETAL DISORDERS and injuries were lacking both for the athletic population. The functional motion screen (FMS) is a relatively new tool that tries to address several factors of motion, with the aim of predicting the overall risk of the musculoskeletal system conditions and injuries. FMS has been designed to identify functional motion deficits and asymmetries that can be predictive of general MSDs and injuries, with the ultimate goal of being able to alter movement deficiencies identified by individual exercise prescriptions.

Preliminary research conducted by Kiesel et al. (2011) suggests that National Football League (NFL) players (n=46) who had a composite score less than or equal to 14 on FMS had an odds ratio of 11.7 (95% [CI] confidence interval: 2.5, 54.5) and a positive probability report of 5.8 (IC 95%: 2.0, 18.4) to suffer a loss injury over time.

Although the specificity was relatively high (0.9; IC 95%: 0.8, 1.0), sensitivity was low (0.5; IC 95%: 0.3, 0.7), indicating that FMS composite scores less than or equal to 14 may suggest a higher risk of injury, but FMS composite scores higher than 14 do not exclude the risk of future injuries. In a separate study on a group of sailors, a composite score of less than or equal to 14 on FMS demonstrated the limited ability to predict all future musculoskeletal injuries (traumatic or overused) with a sensitivity of 0.45 and specificity of 0.71, while the same limit value was able to predict a serious injury (any injury serious enough to remove the participant from the training program) with a sensitivity of 0.12 and a specificity of 0,94. (Teyhen et al., 2014) FMS was also able to predict the risk of injury in collegiate sportswomen.

Finally, in another study, firefighters with previous history of injuries demonstrated lower FMS composite scores. However, it is not clear for which sport or FMS professions is optimal in predicting the risk of injury, what types of lethal injuries are predicted by low FMS composite scores, and whether the initial score less than or equal to 14 points on FMS is valid in different populations. In addition, the researchers found that FMS composite scores increased in football players, 13 firefighters, 6 and 8 service members following corrective exercises that addressed possible deficiencies associated with modified movement patterns noted in FMS component tests. In a group of sailors, 80% of those with a score less than or equal to 14 also demonstrated lower fitness scores on a standardized fitness test, compared to those who had an FMS composite score higher than 14.

However, Okada et al. (2011) found that FMS composite scores were not linked to performance or basic stability measures among healthy participants. The interpretation of FMS scores is limited by little evidence in terms of FMS psychometric properties and, in particular, the reliability of composite and individual component scores. An initial study by Minick et al. (2010) found acceptable levels of interternal agreement on FMS component scores among beginner and expert evaluators in a sample of participants active at college age (to include university athletes). However, this study had several limitations: (1) it did not evaluate the reliability of the test-retest, (2) all assessors evaluated the same movement pattern through video recorded analysis, and (3) only evaluated the agreement of individual scores of FMS components and did not evaluate the overall score of the FMS composite, which is usually used as the main risk indicator of injury. Traditionally, FMS is rated in real time without the benefit of video playback.

Therefore, a more robust reliability study is needed to improve the understanding of the psychometric properties of FMS. Although these initial FMS studies, which established the validity of FMS for predicting msyskeletal disorders of injuries and responding to training, are encouraging, their data is preliminary and not published in widely accessible journals. Exploring the psychometric properties of FMS in a large active population would enhance the generalizability of previous discoveries beyond a limited subgroup of athletes and professional students and colleagues.

2. Objective

The main purpose of this study was to determine the reliability of test-retest and FMS components, composite scores in young and healthy service members, when tested by a group of beginner evaluators in real time. Specifically, the agreement was evaluated on FMS component scores, while reliability, response stability, and error threshold measurements were obtained for FMS compound scores. The research hypothesis was FSM testing in the evaluation of subjects before and after 2 weeks of physical activity according to the FSM program adapted to each subject.

The subjects carried out their activity within the Kinetomed Recovery and Fitness Center Cluj-Napoca under the guidance of the Physical Therapist M.C., being the only certified member of the FSM in Cluj. In the second part of the research for the analysis of the movement called Functional Movement Screen ™ (FMS ™) we used the subjective sampling of the subjects, their inclusion in the research was made after a debate with the Personal Trainer having also the consent of the subjects to record the data to be presented in the paper. The subjects were chosen according to their level of involvement in physical leisure activities according to the legislation in force during the Covid-19 pandemic. We have selected a number of 10 practitioners of physical leisure activities, who carried out their activity in the Kinetomed Recovery and Fitness Center Cluj-Napoca under the guidance of the Physiotherapist.

3. Methods

The 10 subjects of the research were between the ages of 12 and 47, of which 8 were boys and 2 girls. During the research, all the subjects lived in Cluj-Napoca and practiced physical leisure activities in a setting organized under the guidance and coordination of a certified personal trainer. Therefore, in the second part of the research we chose as a hypothesis the Functional Movement Screen ™ (FMS ™) test in the evaluation of the subjects before and after 2 weeks of physical activity according to the FSM program adapted to each topic. Each subject was evaluated according to FMS tests after the analysis of the test the subjects were subjected to the exercise program created by the results after analyzing the obtained parameters. For two weeks the subjects did 6 workouts according to the schedule, 3 workouts per week, Monday-Wednesday-Friday, before each training, the protocol elaborated by FMS was applied. After the 2 weeks of physical activity, the subjects were subjected to the final evaluation of the FMS.

4. Results

The evaluation and centralization of the data was done on a Tablet with IOS operating system, on a platform specially designed by the Functional Movement Screen ™ (FMS ™) where only FMS certified members have access. The data is entered manually in the application, by the FMS Certificate evaluator following the analysis of the subjects. After entering the data in the system, the application offers data analysis, evaluation of subjects and the program of exercises to be followed by each topic. Next I will present the model of means recommended by the FMS application following the test. For the second part of the research in the application of FMS, a t-test was performed on pairs to compare the values. Sig. p. The Paired Samples Test is 0.005. This value is less than 0.05. because of this, we can conclude that there is a statistically significant difference between the Initial Test and the Final Test for FMS Testing and its protocol. Since our subject statistics box showed that applying for 2 weeks the FMS protocol improved in most cases the FMS Final Testing, so we can conclude that FMS Testing has an effect on activities practiced in fitness rooms and beyond. Where FMS testing showed no signs of progress, it is recommended to use the FMS means recommended by the application for a longer time, 2 weeks not being necessary for the subjects. In Table no. 1 Paired Samples Test we have red colored the pairs where there is a significant statistical difference in FMS tests.

Table 1. T-Test Paired Samples Test

Paired Samples Test

		Diferențele perechilor							
					Gradul de încredere (95%)				
Pair (P)		Media	Deviația standard	Media erorii standard	Inferioară	Superioară	t	df	Sig. (p)
Pair 1	Squat_S_1 - Squat_S_2	-.800	.422	.133	-1.102	-.498	-6.000	9	.000
Pair 2	Squat_D_1 - Squat_D_2	-.800	.422	.133	-1.102	-.498	-6.000	9	.000
Pair 3	Squat_T_1 - Squat_T_2	-.800	.422	.133	-1.102	-.498	-6.000	9	.000
Pair 4	Hurdle_S_1 - Hurdle_S_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 5	Hurdle_D_1 - Hurdle_D_2	-.500	.527	.167	-.877	-.123	-3.000	9	.015
Pair 6	Hurdle_T_1 - Hurdle_T_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 7	Lunge_S_1 - Lunge_S_2	-.100	.568	.180	-.506	.306	-.557	9	.591
Pair 8	Lunge_D_1 - Lunge_D_2	-.300	.483	.153	-.646	.046	-1.964	9	.081
Pair 9	Lunge_T_1 - Lunge_T_2	-.500	.972	.307	-1.195	.195	-1.627	9	.138
Pair 10	Ankle_T_1 - Ankle_T_2	-.800	1.229	.389	-1.679	.079	-2.058	9	.070
Pair 11	ShouldMob_S_1- ShouldMob_S_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 12	ShouldMob_D_1 - ShouldMob_D_2	-.600	.516	.163	-.969	-.231	-3.674	9	.005
Pair 13	ShouldMob_T_1 - ShouldMob_T_2	-.700	.483	.153	-1.046	-.354	-4.583	9	.001
Pair 14	ShouldClear_T_1 -ShouldClear_T_2	-.500	.707	.224	-1.006	.006	-2.236	9	.052
Pair 15	Leg_S_1 - Leg_S_2	-.600	.843	.267	-1.203	.003	-2.250	9	.051
Pair 16	Leg_D_1 - Leg_D_2	-.300	.483	.153	-.646	.046	-1.964	9	.081

Paired Samples Test

Pair (P)		Diferențele perechilor							
					Gradul de încredere (95%)				
		Media	Deviația standard	Media erorii standard	Inferioară	Superioară	t	df	Sig. (p)
Pair 17	Leg_T_1 - Leg_T_2	-.600	.699	.221	-1.100	-.100	-2.714	9	.024
Pair 18	Trunk_S_1 - Trunk_S_2	-.200	.422	.133	-.502	.102	-1.500	9	.168
Pair 19	Trunk_D_1 - Trunk_D_2	-.200	.422	.133	-.502	.102	-1.500	9	.168
Pair 20	Trunk_T_1 - Trunk_T_2	-.500	.972	.307	-1.195	.195	-1.627	9	.138
Pair 21	Extension_1 - Extension_2	.100	.316	.100	-.126	.326	1.000	9	.343
Pair 22	Rotary_S_1 - Rotary_S_2	-.400	.516	.163	-.769	-.031	-2.449	9	.037
Pair 23	Rotary_D_1 - Rotary_D_2	-.500	.527	.167	-.877	-.123	-3.000	9	.015
Pair 24	Rotary_T_1 - Rotary_T_2	-.800	.789	.249	-1.364	-.236	-3.207	9	.011
Pair 25	Flexion_1 - Flexion_2	.200	.422	.133	-.102	.502	1.500	9	.168

Subject A.M. in The Initial Testing obtained a total score of 12 points and after applying the FMS exercise protocol to the Final Test he obtained a score of 17 points. This shows us an improvement in terms of correction of movements during tests. There has been an improvement in Shoulder Mobility, Active Straight-Leg Raise and Rotary Stability after applying the protocol. The A.T. subject in the Initial Testing obtained a total score of 8 points and after applying the FMS exercise protocol to the Final Test obtained a score of 17 points. This shows us an improvement in terms of correction of movements during tests. There was an improvement in Deep Squat, Ankle Clearing, Active Straight-Leg Raise Flexion Clearing and Extension Clearing after applying the protocol and the pain disappeared, both during the Final Testing and in practicing free time physical activities. Subject A.C. in the Initial Test obtained a total score of 13 points and after applying the FMS exercise protocol to the Final Test obtained a score of 19 points. This shows us an improvement in terms of correction of movements during tests. There was an improvement in Ankle Clearing, Active Straight-Leg Raise and Rotary Stability and the pain in the shoulder disappeared after the protocol was applied. Subject C.C. in the Initial Test obtained a total score of 15 points and after applying the FMS exercise protocol to the Final Test obtained a score of 16 points. This shows us a small improvement in terms of correction of movements during tests. It is recommended to apply the FMS protocol for a longer period of time. There has been an improvement in Ankle Clearing but the yellow color of the Final Test result indicates that we take care with the subject and that we continue to correct the movement. Subject G.B. in The Initial Testing obtained a total score of 11 points and after applying the FMS exercise protocol to the Final Test he obtained a score of 16 points. This shows us an improvement in terms of correction of movements during tests. There was an improvement in Shoulder Mobility, Active Straight-Leg Raise and Rotary Stability and the pain in the shoulder and Rotary Stability disappeared after applying the protocol The M.S. subject scored 15 points in both the Initial Test and the Final Test. Even though the score was the same, there was an improvement in movements, better stability in Ankle Clearing and Active Straight-Leg Raise. The R.R. subject at the Initial Testing obtained a total score of 13 points and after applying the FMS exercise protocol to the Final Test obtained a score of 20 points. This shows us an improvement in terms of correction of movements during tests. An improvement was observed in Hurdle Step, Ankle Clearing where the pain disappeared and Shoulder Mobility after the protocol was applied. The R.H. subject in the Initial Testing obtained a total score of 9 points and after applying the FMS exercise protocol to the Final Test obtained a score of 12 points. This shows us an improvement in terms of correction of movements during tests, but we recommend applying the FMS protocol because it is noticed difficulties in execution during In-line Lunge, Ankle Clearing and Active Straight-Leg Raise. Subject S.M. in The Initial Test obtained a total score of 15 points and after applying the FMS exercise protocol to the Final Test obtained a score of 19 points. This shows us an improvement in terms of correction of movements during tests. An improvement was observed in the Shoulder Rotary Stability after applying the pain protocol, which also disappeared. The V.H. subject in the Initial Testing obtained a total score of 17 points and after applying the FMS exercise protocol to the Final Test he obtained a score of 20 points. This shows us an improvement in terms of correction of movements during tests. There has been an improvement in shoulder mobility the movement being much more correct.

5. Conclusions

In conclusion, FMS ™ grows in popularity and use by fitness and rehabilitation professionals for functional screening of athletes, patients and clients. Total FMS scores ™ seem to be able to be reliably scored among trained assessors, while individual tests vary in their ability to be assessed with reliability. The current results agree with those found by the previous authors, which suggest that the FMS compound test battery ™ can be used with confidence by trained assessors to assess fundamental motion patterns and reach a total score.

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The Pattern of Scored Goals in Women's Football Teams – Romania

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Abstract
Purpose. The aim of the work is to analyze the way of scoring goals in the Selena women's football team.
Methods. For this, we analyzed the matches of the National Women's Football League championship of the Selena Constanta Team, respectively the matches of the Vasas Odorheiul Secuiesc Team. To obtain the information, we used the FRF TV website and the videos posted by the teams on their pages. The analysis consisted of recording the following data: - the field area where the goals were scored; - the gate area where the goals were scored; - the time period in which the goals were scored; - the percentage of goals scored in each field area shown; - the percentage of goals scored in each area of the gate perimeter.
Results. The most goals were scored in zone G for both teams, the percentage being 18.18% (Selena) and 22.58% (Vasas). In the Selena team, the scoring percentage in the upper areas of the gate are lower than the the center area, respectively the lower area of the gate, which has the best percentage. In the upper area of the gate, the highest percentage is in the center, in area B (11.36%), while the upper lateral areas, A (6.81%) and C (4.54%), have a percentage deficit. The highest enrollment percentages at Vasas are from zones I (16.12%), II (54.83%), III (12.90%), while at Selena the highest percentages are from zones I (27.27%), II (36.36 %) and VI (15.10%). In the Selena Team, the most goals, in absolute value, were scored between minutes 16-30. Vasas, however, do not have a favorite time period, this having goals scored equally in 3 time periods

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of the match, these being from the 31st minute to the 75th minute. Regarding the total number of goals scored in each half, we note that the number of goals scored by the Selena Constanta Team is higher in the first half than the second - 26 goals compared to 18 goals in the second half. While, for the team from Odorheiul Secuiesc, the ratio is reversed - the number of goals scored is higher in the second half, compared to the first half, namely 19 goals scored in the second half, compared to only 11 in the first half.

Conclusions. The most goals were scored from the central axis of the gate perimeter and predominantly from zones II and I - Selena Constanța 28 goals, Vasas - 22 goals. The most goals were scored from zone II both at Selena Constanța (16 goals) and at Vasas (17 goals). Most goals were scored in the lower left corner (zone G) for both teams, the percentage being 18.18% (Selena) and 22.58% (Vasas). The most productive period of scoring a goal was the middle of the first half, for the Selena Constanta Team, followed by the first 15 minutes of the second half, while for the Vasas Team, the most productive periods are the end of the 1st half and the first half of the 2nd half. The number of goals scored by the Selena Constanta Team is higher in the first half compared to the second - 26 goals compared to 18 goals in the second half. While, at the team from Odorheiul Secuiesc, the ratio is reversed - the number of goals scored is higher in the second half, compared to the first half.

Keywords: *notational analysis, women's football, goal scoring pattern.*

1. Introduction

Early research that used notational analysis focused on the analysis of each movement or rate of effort during a soccer match (Yamanaka & Hughes, 1993). As a result of the data provided by the notational analysis and based on comprehensive statistics of the number of goals scored, some practitioners were able to formulate the laws of training.

Considerable effort has been devoted to establishing objective forms of analysis and demonstrating their importance in the training process (Bangsbo & Peitersen, 2000). But there are difficulties faced by any individual trying to objectively analyze and remember the events that occur in complex team games such as football. One of the main solutions to these inherent problems has been the use of notational analysis systems. Coaches, researchers in the field have designed and developed information collection systems that over the last three decades have been markedly improved (Jones, James & Mellalieu, 2004).

While the traditional analyst often used a pen and notebook to write down all the events he considered relevant, technologies such as Opta, Dartfish or Sportscode have become a central asset for today's notational analysts (Hughes & Franks, 2001). The use of a video camera and video analysis software can now provide the analyst with a wide range of features and tools to collect as much information as is needed to assess performance against specific performance indicators (Olsen, 1995, Murphy, Reilly & Spinks, 2002).

Notational analysis is a technique by which the permanent recording of the actions that belong to a sports event is made and is widely used by sports teams (Mitrotasios & Armatas, 2014, Gidu, et all, 2021). In football, notational analysis has provided and continues to provide valuable information that coaches and athletes use to improve their training process. Since scoring a goal is the most important action in football, most notational analyzes have been made in this direction. A number of authors have found that a large proportion of goals are scored from free kicks, which represent 1/3 of all goals scored (Bangsbo & Peitersen, 2000, Scanlan, et al., 2020, Mușat et all, 2021).

Since, according to our knowledge, not many studies have been carried out in Romania that have as their theme this type of analysis in women's football, we thought that a work like this can be not only interesting, but also particularly useful for specialists in the field.

We assumed that the analysis of the way goals are scored in women's football teams can reveal different patterns in matches played at home, compared to those played away.

2. Method

For this, we analyzed the matches of the National Women's Football League championship of the Selena Constanta Team, respectively the matches of the Vasas Odorheiul Secuiesc Team. To obtain the information, we used the FRF TV website and the videos posted by the teams on their pages. The matches of the 2 teams were analyzed during 3 competitive seasons, starting with the 2018-2019 season – 120 soccer games, 60 for each team. The study was based on the researcher's personal observation that recorded the following data:

- the field area where the goals were scored (Figure 1);
- the goal area where the goals were scored (Figure 2);
- the time period in which the goals were scored;
- the number of goals scored;

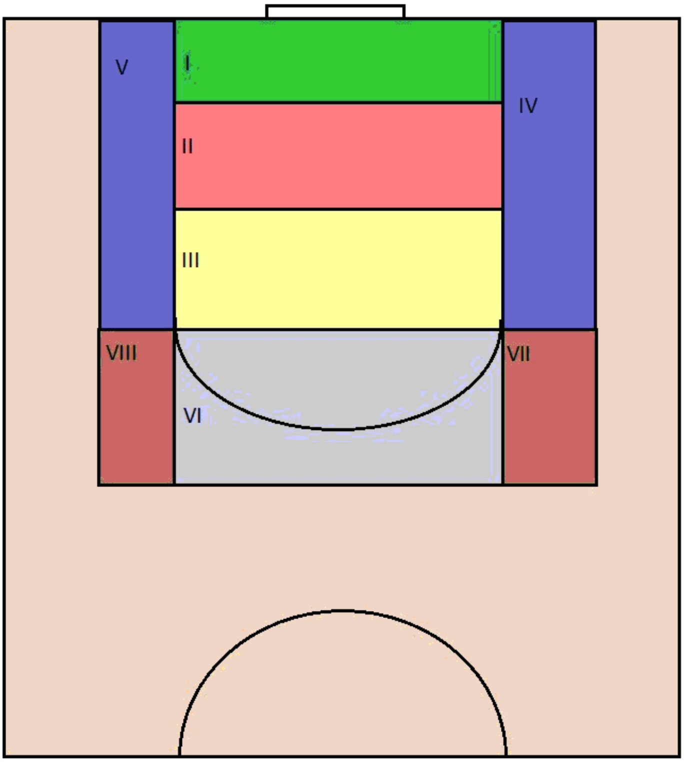

Figure 1. The areas of the field where the goals were scored

I. the 6m square; II. the space between the edge of the 6m square and the point at 11m; III. the space between the point at 11m and the edge of the 16m square; IV. the space located on the right side of the 16m square and contained between its lateral edge and that of the 6m square (which extends imaginarily up to 16m); V. the space located on the left side of the 16m square and contained between its lateral edge and that of the 6m square (which extends imaginary up to 16m); VI. the space located outside the 16m square, contained between the side lines of the 6m square, imaginary extended; VII. the space located outside the 16m square, on the right side, between the lateral lines of the 16m and 6m squares, imaginary extended; VIII. the space located outside the 16m square, on the left side, between the side lines of the 16m and 6m squares, imaginary extended

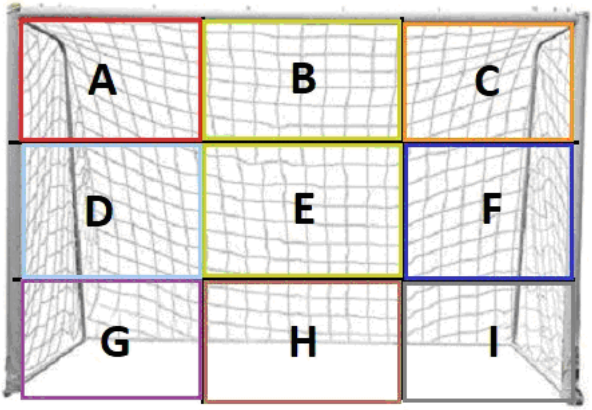

Figure 2. The areas of the goal where the goals were scored

A - left link of the gate; B - the center of the top gate; C - right link of the gate; D - half height left; E - half height of the center of the gate; F - half height right; G - lower left corner; H - the center of the lower gate; I - lower right corner.

3. Results

3.1. The field area where the goals were scored

The highest enrollment percentages at Vasas are from zones I (16.12%), II (54.83%), III (12.90%), while at Selena the highest percentages are from zones I (27.27%), II (36.36 %) and VI (15.10%).

3.2. The area of the goal where the goals were scored

Most goals were scored in zone G for both teams, the percentage being 18.18% (Selena) and 22.58% (Vasas). In the Selena team, the scoring percentage in the upper areas of the goal are lower than the area in the center of the goal, respectively the lower area that has the best percentage.

3.3. Time period in which goals were scored

In the Selena team, the most goals, in absolute value, were scored between minutes 16-30. Vasas, however, do not have a favorite time period, this one having goals scored equally in 3 time periods of the match, respectively from the 31st minute to the 75th minute, proving that they have a more homogeneous team and a better physical condition.

The number of goals scored. Regarding the total number of goals scored in each half, we note that the number of goals scored by the Selena Constanța team is higher in the first half compared to the second - 26 goals, respectively, 18 goals in the second half. While, for the team from Odorheiul Secuiesc, the ratio is reversed - the number of goals scored is higher in the second half, compared to the first half, namely 19 goals scored in the second half, compared to only 11 in the first half.

4. Discussions

4.1. The field area where the goals were scored

Looking at the graph below, it can be seen that the most goals were scored from zone II both at Selena Constanța (16 goals, which means 36.36%), and at Vasas, where more than half of the total goals were scored from this area (17 goals, respectively 54.83%).

At Selena, from zone I, a percentage close to that recorded in zone II was scored, the difference being four goals (12 goals from zone I and 16 from zone II).

In third place in terms of scored goals is zone VI with a significantly lower number of goals compared to the first two zones (7 goals).

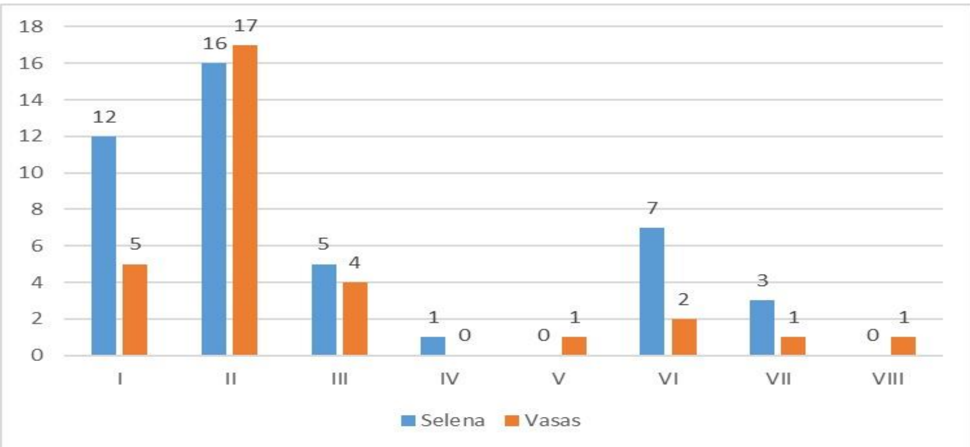

Figure 3. The field area where the goals were scored

The most goals scored in Vasas are from zones II (17 goals), I (5 goals) and III (4 goals), while in Selena the highest percentages are from zones II (16 goals), I (12 goals), and VI (7 goals). The first two areas are common to both teams, the difference being Selena's VI area, which proves that they had a better percentage of scoring goals from outside the 16m box. Regarding the side areas of the 16m box m (zone IV and V), as expected, the number of goals scored is lower than the central zones in both Selena and Vasas, both teams having only one goal scored from the side zones. And Garganta J (1995), Yiannakos & Armatas (2006), Armatas et all (2007) and Kubay (2020) find that the majority of goals were scored inside the goal area.

4.2. The area of the goal where the goals were scored

The most goals were scored in the G zone for both teams, 8 for Selena and 7 for Vasas. In the Selena team, the number of goals scored in the upper areas of the goal is lower than the area in the center of the goal, respectively the lower area that has the best percentage. In the upper area of the goal, the highest number of goals scored is in the center, in area B (5), while the upper side areas, A (3 goals) and C (2 goals), are poorly exploited.

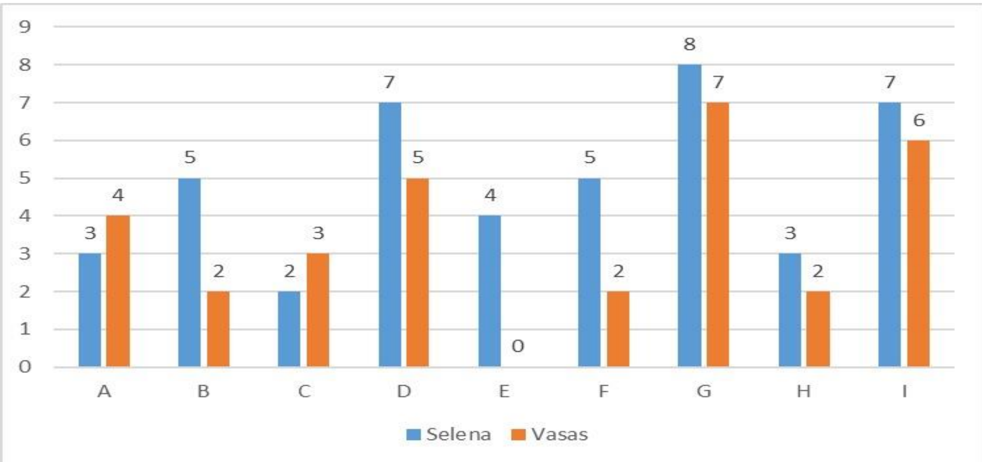

Figure 4. The goal area where the goals were scored

The D-G side area is superior to the F-I area, scoring more goals on the left side of the goal – 15 goals (area D -7 and area G – 8 goals), while a total of 12 goals were scored in the right area of the goal (zone F - 5 and zone I – 7 goals). From the total surface of the goal, the most accessed part is the lower area, made up of areas G, H, I. After this analysis, I noticed that the shots placed in the lower corners were more favorable to the Selena team. In zones E and H it is less likely to score goals, because these zones are always covered by the goalkeeper. In the Vasas team, most goals are scored on the left side of the goal, namely zone A (4 goals), D (5 goals) and G (7 goals). As with the Selena Constanța team, most of the goals were scored in the lower right and left corners.

4.3. Time period in which goals were scored

In the Selena team, the most goals, in absolute value, were scored between minutes 16-30, respectively 12 goals. Vasas, however, do not have a favorite time period, this having equal goals scored in 3 time periods, namely, 31-45, 40-60 and 61-75, proving that they have a more homogeneous team and a better physical condition.

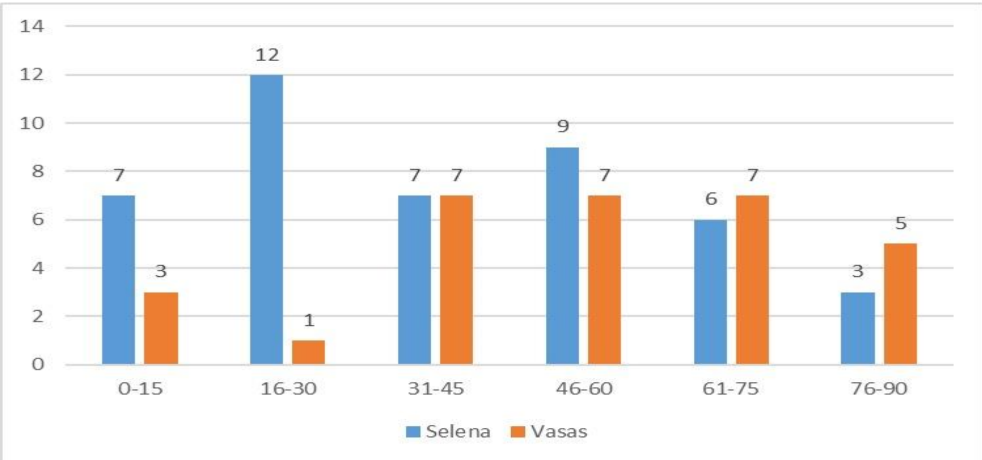

Figure 5. The time period in which the goals were scored

4.4. The number of goals scored

Regarding the total number of goals scored in each half, we note that the number of goals scored by the Selena Constanța team is higher in the first half compared to the second - 26 goals compared to 18 goals in the second half. While, for the team from Odorheiul Secuiesc, the ratio is reversed - the number of goals scored is higher in the second half, compared to the first half, namely 19 goals scored in the second half, compared to only 11 in the first half.

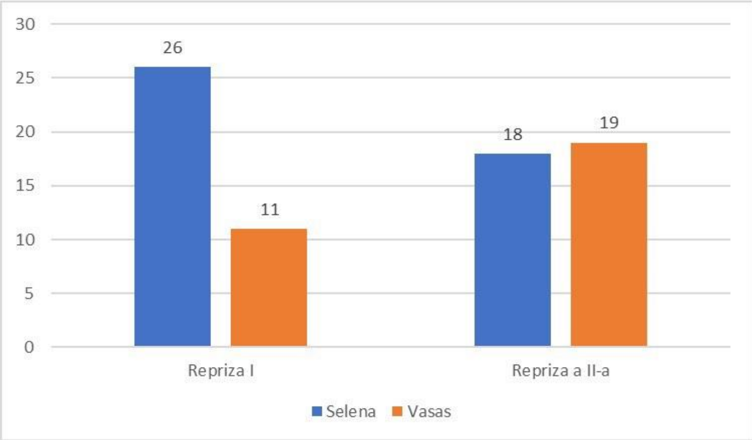

Figure 6. The number of goals scored

Overall, the efficiency in terms of goals scored is higher for the seaside team – 44 goals, compared to 30 goals for the Vasas team. The difference can be attributed to the value of the echelon in which the two teams evolve. At the Selena Constanța team, I also watched the matches from the second echelon of women's football - where the level of the participating teams is not that high. While at the Vasas team, I only watched the matches in the League 1 championship, where, the value of the teams being more homogeneous, fewer goals are scored.

Armatas et all (2007) and Kubay (2020) concluded that more goals were scored in the second half (52.4 vs. 47.6).

5. Conclusions

Most goals were scored from the central axis of the goal and predominantly from zones II and I - Selena Constanța 28 goals, Vasas - 22 goals.

The most goals were scored from zone II both at Selena Constanța (16 goals) and at Vasas (17 goals).

Most goals were scored in the bottom left corner (zone G) for both teams, the percentage being 18.18% (Selena) and 22.58% (Vasas).

The most productive period of scoring a goal was the middle of the first half, for the Selena Constanța team, followed by the first 15 minutes of the second half. While for the Vasas team, the most productive periods are the end of the 1st half and the first half of the 2nd half.

The number of goals scored by the Selena Constanța team is higher in the first half compared to the second - 26 goals compared to 18 goals in the second half. While, at the team from Odorheiul Secuiesc, the ratio is reversed - the number of goals scored is higher in the second half, compared to the first half.

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Sports Supplements in COVID-19 Prophylaxis

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Abstract
Sarcopenia is an aggravating factor in the evolution of COVID-19.Avoiding its installation could be a prophylactic and curative factor.Therefore, the prophylaxis of severe forms of COVID-19 through exercise could be supported by the administration of supplements based on arginine, glutamine, n-3 PUFA or carnitine.These substances have roles in treating sarcopenia, stimulating immunity and mitochondrial biogenesis, interferon metabolism.These antioxidants could accelerate the adaptation of the vascular endothelium to exercise and thus prevent infection with SARS-CoV-2.The beneficiaries could be especially the elderly, those suffering from type 2 diabetes, liver cirrhosis, cardiovascular diseases (diseases at risk for COVID-19).Individuals with genetic defects in interferon metabolism, for the purpose discussed in this paper, should perhaps avoid n-3 PUFA supplementation.

Keywords: *sports supplements; COVID-19; sarcopenia.*

1. Introduction

During COVID-19 infection, hospitalized patients at risk for sarcopenia have an increased risk of mortality (Riesgo et al, 2021). .In a review article discussing whether COVID-19 may be a factor for cachexia in intensive care patients (Virgens et al., 2021) the following facts, taken from the literature, are set out:

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- arginine and glutamine are non-essential amino acids for which the role in recovery of critically ill patients is discussed, but for striated muscles the effect is unclear (Singer et al., 2019)
- n-3 PUFAs have been shown to optimize tissue recovery (AssociaçãoBrasileira de CuidadosPaliativos, 2011)
- l-Carnitine supplementation has protective effects against several mechanisms of induction of sarcopenia, favoring protein synthesis (Esfahani et al, 2019)

These substances are used as sports supplements, namely arginine (Viribay et al., 2020), glutamine (Coqueiro et al., 2019), n-3 PUFA (Gammone et al., 2018), l-Carnitine (Sawicka et al., 2020).Given the special role of moderate-intensity exercise in preventing hospitalized forms of COVID-19 (Hagiu, 2021), the question may arise whether supplementing with certain substances in certain categories would not increase the chances of preventing COVID-19 in case of SARS-CoV-2 infection, as well as creating the premise of an easier evolution.Therefore, the paper aims to analyze the effects of these supplements on sarcopenia, immunity (its role in the fight against COVID-19 is studied – Chowdhury et al. 2020), stimulation of mitochondrial biogenesis (the main factor in preventing severe forms of COVID-19 through exercise – Hagiu, 2020). Given that exercise can improve the ability to defend against SARS-CoV-2 in individuals who are genetically deficient in interferon metabolism (Hagiu, 2021b), the paper also aims to investigate the action of these supplements on this issue.

2. Effects of arginine, glutamine, n-3 PUFA or carnitine supplementation on COVID-19 evolution

2.1. Roles for treating sarcopenia

a) Arginine and glutamine supplementation has been shown to be useful in the nutritional management of type 2 diabetes sarcopenia (Maykish&Sikalidis, 2020). It is known that diabetes itself is a risk factor for severe forms of COVID-19 (Zhou et al, 2021).

b) Although the dosage still needs to be investigated, supplementation with n-3 PUFA is a future alternative for the treatment of sarcopenia due to age (Dupont et al., 2019).

c) L-carnitine stops the decrease in muscle mass caused by liver cirrhosis (Ohara et al., 2018) the effect may be due to downregulated myostatin (Nakano et al., 2020). Data from the specialized literature suggest that pre-existing liver diseases worsen the evolution of COVID-19 (Mohammed et al., 2021)

2.2. Roles in immunity

a) l-arginine and its metabolites (e.g., ornithine and citrulline) are able to activate T-cells (Kim et al., 2018). This fact is of particular importance, as the protective role of T-cells in COVID-19 is known (Noh et al., 2021)

b) The functioning of the immune system is dependent on the intake of glutamine, this amino acid controlling the expression of specific genes (Curi et al., 2016).

c) n-3 PUFA acts on cells involved in inflammation and immunity, having anti-inflammatory and immunomodulatory effects (Calder, 2013).

d) A study in experimental animals (rats) showed that supplementation with L-carnitine may have the effect of improving immunity in elderly animals, in which there is a decline in this function (Thangasamy et al., 2008).

Stimulation of mitochondrial biogenesis

a) L-Arginine supplementation is beneficial in patients with mitochondrial etiology (Barros et al., 2021)

b) There are arguments that glutamine stimulates mitochondrial biogenesis (Sumikawa et al., 2022), (Kumar, Giri&Shaha, 2018)

c) The same activation of mitochondrial biogenesis can be obtained by supplementation with n-3 PUFA (Flachs et al., 2005).

d) Due to the ability of carnitine to act as a type 1 histone deacetylase inhibitor, supplementation can stimulate mitochondrial biogenesis in the elderly (Mccarty, DiNicolantonio& O'Keefe, 2020), category at risk for SARS-CoV-2 infection and COVID-19 complications.

2.3. Effects on interferon metabolism

a) Arginine has an effect on the biological action of IFNβ-1b, therefore it can be used for new formulations (Fazeli et al., 2014).

b) In vitro, an increased intake of glutamine has been shown to increase interferon-gamma production (Boelens et al., 2004).

c) In contrast, in experimental animals (mice), n-3 PUFA has been shown to reduce the expression of interferon-gamma receptors (Feng, Keisler& Fritsche, 1999).

As expected from the previous paragraph, supplementation with these substances may influence the evolution of COVID-19, including in terms of amelioration of sarcopenia:

a) The addition of oral L-arginine to standard therapy in patients with COVID-19 significantly reduces the length of hospital stay and the need for respiratory assistance to 10, but not to 20 days after starting treatment (Fiorentino et al., 2021)

b) According to some research, glutamine, as an antioxidant, can be used in the treatment of moderate-severe forms of COVID-19, resulting in a reduction in the severity of sequelae (Adebola Okunola, 2021)

c) n-3 PUFA and their metabolites have been considered to have an adjuvant role in the treatment of COVID-19 and cardiovascular complications of this disease (Darwesh et al., 2021)

d) A genetic predisposition to high plasma concentrations of carnitine may reduce the likelihood of COVID-19 disease and the severity of the disease, this supplement, a potential substitute for dexamethasone, exerting its action through its molecular functions (Li et al., 2021)

Table 1 summarizes the supplementary roles of arginine, glutamine, n-3 PUFA and carnitine on sarcopenia, immunity, stimulation of mitochondrial biogenesis, and interferon metabolism.

Table 1. Effects of supplements on sarcopenia, immunity, mitochondrial biogenesis, interferon metabolism

	Roles for treating sarcopenia	**Roles in immunity**	**Stimulation of mitochondrial biogenesis**	**Effects on interferon metabolism**
arginine	+ (Maykish&Sikalidis, 2020)	+ (Kim et al., 2018)	+ (Barros et al., 2021)	+ (Fazeli et al., 2014)
glutamine	+ (Maykish&Sikalidis, 2020)	+ (Curi et al., 2016)	+ (Sumikawa et al., 2022), (Kumar, Giri&Shaha, 2018)	+ (Boelens et al., 2004)
n-3 PUFA	+ (Dupont et al., 2019)	+ (Calder, 2013)	+ (Flachs et al., 2005)	- (Feng, Keisler& Fritsche, 1999)
carnitine	+ (Ohara et al., 2018)	+ (Thangasamy et al., 2008)	+ (Mccarty, DiNicolantonio& O'Keefe, 2020)	there are no data

3. Discussions

Antioxidant supplements were proposed for the elderly in combination with resistance exercises to increase muscle mass (Labonté et al., 2008). Antioxidants such as quercetin and vitamin C have been proposed for the prevention of COVID-19 (ColungaBiancatelli et al., 2020), and theoretically antioxidants can accelerate the adaptation of the vascular endothelium to effort and prevent infection with SARS-CoV-2 (Hagiu, 2021a). Supplementation with the substances discussed in the paper can be especially beneficial for the elderly, sufferers of type 2 diabetes, cirrhosis of the liver, cardiovascular diseases.Ideally, the supplement should support the prophylactic use of moderate-intensity exercise programs for severe forms of COVID-19. In those with genetic disorders of interferon metabolism, the administration of n-3 PUFA supplements would require caution.

4. Conclusions

The administration of supplements based on arginine, glutamine, n-3 PUFA or carnitine, preferably in support of moderate-intensity exercise programs, could potentiate the effects of preventing hospitalization of COVID-19 and the course of the disease. This is due to multiple metabolic pathways, to which is added the prevention or improvement of sarcopenia.The beneficiaries are mainly the elderly, but also those suffering from type 2 diabetes, liver cirrhosis, cardiovascular diseases.In the case of a genotype characterized by poor interferon metabolism, n-3 PUFA supplements should be avoided.

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Exploring Differences in Gait Assessment Using Inertial Sensors Among Elderly

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Abstract
Introduction: The general life expectancy for the elderly over 60's is constantly growing and with old age the risk of chronic diseases and health limitations increases. This leads to an increasing need for facilities in the health and social system. Being aware of the necessities of instrumented assessment we can act better to prevent falls, understand different gait patterns, and improve quality of life in this category. **Objective**: For this study, we aimed to analyze and identify the differences and/or similarities found after the assessment of the elderly with and without Parkinson's disease in terms of gait and risk of falling with the help of inertial sensors. **Methods**: A total of 20 participants were recruited for this study, 10 elderly people without neurological pathologies (mean age 76 ± 7.13 years) and 10 participants with Parkinson's disease (mean age 72.7 ± 8.32 years). The measurements were performed using the inertial sensor G-Walk, which transmitted information via Bluetooth to the software while participants were asked to perform the Timed Up and Go Test (TUG) and then the walking analysis over a distance of 10 meters. Results: For the TUG test only 5 out of the 17 variables extracted for the analysis, were statistically significant different. The Parkinson Disease group had a higher risk of falling compared to the elderly group, without neurological pathologies. **Conclusions**: BTS G-WALK system provide an accurate and reliable method of assessment, detecting even minimal changes in the patient's motor performance, which is impossible in case of classical assessments. This assessment, which is essential in the field of rehabilitation, helps specialists in the field to identify, quantify and monitor the effectiveness of recovery treatments and intervention programs.

Keywords: *risk of falling; gait; Parkinson; elderly; inertial sensors.*

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1. Introduction

The World Health Organization (WHO) estimates that by 2050, the global population of the elderly over 60 will increase to 2 billion, compared to 900 million in 2015. The general life expectancy for this category is constantly growing and with old age the risk of chronic diseases and health limitations rises, leading to an increasing need for facilities in the health and social system (World HealthOrganization, 2022). Along with the increase in life expectancy, the interest in finding effective solutions for improving the quality of life become more acute. More and more researchers are looking for solutions to identify the best methods of evaluation (Frontera, 2003). The necessity of using innovative technologies in the medical field made the utilization of wearable inertial sensors in the assessment and rehabilitation field a must (Bonato, 2005; Ruiz-Ruiz, 2021).

Based on recent surveys, the prevalence of neurological diseases in the elderly population is increasing. (Dumurgier & Tzourio, 2020) Among these neurological diseases Parkinson's is one of the most encountered, being based on the progressive degeneration of various areas of the brain that produce dopamine and mostly affecting people over 50 years. (Slaughter, 2001)

Bradykinesia, stiffness, rest tremor and postural instability are the hallmarks of the disease and have a negative impact on movement quality, gait performance, balance, and risk of falling (Brodie, 2014). In addition, non-motor features such as cognitive decline, fatigue, apathy, and depression are common and substantially affect patient functioning and quality of life (Rizos, 2014).

Inertial sensors are an excellent option for evaluating the biomechanics of human movement (Kobsar, 2020). These technologies use accelerometers, magnetometers and gyroscopes and can be a bridge between the complex systems found in movement analysis laboratories and clinical systems. They bear a potential for dynamic three-dimensional analysis of gait without the various constraints like space or costs (Muro-de-la-Herran, Garcia-Zapirain, & Mendez-Zorrilla, 2014).

In recent years, the validity and reliability of wearable inertial sensors have been the subject of many studies (Macadam, Cronin, Neville, &

Diewald, 2019) (Mark, Schall, Chen, & Cavuoto, 2022), including fall risk assessment in which researchers (Montesinos, 2018) showed that inertial sensors provides an objective data and a greater accuracy.

The aim of the present research was to analyze and identify the differences and similarities, found after the assessment of the elderly without neurological pathologies and Parkinson's disease patients, in terms of gait and risk of falling with the help of inertial sensors.

2. Materials and Methods

A total of 20 participants from Cluj-Napoca were recruited for this study, 10 elderly people without neurological pathologies (mean age 76 ± 7.13 years) and 10 participants with Parkinson's disease (mean age 72.7 ± 8.32 years). The demographic and anthropometric characteristics of the subjects are summarized in Table 1.

Table 1. Demographic and anthropometric characteristics of the subjects

Group	*Subjects (n)*	*Gender (F /M)*	*Age (years)*	*Weight (kg)*	*Height (m)*	*BMI*
Parkinson's	**10**	**7/3**	**72.7 ± 8.32**	**79.4± 23.09**	**1.61± 1.14**	**30.43± 6.77**
Elderly	**10**	**8/2**	**76 ± 7.13**	**74.10± 13.11**	**1.62± 1.17**	**28.13± 3.76**

Mean ± standard deviation, BMI - body mass index

From the point of view of demographic and anthropometric data, no significant differences were identified between the two groups. The patients were informed about the study and gave their consent by signing the informed consent form, assuring them of the confidentiality of the recorded data.

The inclusion criteria for the elderly group were:

- the ability to walk without physical assistance or assistive devices,
- the absence of neurological diseases,
- age over 60 years.

For the Parkinson's group, the inclusion criteria were:

- patients with confirmed Parkinson's disease,

- permission from the neurologist to carry out physical activity,
- Hoehn & Yahr scale (H&Y) ≤3 in Levodopa "ON" conditions,
- partial or total autonomy of the patient to walk.

For the present study we used as an assessment tool the BTS G-Walk system (BTS Bioengineering S.p.A. Italy), a wireless system consisting of an inertial sensor, composed of a triaxial accelerometer, a magnetic sensor, and a triaxial gyroscope that is positioned on the L5 vertebra allowing a functional analysis of gait. (Bissolotti, Gaffurini, & Meier, 2015)

The tests performed using the G-Walk system were as follows:

The Timed Up and Go (TUG) test is widely used in healthcare to assess fall risk and distinguish between high and low fallers. Also, the TUG test, in addition to the risk of falling, assesses the tested person's mobility and balance. Before sitting in the chair, the patient was strapped with the G-Walk sensor at the L5-S1 level. Then the patient sat on a chair, with his back against its back and his feet on the ground. It is recommended to use a chair with the seat at a height of 44-47 cm. The patient stands up at the therapist's command: he walks 3 meters at a comfortable speed, turns around, bypassing the 3-meter mark and sits down after turning his back to the chair. Timing starts at the "Start" command and stops when the patient is back in the chair.

There are several opinions regarding the interpretation and normal values of this test, the average times obtained varying according to the study and the participants. According to Shumway-Cook et. all if a patient performed the test in 14 seconds or more, then he was classified as at high risk of falling (Shumway-Cook, 2000). Average TUG scores can range from 8 to 12 seconds (in people with Parkinson's disease) to 13.5 seconds (elderly) or 15 seconds (if subjects have fallen prior to the test or have a double duty) (Morris, 2001).

Following the TUG evaluation, an individual report was generated on the evaluated parameters: duration of TUG analysis, fall risk. Also, the assessment with the G-Walk sensor allowed us to analyze this test in stages, more precisely the values obtained in seconds for different parameters: rising from the chair, walking forward, bypassing the 3 m sign, turning, sitting on the chair, acceleration anterior-posterior, lateral, vertical. This would not have been possible through a classic evaluation.

Gait analysis – 10 m walking test

After establishing the distance of 10 meters in the corridor of the institution, we trained the patients in sight covering the predetermined distance, at a speed at which he usually walks. After that, he was fitted with the belt with the G-Walk sensor, at the L5-S1 level. The BTS G-Walk system measures gait cycles performed by the right lower limb and the left lower limb.

The data obtained after the gait evaluation: the qualitative index of the walking cycles performed by the left lower limb LEFT WALK QUALITY INDEX, respectively the right lower limb – RIGHT WALK QUALITY INDEX, the symmetry index that shows the symmetry between the walking cycles performed by the right lower limb compared to the left lower limb and propulsion

Main characteristics obtained from the evaluation:

1. analysis of the spatio-temporal parameters of walking:

- evaluation duration (evaluated in seconds)
- cadence (number of steps/minute)
- walking speed (meters/second)
- the length of the walking cycle for the left side and for the right side expressed in meters
- the length of the walking cycle for the left side and for the right side expressed as a percentage
- the number of steps analyzed

2. analysis of the symmetry of the pelvic kinematics in the three planes: sagittal, frontal, and transverse.

In our research, we considered only the spatio-temporal parameters for the statistical analysis.

3. Statistical Analysis

In the framework of the preliminary research, the data obtained from the evaluations were exported to Microsoft Excel following their processing and interpretation with the help of IBM SPSS Statistics 23 (Statistical Package for Social Sciences) statistical program, that allowed the creation of statistical-mathematical indices such as:

- Mean
- Standard deviation.
- Minimum value.
- Maximum value.

T-tests were performed to compare groups for age, body mass, and body height. The first tests applied in the statistical analysis were the Shapiro-Wilk test for testing the normality of the data distribution and the homogeneity of variance test (Levene's). The meaning statistic was set at a threshold value of 0.05. The effect size was calculated with the formula Cohen's ratio given by the ratio of the difference of the means (M) of the two groups to the mean of the standard deviations (SD) of the two groups, as follows: *effect size = M1(gr1) – M2(gr2)/ (SDgr1 + SDgr2)/2* (Cohen, 1988)

4. Results

The total duration of the TUG test varied greatly between the two groups (table 2), the software automatically classifying those in the Parkinson's group as being at increased risk if they recorded values >12 s.

Recorded values ranged from 10.76 to 37.85 s for both groups. The subjects in the elderly group obtained an average TUG time of 14.10 ± 2.25 and those in the Parkinson's group obtaining an average time of 23.65 ± 9.74 s, the result being statistically significant different between the two groups in terms of TUG duration (p=0.007, Cohen's d=1.34).

Table 2. Spatiotemporal parameters for timed up and go test (TUG)

TUG Parameters	Group	Mean	Standard deviation	Standard error	*p*
TUG analysis duration	EG	14,104	2,256	0,713	0,007
	PD	23,652	9,745	3,082	
Forward gait (s)	EG	3,524	1,787	0,565	0,134
	PD	7,534	7,879	2,492	
Mid turning (s)	EG	2,921	0,652	0,206	0,064
	PD	3,516	0,695	0,220	
Return gait (s)	EG	3,174	1,360	0,430	0,452
	PD	4,339	4,594	1,453	

TUG Parameters	Group	Mean	Standard deviation	Standard error	p
End turning (s)	EG	1,700	0,772	0,244	0,005
	PD	2,842	0,838	0,265	
STS duration (s)	EG	0,980	0,282	0,089	0,034
	PD	1,410	0,522	0,165	
STS AP acc m/s^2	EG	1,464	0,536	0,170	0,419
	PD	1,717	0,804	0,254	
STS lateral acc	EG	0,988	0,503	0,159	0,517
	PD	0,838	0,512	0,162	
STS vertical acc	EG	2,513	0,552	0,175	0,479
	PD	2,828	1,263	0,399	
Stand TS duration	EG	1,634	0,524	0,166	0,907
	PD	1,610	0,367	0,116	
Stand TS AP acc	EG	2,152	1,109	0,351	0,004
	PD	0,914	0,445	0,141	
Stand TS lateral acc	EG	2,022	0,824	0,260	0,048
	PD	1,294	0,702	0,222	
Stand TS vertical acc	EG	2,652	1,381	0,437	0,849
	PD	2,512	1,838	0,581	
STS flexion peak	EG	23,750	9,501	3,004	0,204
	PD	29,860	11,175	3,534	
STS extension peak	EG	18,430	6,532	2,066	0,578
	PD	20,070	6,401	2,024	
Stand TS flexion peak	EG	30,750	6,125	1,937	0,578
	PD	28,810	8,932	2,825	
Stand TS extension peak	EG	7,360	5,406	1,710	0,062
	PD	3,790	1,697	0,537	

TUG – Timed Up and Go; STS – Sit to Stand; AP – antero-posterior; STS – Sit To Stand; Stand TS – Stand To Sit; acc – acceleration; EG – Elderly Group; PD – Parkinson's Disease

From the 17 variables extracted for analysis (table 2), only 4 were found to be statistically significant different, more precisely: the End Turning at 180^0 (p=0.005, Cohen d=1.41), the time to get up from the chair in STS (p=0.034, Cohen d=1.02), the antero-posterior acceleration during Stand to Sit AP acc (p=0.004, Cohen d=1.46) and the lateral acceleration Stand to sit lateral acc (p=0.048, Cohen d= 0.95).

Table 3. Gait parameters

Gait Parameters	Group	Mean	Standard deviation	Standard error	p
Walk QI left	EG	93.45	3.43	1.09	0.953
	PD	93.35	3.92	1.24	
	EG	93.76	3.59	1.14	

Gait Parameters	Group	Mean	Standard deviation	Standard error	*p*
Walk QI right	PD	92.87	8.39	2.65	0.761
Symmetry Index	EG	93.14	3.40	1.07	0.490
	PD	91.34	7.33	2.32	
Strides Length (m)	EG	1.10	0.14	0.04	0.504
	PD	1.06	0.14	0.05	
Left Stride duration (s)	EG	1.05	0.09	0.03	0.001
	PD	1.30	0.17	0.05	
Right Strides duration (s)	EG	1.04	0.08	0.03	0.001
	PD	1.30	0.18	0.06	
Propulsion Index Left	EG	5.78	1.36	0.43	0.017
	PD	4.22	1.30	0.41	
Propulsion Index Right	EG	5.54	1.56	0.49	0.019
	PD	3.87	1.31	0.42	
Cadence (steps/min)	EG	116.39	9.35	2.96	0.002
	PD	99.73	11.05	3.49	
Speed (m/s)	EG	1.06	0.17	0.05	0.018
	PD	0.87	0.17	0.05	

QI – Quality Index; (m) – meters; (s) – seconds; EG – Elderly Group; PD – Parkinson's Disease

Table 3 shows the parameters analyzed after the gait assessment. Out of the 10 parameters analyzed, significant differences could be observed between the two groups for the following variables: left and right stride duration (p=0.001, with strong effect size Cohen d=1.82, respectively d=1.83), left/right propulsion (p=0.017/p=0.019, with a strong effect size Cohen d=1.17, respectively d=1.15), cadence (p=0.002, Cohen d=1.62) and speed (p=0.018, Cohen d=1.16). As a conclusion, the elderly group without neurological pathologies presents significant differences, when compared to the one with Parkinson's disease, regarding the analysis of walking.

5. Discussion

Gait analysis using an inertial sensor system is indicated both in elderly people without neurological disease and in people suffering from neurological diseases, in our case Parkinson's disease, as it allows detailed quantitative and qualitative assessments, useful in scientific research and clinical practice.

The use of the BTS G-Walk instrument in the evaluation of the patients allowed us to carry out a complete initial analyzes, the tests being easy to perform generating results that could be compared with normal intervals.

The BTS G-Walk system offers a precise and reliable evaluation method, even detecting the patient's motor performance changes, which is impossible in the case of a classic evaluation. This evaluation, essential in the field of rehabilitation, helps doctors and specialists analyze and quantify the effectiveness of treatments and rehabilitation therapies.

Following the comparative analysis between people with Parkinson's disease and the elderly without neurological pathologies we could identify more than one variable, different from a statistical point of view. Thus, the most significant differences among people without Parkinson were encountered for the analysis of gait, where out of 10 parameters analyzed, 6 were identified being significant different, more precisely stride duration, propulsion index for both legs, cadence, and speed.

For TUG analysis out of the 17 variables extracted for analysis we could see statistically significant differences only for 5 of them. The PD group, having a higher risk of falling compared to elderly group. Time obtained for End turning 180^0 (p=0.005, Cohen D=1.41), Sit to Stand STS (p=0.034, Cohen D=1.02), antero-posterior acceleration during sitting stool stand to sit APC (p=0.004, Cohen D=1.46) and the side acceleration stand to lateral site (p=0.048, Cohen D=0.95) being statistically significant different for the two groups.

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Study Concerning Several Correlations Between Jump Score, Speed Score, and Anthropometrical Indicators Among Soccer Players

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Abstract
The anthropometrical measurements and the results recorded by the athletes – amateurs and professionals – in various effort tests may represent references for coaches regarding their state and training level. A quality's development and functionality level may influence another, and thus the fitness level. This study aims to identify correlations between the results obtained in the assessment of the jump force of lower limbs (squat jump, countermovement jump, and free jump, short-distance movement level (5, 10, and 20 m), and anthropometrical measurements (body mass index, fat tissue, and muscle mass) among soccer players. We measured and tested 19 athletes, soccer players (18.7 years ± nine months). Our study has not found any significant correlation between the anthropometrical indicators and jump or speed scores. Our findings show positive correlations (*r = 0.55163; p = 0.026749*) between the force index calculated using the three trials (jump score) and the speed score. We have also found a positive correlation between speed and jump force trials: squat jump, countermovement jump, and free jump, as well as a negative correlation between jump score and 20-m speed.

Keywords: *evaluation, correlations, soccer players.*

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1. Introduction

One of the main game and training factors in soccer is represented by physical training (in turn comprising two primary components (i.e., general and specific physical training). With its well-known genetic and nutritional factors, general physical training directly influences various anthropometrical indicators, such as body mass index (BMI), body fat, or muscle mass. In turn, they may directly affect the expression level of essential motor qualities in soccer, like force and speed (Cormier, 2021).

Within the specific physical training, jump force assessment is a significant reference for practice planning and evaluation of injury risk (Croisier, 2008) and the momentary state of the players' fitness level (Myer, 2011; Kusnanik, 2017). To measure jump force for lower limbs, specialists use various methods and devices recording ever more complex data regarding the power specific to a single jump or several repeated jumps, the flight duration, the difference between the agonistic and antagonistic muscle, or the impact on the osteoarticular system (Gokeler, 2019; Herrington, 2013; Read, 2017), especially at knee level (Hewett, 2005; Fältström 2017). Furthermore, numerous studies have reported the different potential jump scores between girls and boys, athletes practising other sports, or depending on age (Fort-Vanmeerhaeghe, 2019; Lininger, 2017; Smith, 2017). Some studies have shown how a quality can influence another, i.e., the correlation between speed and jump force (Yapici, 2014, Schons, 2018), while other studies have shown direct connections between jump force and some anthropometrical indicators (Trofin, 2021).

2. Method

This study aims to identify specific correlations between the results obtained in the assessment of the jump force of lower limbs (squat jump, countermovement jump, and free jump, short-distance movement level (5, 10, and 20 m), and anthropometrical measurements (body mass index, fat tissue, and muscle mass) among soccer players.

In this study, 19 soccer players (elite level) between 17 and 21 participated voluntarily; they agreed with the processing and publication of the data gathered throughout the research. The assessment of the anthropometrical parameters observed the methodology below:

For correct measurement of an athlete's height, they must stand barefoot (orthostatism), leaning their backside, head, and heels against a vertical wall; the head faces forward. Using a telemeter or a ruler (you can put a cm-graduated grid on the wall – subdivisions of at least 0.5 cm), you measure the distance from the floor to the perpendicular wall projection of the vertex point level (the highest cranial point), determined by a tool with an angle of 900 (e.g., a set square with sides of 15-20 cm) – one of the sides on the vertex and one on the wall. You record it in cm and subdivisions of 0.5 cm. Within the field tests performed for this profile, a telemeter with Bosch GLM 80 laser was used to obtain as highly accurate measurements as possible from the perspective of this parameter.

2.1. Weight and body composition

The indicators of body composition within our research are as follows: weight, fat tissue percentage (%), muscle mass, body fat, and body mass index (BMI).

We assessed all these parameters using body composition Omron HBF-511B-E scales, which feature the parameters mentioned above using the BIA (bioelectrical impedance analysis), based on eight sensors ensuring their accuracy.

Procedure: the first part of the protocol includes inputting data about athletes' age, height, and gender. Subsequently, the athletes stand barefoot with the feet on the two sensors at the level of the lower limbs while taking their outstretched arms forwards and grabbing the lower limb sensors, maintaining the position until the analyser assesses all the data.

The force test used trials for the jump force of lower limbs using the device called OPTOJUMP. We included the following tests: Squat Jump (SJ), Countermovement Jump (CMJ), and Free Jump (FJ) according to standard procedures (Trofin, 2017).

We assessed speed using Microgate photocells on distances of 5 m, 10 m, and 20 m (with a standing start).

For each player, each of the force tests (including the squat jump, countermovement jump, and the free move jump) and each of the speed tests (5m, 10m, and 20m) were graded on a 4-step scale ranging from mediocre through medium, good, to very good performance. To derive a Jump/Speed score, we transformed the scale into a numerical scale, ranging from 1 (mediocre) to 4 (very good). As such, both the resultant overall Jump and Speed scores could vary between a minimum 3 up to a maximum of 12 points.

3. Findings and discussions

The table below features the statistical scores obtained in the anthropometrical measurements, tests of the jump force of lower limbs and speed.

Table 1. Means and SDs of anthropometric measures and individual jump scores

	Mean	**SD**	**Min**	**Max**	**Amplitude (Max-Min)**
Height	178.13	5.33	170.00	188.00	18.00
Weight	71.24	8.90	50.10	83.70	33.60
BMI	22.45	2.58	16.36	26.13	9.77
Muscle mass	41.89	2.08	37.70	45.60	7.90
Body Fat	15.73	4.22	7.60	23.90	16.30
Squat jump	35.09	4.34	29.10	44.70	15.60
Countermovement jump	36.36	4.56	28.10	47.30	19.20
Free jump	39.88	6.53	29.70	53.40	23.70
5m	1.04	0.04	0.98	1.10	0.12
10m	1.72	0.10	1.50	1.88	0.38
20m	3.00	0.11	2.85	3.20	0.35
Spine mobility	-7.19	10.90	-18.00	25.00	43.00

The results obtained by the subjects within this study are consistent with the general mean reported by other authors in the same field (Trofin, 2017, Georgiy, 2019). Hence, the height mean is 178.1 cm (SD=5.33), and the weight average is 71.24 kg (SD=8.90); the BMI average is 22.45 (SD=2.58). Furthermore, our subjects have recorded a good muscle mass level (mean=41.89%; SD=2.08) correlated with normal body fat levels (mean=15.73%; SD=4.22). Concerning the jump force assessment, we have recorded the following results: squat jump (mean=35.09 cm; SD=4.34). countermovement jump (mean=36.36 cm; SD=4.56), and free jump (mean=39.88 cm; SD=6.53). Regarding the assessment of running speed, statistics show the following figures: 5 m (mean=1.04 sec; SD=0.04), 10 m (mean=1.72 sec; SD=0.10), and 20 m (mean=3.00 sec; SD=0.11).

To identify potential correlations between the indicators assessed, we have calculated Pearson's Correlation (Figure 1):

Pearson's Correlations

Variable		Jump_score	Înălțime	Greutate	Masă_Musculară	IMC	G_Corporală	Speed_score
1. Jump_score	Pearson's r	—						
	p-value	—						
2. Înălțime	Pearson's r	0.131	—					
	p-value	0.628	—					
3. Greutate	Pearson's r	−0.126	0.409	—				
	p-value	0.641	0.116	—				
4. Masă_Musculară	Pearson's r	0.428	−0.053	−0.617	—			
	p-value	0.098	0.844	0.011	—			
5. IMC	Pearson's r	−0.214	−0.073	0.879	−0.645	—		
	p-value	0.426	0.789	< .001	0.007	—		
6. G_Corporală	Pearson's r	−0.453	−0.108	0.565	−0.969	0.670	—	
	p-value	0.078	0.690	0.023	< .001	0.005	—	
7. Speed_score	Pearson's r	0.552	−0.073	−0.049	0.292	−0.019	−0.318	—
	p-value	0.027	0.788	0.856	0.272	0.945	0.231	—

Figure 1. Pearson's correlations (jump score, height, weight, muscle mass, BMI, body fat, speed score)

The data recorded within our study and the statistical calculations regarding the purpose of the research have highlighted only one correlation: between speed score and jump score (*r=0.552; p=0.027*). This correlation is positive; in other words, the higher the jump score, the higher the speed score (Figure 2). On the other hand, our study has failed to find any significant correlation between the anthropometrical indicators and the jump score or speed score.

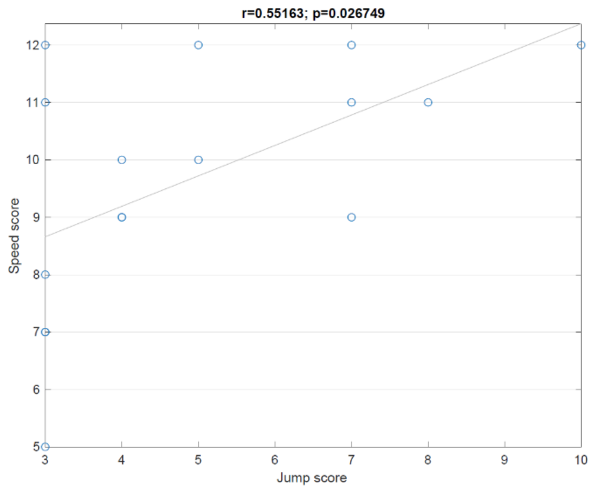

Figure 2. Positive correlation between jump score and speed score (*r=0.55163; p=0.026749*)

It is also worth noting a correlation tendency between muscle mass and jump score (r=0.428). However, it is not statistically significant (*p=0.098*) but may still be considered, especially within the practice in the field. Force has been proven to be influenced directly by the development level of muscle mass.

Subsequently, we have been interested in calculating Pearson's correlation index between jump score and each of the speed tests performed (Figure 3). Thus, among the three, we have found a negative correlation between jump score and 20-m speed (*r=0.919; p=0.01*); in other words, the higher the jump score, the lower the time for 20 m.

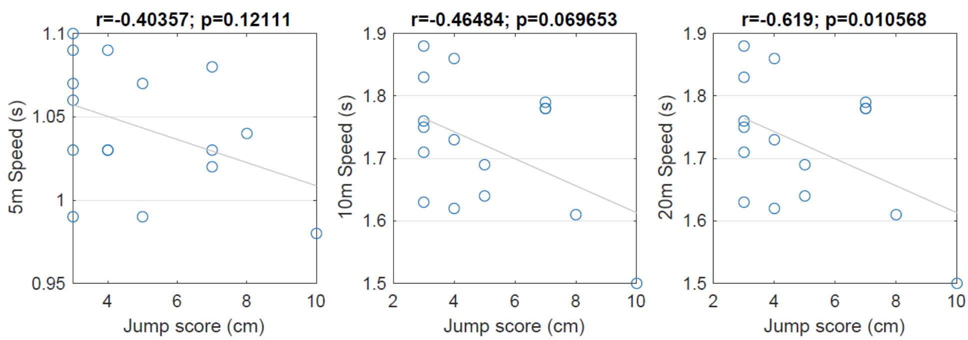

Figure 3. The correlation level between jump score and speed trials (5m, 10m, 20m)

We have made the same calculations for speed score and jump tests: squat jump, countermovement jump, and free jump (Figure 4). In this case, we have recorded positive correlations for all three comparisons with speed score: 5 m (*r=0.69; p=0.002*), 10 m (*r=0.81; p=0.0001*), and 20 m (*r=0.57; p=0.02*), which shows the direct relationship between speed and jump scores.

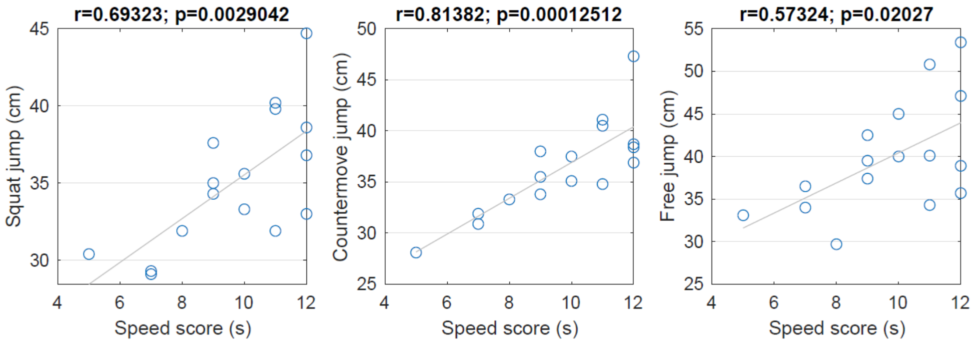

Figure 4. The correlation level between speed score and jump trials

4. Conclusions

Our findings show that jump score correlates positively with speed score, which means that jump score directly influences short-distance running speed.

Separately, we have found a positive correlation between speed score and jump tests (squat jump, countermovement jump, and free jump) and a negative correlation between jump score and 20-m speed.

Our study has not found any significant correlation between the anthropometrical indicators and jump or speed scores.

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Influence of Different Types of Footwear on Sport Performance Characteristics, in Long Distance Running - Case Study

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Abstract
Over the past decade, long-distance running shoes have gone through a continuous process of technologization. By 2017, major footwear manufacturers were focused on making running shoes as light as possible, made of the thinnest material possible to maximize athletic performance. Since 2017, the sports equipment company, Nike, has been producing the Nike Vaporfly shoe, the first footwear model with a carbon plate in the sole. Currently, the most feasible way to break the 2-hour marathon barrier is to reduce the energy cost of running. Thus, improving the equipment used during running is important. The aim of this study is to highlight the differences in the economics of running with different types of footwear. Thus, the aim was to collect these parameters which are influencing the running economy on a 26-year-old male athlete who used different running shoes in pre-determined training sessions. The characteristics of running dynamics were measured using Garmin's smart watch (Forerunner 955), heart rate monitoring belt (HRM-pro) and device (dynamic pod) from the same manufacturer. The parameters analyzed after data collection, were: average ground contact time, average vertical ratio, power during running, and heart rate data. Comparison of these indicators with the footwear used, shows that running shoes with carbon plate bring benefits on running economy. Choosing the right shoes for training or competition is an important factor in improving these parameters.

Keywords: *running, marathon, running economy, running shoes.*

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1. Introduction

Over the past decade, running shoes have undergone a continuous process of technologization, ranging from a minimalist sole to the introduction of carbon plates and manufacturing from recyclable products. Although the premier discipline of long-distance running, the marathon, was introduced at the 1896 Summer Olympics, one of the first pairs of running shoes dates back to 1865 (Larson, 2012). Nowadays, competition from sporting goods manufacturers is increasing, which requires continuous product innovation.

In 2017, sporting goods manufacturer Nike introduced the first carbon plate technology in long-distance running shoes with the Nike Vaporfly 4%. The aftermath of this introduction resulted in all athletes wearing these shoes setting world records over 100km, marathon, half marathon and 15km the following year (Burns &Tam, 2020). In October 2019, athlete Eliud Kipchoge becomes the first runner to complete the 42.195 km marathon distance in less than 2 hours. This with a pair of prototype running shoes, Nike Vaporfly Next%. A 2005 study attempted to predict the possible limits of the men's marathon world record (Navil & Whyte 2005), which was beaten by the Kenyan runner by nearly 4 minutes. The age of technology continues to have a major impact on many sports such as cycling, swimming, and the components of athletics (Balmer, Pleasence & Nevill, 2012; Haake, 2009; Dyer, 2016). In 2012, it was suggested that all significant achievements in sports are due to technological improvements rather than the body. Therefore, innovation, design, and application of technology in competitive sports are of great importance to athletes seeking to improve their performance.

In recent years, attention has been drawn to the Nike Vaporfly Next and Alphafly running shoes, whose performance is not considered ethical according to previous findings (Burns & Tam, 2020). The advent of these technologies challenges the philosophy of sport, which is that sports technology requires an ethical foundation rather than an attitude of winning at all costs.

Lighter running shoes lead to an improvement in the energy cost of running (Franz, Wierzbinski & Kram, 2012; Frederick, Daniels & Hayes, 1984). By influencing parameters related to running economy, they help improve athletic performance (Hoogkamer et al., 2016). Nowadays, all running shoes have soles made of different foams to which carbon plates or rods are added to provide better cushioning and mechanical energy return.

2. Objective

The aim of this study was to determine the differences between different running shoes in terms of running economy. The shoes used in this study were: Nike Vaporfly Next%, Nike ZoomFly3, Craft CTM Ultra Carbon 2, Asics MetaSpeed Sky. Figure 1 shows the structure of the Vaporfly shoes.

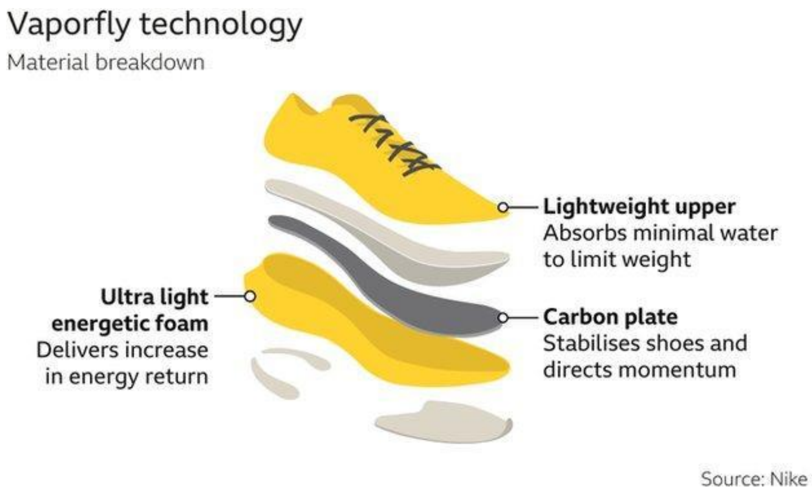

Figure 1. Vaporfly technology (Roan, 2020)

3. Materials and methods

All analyzed data were collected from a 26-year-old amateur voter who is 172 cm tall and weighs 72 kg. The subject has healthy lifestyle habits with an average sleep of 7-9 hours per night and daily activity of 6-10 hours. Clinically healthy, no alcohol, tobacco or drug dependence. An athletic history as a former martial artist and current amateur triathlete has resulted in a positive body response to the procedure. Willingness to participate in a 4-week training programmed was an important factor in subject selection.

The training programme was designed to test 4 pairs of different running shoes, each used under similar conditions. Running speeds during training were 10 km/hr, 12 km/hr, and 14 km/hr, with each pair of shoes covering a distance of 7 km per session. The Mezocycle began in July 2022 and ran for 4 weeks with 3 training sessions per week held on Mondays, Wednesdays, and Fridays at 06:00 AM. The runs took place on an athletics track that met all the conditions imposed by FRA. Table 1 shows the training distribution.

Table 1. Distribution of workouts per week

	Nike Zoom Fly 3			Nike Vaporfly Next			Craft CTM Ultra 2			Asics Metaspeed SKY		
Week 1	10km/ hr	12km/ hr	14km/ hr									
Week 2				10km/ hr	12km/ hr	14km/ hr						
Week 3							10km/ hr	12km/ hr	14km/ hr			
Week 4										10km/ hr	12km/ hr	14km/ hr

Data were collected using Garmin sports and fitness tracking devices. Forerunner 945 series watches, whose dedicated platform (https://connect.garmin.com/) supports IT, were used to collect data in an organised format. To eliminate possible errors due to lack of contact or excessive sweating, heart rate was measured using a special wristband (HRM-Tri) from the same manufacturer. The indicators of running dynamics were measured with the device (Garmin Dynamic Pod).

The parameters analysed during the study were: Duration of ground contact (mm), vertical oscillation (cm); the latter were correlated with heart rate and running performance. The report of the parameters are presented in Figure 2.

Figure 2. Garmin Indicators Report

Adherence to the principles of research ethics was a priority, and subjects were well informed about the conduct of the study. After explaining the collection and processing of personal data, informed consent was obtained from the participants.

The results obtained were statistically processed using data analysis and processing programs: Microsoft Excel 2022 and IMB SPSS Statistics 36.

The shoes used in the study were very different: running shoes from three different suppliers, Nike, Craft and Asics, three of them with carbon plates or upper technology, as can be seen in Figure 3.

Figure 3. Running shoes (Top4running.ro 2022)

4. Results

The analysis of Figure 4 shows that there are small differences between pairs of shoes in the parameters related to the duration of ground contact. The Nike Zoomfly 3 recorded the longest ground contact in all 3 training sessions with an average of 239 ms and is also the only shoe that is not made of carbon material. The best times were achieved by the Asics shoes with an average of 218ms in the 3 training sessions, they also have the lowest 5mm drop.

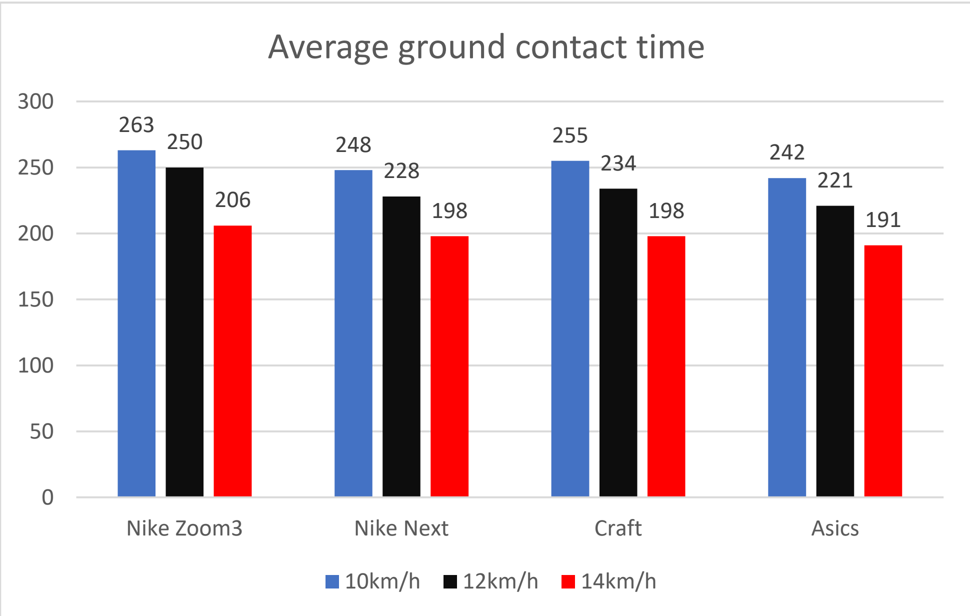

Figure 4. Average Ground contact time (ms)

The analysis of Figure 5, as for the mean value of vertical oscillation during running, a positive correlation is found between a low vertical fluctuation and a higher running speed. When analysing the individual running shoes, the Nike Zoomfly3 brings up the rear of the ranking with an average vertical fluctuation of 10.4 cm. The Asics Metaspeed Sky and Nike Vaporfly Next shoes have the best average values with 9.46 cm and 9.70 cm, respectively.

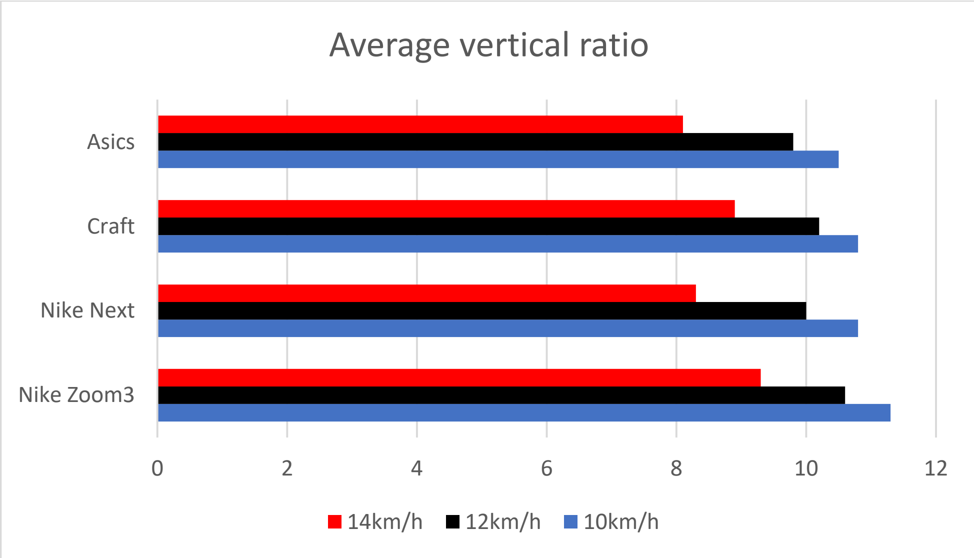

Figure 5. Average vertical ratio (cm)

Analysing Figure 6, a positive correlation between running performance and running speed is observed. The running shoes equipped with Carbon Plate technology are close in terms of running performance, while the pair of Nike Zoomfly3 performs less during the 366W training session.

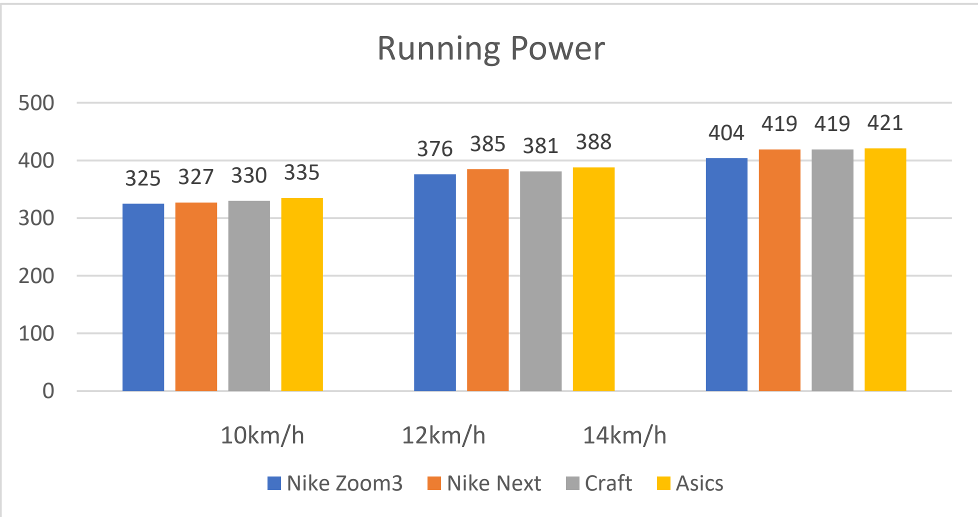

Figure 6. Running Power (W)

5. Discussions

In this study, we compared different pairs of running shoes, analysing 3 indicators of economic running. Regarding the indicator of duration of contact with the ground, we note a difference of 8.79% between the Nike Zoomfly3 shoe, which does not benefit from Carbon Plate technology, and the Asics Metaspeed Sky shoe, which takes first place in the analysis of the indicators. If we compare the weight of the two shoes, we notice a big difference: the Asics shoe is 16.7% lighter. In terms of average vertical oscillation, the comparison of the two shoes shows that the Nike ZoomFly3 generates almost 1 cm more oscillation when running compared to the Asics Metaspeed Sky. Differences are also seen in the parameter related to performance during running, with the Asics manufacturer's shoe having a 3.5% higher average value than the Nike Zoomfly3 shoe.

In the literature, the studies are divided into advantages and disadvantages of the use of carbon fibre technology. With the breaking of the 2-hour marathon mark, much speculation has arisen about the ethics of carbon fibre running shoes. This type of technologization of the running shoe through the introduction of carbon plates increases the stiffness of the shoe and helps to reduce the movement of the metatarsophalangeal joint and increase ground contact reaction force (Madden, Sakaguchi & Tomaras, 2016; Flores, Delattre, Berton & Rao, 2019, Beck et al., 2019, Cicoja et al., 2021).

Other studies suggest that the curved sole shape leads to better running shoes, but not to higher stiffness of the shoe. The carbon plate helps improve the lift of the foot from the ground and reduces the energy cost of running. Current studies show promise for making this innovation mainstream, but more testing is needed (Day & Hahn, 2020).

Analysis of other studies has shown that midsole thickness affects running performance. Lower sole density may be associated with increased metabolic consumption, as greater muscle activity is required to absorb impact forces (Tung et al., 2014). This idea is also supported by other researchers who suggest that running with shoes results in 3-4% lower oxygen consumption and metabolic performance than running without shoes (Franz et al., 2012).

6. Conclusions

Evaluation of parameters related to running economy has shown that running shoes with carbon plate or carbon rod technology produce improvements in these indicators. However, there are concerns about the limitations of the accepted equipment technology. Given this, ongoing analysis of the technology introduced into the sport is required.

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Effects of Dry Needling on Hamstring Pain Sensitivity and Flexibility of Professional Athletes

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Abstract
Dry needling therapy is an up-to-date therapeutic method aimed at the rehabilitation of a wide range of pathologies and sports injuries. The form of minimally invasive therapy can also be recommended to professional athletes in order to optimize sports recovery and their reintegration into elite sports. Currently, there are a multitude of strategies for managing and preventing sports injuries. The current study aims to identify the short-term effects of a complex therapeutic approach that combines dry needling therapy with manual therapy and stretching. The subjects of the research represented 64 professional athletes with at least one official appearance during the last three competitive seasons in the first three championships in Romania. They were divided into two groups: group A – combined dry needling treatment, manual therapy + stretching; group B – manual therapy + stretching. The main measurements were the level of pain during passive stretching assessed by means of the numerical pain rating scale (NRS) and the flexibility by means of knee extension goniometry. The impact of dry needling therapy highlighted statistically significant differences in terms of passive stretching resistance values and hamstring flexibility ($p<0.05$). The results confirm the importance of dry needling therapy as part of a combined treatment in the rehabilitation of athletes with different categories of muscle injuries that cause pain and limitation of functionality in the lower limbs.

Keywords: *sport rehabilitation, flexibility, dry needling, manual therapy, stretching.*

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1. Introduction

The complexity of sports injuries determines the need for the intervention of physiotherapists as an active, essential part of the interdisciplinary sports team. Injuries can vary in terms of severity: from mild injuries that have only the presence of pain as a symptom, without requiring the intervention of the medical staff, to serious injuries that cause the athlete to no longer take part in sports activities (Davies et al., 2020). Currently, there are a multitude of strategies for managing and preventing sports injuries. Sports injuries can have unpleasant consequences not only on the health, but also on the lifestyle of the players, including an increased risk of depression or anxiety, with financial losses certainly present. A recent systematic review suggests the negative impact of sports injuries on sports performance (Drew, Raysmith & Charlton, 2017).

Muscular injuries represent a large part of sports injuries (10-55%), their treatment being of major importance, as the inability of athletes to participate in sports competitions can be of the order of weeks or months. This category of trauma is very common in sports, especially in football. A number of epidemiological studies suggest that 1.8-2.2 muscle injuries occur in 1000 hours of training or competition (30% of all injuries) (Guillin & Rochcongar, 2017). Traumas are usually produced by a strong eccentric contraction or excessive stretching of the muscle fibers. These situations produce excessive mechanical stress and occur during sudden acceleration or deceleration. Muscle strains tend to occur most frequently in the biarticular muscles (rectus femoris, hamstrings, gastrocnemius) but being the fact that they can generate a higher level of muscle tension through the passive positioning of the joints (Delos, Maak & Rodeo, 2013; Fields & Rigby, 2016).

Dry needling (DN) is a modern treatment performed with dry needling and was designed to relieve muscle pain. During dry needling, a practitioner inserts several threadlike needles into the skin. Thread needles are fine, short, stainless steel needles that do not inject fluid into the body. That is why the term “dry” is used.

A review on the current literature (PubMed, Medline, PEDro, Ebsco in the years 2010-2021, English only) identifies a number of previous studies that present a multitude of advantages of the dry needling therapy in the treatment of the muscle pain or other pathological context (Table 1).

A systematic meta-analysis carried out in 2017 presents a brief but sufficient presentation to describe this type of therapy. Practitioners place needles into "trigger points" in muscle or tissue. Dry needling is sometimes called intramuscular stimulation (Gattie et al., 2017). Dy needling is a very effective therapy for treating muscles and fascia, where the therapist inserts the needle into the painful point, thereby stimulating oxygen supply to the fascia and tense muscle fibers and fascia (Iacob et al., 2021).

Table 1. The dry needling therapy use in the hamstring pain or tightness

Study	Subjects	Output measures	Results
Alaei et al.	Healthy subjects, hamstring tightness (n=32)	AKET, muscle compliance, passive peak torque, stretch tolerance	Improvements in all outcomes was better for the DN group than for the SS (static stretching) group
Bazzaz-Yamchi et al.	Healthy subjects, hamstring tightness (n=10)	VAS, PKE hamstring tightness	A single session of deep DN improved pain and function and increased hamstring flexibility
Geist et al.	Hamstring extensibility deficits (n=27)	Hamstring extensibility – goniometry, hop tests	It does not appear dry needling results in increased extensibility
Ansari et al.	Healthy subjects with shortened hamstrings (n=15)	The active knee extension test, muscle compliance, passive peak torque, and stretch tolerance	This is the first study that demonstrates the beneficial effects of DN on hamstring flexibility, muscle compliance, and stretch tolerance without added stretching
Mason et al.	Hamstring pain and active trigger points (n=39)	Pain scale	Lack of significant improvements
Jayaseelan & Ricardo	Proximal hamstring tendinopathy (n=2)	Pain and functionality scales	Short- and long-term pain reduction and functional benefits

There are some studies which confirm that dry needling is effective in improving hamstring flexibility compared with static stretching. With one session of dry needling patients can have an effective treatment for hamstring tightness and increase of flexibility (Alaei et al., 2020). There is also a scientific evidence that a single session of deep dry needling improved pain and overall function and increased hamstring flexibility. This pilot study supports the use of DN in patients with low back pain and hamstring tightness; however, future research with a rigorous study design of randomized controlled trial is required to confirm the findings (Bazzaz-Yamchi et al., 2021).

Another study that covers up the effects of dry needling among asymptomatic individuals with hamstring tightness reveals that dry needling results do not appear in increased extensibility beyond that of stretching alone in asymptomatic individuals. Our study findings suggest that dry needling may improve certain dimensions of functional performance, although no clear conclusion can be made (Geist et al., 2017). There are other studies that demonstrates the beneficial effects of dry needling in hamstring flexibility, muscle compliance, and stretch tolerance without any stretching added. The beneficial effects of DN should encourage clinicians to use this therapy as a novel strategy for increasing muscle flexibility (Ansari et al., 2020).

Mason et al., supports the effectiveness of DN and stretching vs. stretching alone on hamstring flexibility in patients with knee pain ended up with the results that two sessions of dry needling did not improve hamstring range of motion or other knee pain-related impairments more than sham dry needling in a young active population with atraumatic knee pain (Mason et al., 2016). There is a study which presents the rehabilitation of proximal hamstring tendinopathy utilizing eccentric training, lumbopelvic stabilization and trigger point dry needling. The specific treatment provided short- and long-term pain reduction and functional benefits. Further research is needed to determine the effectiveness of this cluster of interventions for this condition (Jayaseelan & Ricardo, 2013).

Even with multiple effects addressed for healthy individuals with muscle tightness or in the rehabilitation of a vast spectrum of pathologies, there is currently no strong scientific foundation to support the importance of a combined treatment that focuses on dry needling therapy in the rehabilitation of muscle injuries in professional athletes.

2. Material and method

2.1. Participants

The subjects of the research were 64 professional sport players (19-35 years old), having the main criteria for selection of a muscle injury located in the posterior part of the thigh. Confirmation of the clinical and functional diagnosis and in most cases imaging was necessary in establishing the treatment plan and involved in verifying the inclusion criteria.

In addition to the diagnosis of hamstring muscle injury, the participants were selected based on the other following inclusion criteria: (1) specific muscle pain in the posterior thigh; (2) limited functionality during hip flexion and knee extension; (3) professional sport activity ongoing; (4) at least one official appearance during the last three competitive seasons in the first three championships in Romania (football, basketball, handball, futsal); (6) fully agreement of the subjects related to the acceptance of dry needling therapy; (7) lack of basic contraindications in safe dry needling therapy (needly phobia, lymphedema, mental illness, infectious diseases, other medical emergencies). The exclusion criteria included situations in which the subjects had to interrupt the institutionalized rehabilitation plan due to pandemic considerations (infection with the Covid-19 virus or direct contact with infected persons, placement in institutionalized/home quarantine).

Subjects consisted of two groups randomly devided which benefited of a different treatment protocols (Table 2).

Table 2. Baseline characteristics of the research subjects

Variable (unit)	Group A (n=34)	Group B (n=30)
Gender (M/F)	24/10	21/9
Age (years)	28.21 ± 9.82	29.54 ± 8.96
Weight (kg)	77.14 ± 9.62	78.45 ± 8.98
Height (cm)	185.14 ± 9.75	183.72 ± 8.22
Sport type	Football = 32 Basketball = 7 Handball = 5 Futsal = 3 Tennis = 9 Others = 8	

2.2. Therapeutic intervention

The research methodology followed very strictly the therapeutic and ethical principles specific to the research activity and physiotherapy area. The study design consisted in the following stages: identification of the subject group according to established inclusion and exclusion criteria; analysis and selection of test methods and evaluation of subjects; performing the initial and final testing, implementation of the rehabilitation program for every group of subjects; presentation and interpretation of data; drawing up conclusions. The research was carried out between June 2020 and April 2022 in several locations in order to establish a representative group of subjects and follow the most suitable means of assessment and treatment. Active collaboration with a group of sports physiotherapists engaged in the recovery of performance athletes was necessary to implement the treatment protocol and constantly monitor the subjects' functional parameters.

The current study aims to identify the short-term effects of a complex therapeutic approach that combines dry needling therapy with manual therapy and stretching.

Subjects consisted of two groups randomly devided. The therapeutic plan for the rehabilitation of muscle injuries usually includes 3 stages: the acute stage, the functional rehabilitation stage and the stage aimed at sports reintegration. In order to highlight the effect of the combined therapy, which had dry needling as a priority means, the functional parameters were analyzed in two tests: initial (baseline) and after 6 weeks (completion of the functional rehabilitation phase). After this phase, the sports reintegration took place within the sports clubs. In this 3rd phase the therapeutic interventions through the chosen protocol were more sporadic, with a lower frequency.

Both groups followed a therapeutic strategy for approximately 6 weeks, three sessions of 60 minutes per week. Group A received a dry needling treatment specific for trigger points area, combined with manual therapy and active exercices (stretching, isometric and eccentric contractions), while group B benefited of a more classical treatment with electroterapy (for acute phase), manual therapy and active exercises. Manual therapy techniques including deep tissue massage, trigger point and stretching were used in the functional rehabilitation phase for both groups during every therapy session (for approximately 15-20 minutes).

The main objectives of the first two phases of the rehabilitation were implemented in accordance with the principles of rehabilitation, for all research subjects. For the acute phases, the most important were limitation of tissue damage, pain reduction, control of the inflammatory response, protection of the affected area. As a part of functional rehabilitation stage we targeted, complete elimination of pain and symptoms, increasing muscle strength of thigh muscles, flexibility on active knee and hip movements, development of neuromuscular control, progressive intensity in functional and sport coordination efforts.

This study consisted of a treatment protocol for the myofascial pain syndrome and trigger points at minimum 5 cm distance from the injury spot for agonist, antagonist and synergist muscles, including low back muscles. The intervention program included specific dry needling therapy for the trigger points of the following muscles: femoral biceps, semitendinosus, semimembranosus, quadriceps, gastrocnemius, gluteus maximus, gluteus medius, gluteus minimus, quadratus lumborum, iliopsoas and sporadically at the level of the back muscles (trapezius, large dorsal, spinal erectors). The initial position of the subjects was supine, ventral or heterolateral, depending on the technique specific to each application. Dry needling was performed using Seirin B type needles: No.8 (0.30) x 30 mm and No.8 (0.30) x 50 mm. The technique was performed safely, taking into account the precautions specific to the segments: the branches of the spinal nerve roots, the blood vessels, the retroperitoneal cavity, the kidneys, the lungs.

The entire team of physiotherapists who supported the development of the research constantly monitored, the fulfillment of the objectives and the observance of the methodology being adapted according to the particularities of the patients and their level of compliance with the treatment.

2.3. Assessment

The outcome measures were assessed both before and after the 6-week interventions were completed. In order to test the values of pain during passive stretching and flexibility, it was necessary to perform the initial and final NRS (numerical pain rating scale) performance and the adapted goniometry of the knee.

Testing the posterior thigh muscles required positioning the patient in the supine position. Passive stretching performed by the therapist described flexion of the thigh to the pelvis with the knee fully extended (similar to the Lasegue test). The self-evaluation of each patient was required on a numerical scale ranging from a minimum of 0 (no pain) to a maximum of 10 (severe pain).

The flexibility of the hamstrings was analyzed by measuring the amplitude of the active knee extension movement from the initial position of flexion to 90^0, and the hip is flexed to 90^0. This measurement was performed with subjects in the supine position on the therapy bed/table. The value of the goniometry included the performance of the maximum active extension movement without/until the onset of pain.

2.4. Statistical analysis

Evaluation of the therapeutic effect for both groups was made using SPSS software (SPSS Inc., Chicago, IL) with a p - value of < 0.05 as reference for statistical significance. More than this, there was used a relevant volume of statistical tests as follows: mean (arithmetic mean), standard deviation (SD), T test (Independent-Samples T Test) and the Pearson correlation coefficient.

3. Results

This section includes the most relevant results that analyzed the functional parameters of the subjects within the initial and final evaluation.

Table 3. Differences between initial and final measurement of the group A

Variables	N	Test	M	SD	t-value	*p*-value	95% Confidence Interval Min	Max
Active knee extension (^{0})	34	Initial	21.81	5.12	14.894	.000	17.150	22.600
		Final	1.94	1.48				
NRS_A		Initial	6.69	.873	21.590	.000	4.867	5.883
		Final	1.31	.479				

Group A (N = 34) includes the group of subjects who required physiotherapy and dry needling treatment following muscle injuries in the hamstrings area. Table 3 shows the results of group A obtained using the Independent-Samples T Test. The value of the active knee extension angle shows a statistically significant evolution between the initial assessment (M = 21.81, SD = 5.12) and the final assessment (M = 1.94, SD = 1.48). The group of subjects registered a significant decrease in range of motion and flexibility deficit (approximately 19^0); t(30) = 14.894, *p* =.000. The score of the numerical pain assessment scale during the passive stretching movement of the posterior thigh muscles showed significant differences between the initial (M = 6.69, SD = .873) and the final (M = 1.31, SD = .479) testing; t(66) = 21.590, *p* = .000, evolution also confirmed by the displayed results in the Table 3.

Table 4. Differences between initial and final measurement of the group B

Variables	N	Test	M	SD	t-value	*p*-value	95% Confidence Interval Min	Max
Active knee extension (^{0})	30	Initial	20.96	4.56	14.427	.001	12.740	16.546
		Final	6.32	2.09				
NRS_B		Initial	6.93	1.01	11.698	.002	2.604	3.682
		Final	3.79	.995				

Table 4 presents the results of group B (N = 30) obtained using the Independent-Samples T Test which analyses the differences between means for active knee extension and numeric pain rating scale results. The final goniometry assessment describes still a deficit of 6^0 in active knee extension, which explains a limited range of motion (M = 6.32, SD = 2.09), especially if we compare the values with those obtained by the group A. Even if the group of subjects registered an adequate decrease in range of motion and flexibility deficit (approximately 14^0); t(58) = 14.427, *p* =.001, this difference, even statistically significant, does not confirm the complete rehabilitation of the subjects after 6 weeks of treatment. The score of the numerical pain assessment scale during the passive stretching movement of the posterior thigh muscles showed a good difference between the initial (M = 6.93, SD = 1.01) and the final (M = 3.79, SD = .995) testing; t(58) = 11.698, p = .002. These values confirm the presence of a statistically significant difference, but there is a pain level of 3-4/10 after 6 weeks of treatment also suggests that the rehabilitation was rather incomplete.

The results recorded within the 95% Confidence Interval validate the homogeneity of the subject groups in relation to the two main treatment measurements.

To evaluate the linear relationship between the final value of the knee goniometry and the NRS scale following passive stretching, the Pearson correlation coefficient (r) was calculated. A strong and statistically significant positive correlation was thus identified, r(32) = .82, p = .000 within the final results belonging to group A of subjects. The same parameters were analyzed in order to interpret the Pearson correlation coefficient (r) and for group B where r(28) = .76, p = .006. The results of both groups indicate a favorable correlation between the reduction of the knee mobility deficit and the sensitivity to the passive stretching performed by the physiotherapist. These statistical interpretations confirm the fact that both measurements are essential in the analysis of therapeutic efficiency and influence each other in the rehabilitation process.

4. Discussions

The criteria for completion of the rehabilitation protocol included: confirmation of the imaging examination (Schut et al., 2016), restoration of maximum amplitude for the range of motion and flexibility (the maximum accepted value of the deficit compared to the healthy limb of 0-5^0); significant reduction of pain when performing passive stretching (maximum accepted value was 2 units), restoration of muscle strength (minimum 90-95% compared to the contralateral limb) and performance of specific functional tests (Ernlund & Vieira, 2017; Wong, 2015).

The current research is also an appropriate means of confirming the usefulness of the methods for measuring and evaluating the level of pain and functionality. The analysis of the flexibility of the muscles with the role of antagonist was carried out in several systematic studies to test the functionality within the evaluation of the subjects. The correct value of the goniometer is a relevant indicator for the objectives of the rehabilitation plan. To interpret the deficit on active knee extension movements, initial measurements were taken on both the affected and the unaffected lower limb (Table 3). The initial values were comparable to the mean extension deficit in the study by Malliaropoulous et al. (2010) or Aguilar (2012).

Flexibility is a parameter that can be measured through the goniometry of actively performed movements, in the direction of activation of the antagonist muscles (Maniar, 2016). These items were monitored throughout the rehabilitation plan but representative measurements were taken at the beginning and end of the treatment plan in the specific rehabilitation clinic/office.

The subjects in group A benefited from a very effective combined treatment that improved the parameters describing pain during passive stretching, known also as stretch tolerance and flexibility measured by goniometry. Comparing the results with those reported for the period 10-30 days after trauma from the studies developed by Reurink (2015), Silder (2013), determines an advantage for group A from the current research.

The statistical interpretation of the results of group B of subjects identifies the presence of a small functional deficit at the end of the 6 weeks of evaluation (Table 4). This lack of movement practically placed the group of subjects in the need to extend the therapeutic plan by another week in order to fulfill one of the main criteria for completing the treatment: a maximum of 5 degrees of movement deficit compared to the healthy limb. The final results of the scale that evaluated the level of pain during the passive stretching performed by the physiotherapist also suggested that the subjects in group B did not perhaps benefit from the most effective treatment plan.

The usefulness and applicability of the two measurements as testing methods is also suggested by the strong direct proportional correlation that is established between their final results. Statistical analysis through the Pearson coefficient confirms that the two components that describe the functionality and symptoms of the affected member influence each other. In other words, it is necessary to establish a therapeutic plan in accordance with the specific principles of sport rehabilitation and which has as its objective both the reduction of pain during passive stretching and the increase of flexibility.

This difference in the final results, even of a few degrees or units in the NRS scale, can issue a series of interesting perspectives, all these small differences being extremely important in the rehabilitation of athletes. Group B benefited from a treatment considered suitable, but the involvement of the dry needling therapy for the other subjects in group A represented a real advantage. In addition to the potentially extremely beneficial purely therapeutic effects that practically shortened by one week the period of unavailability of the subjects in group A, it is necessary to analyze the behavioral factors or that describe the level of therapeutic compliance of the two groups of subjects. An extremely interesting aspect for further research can be the analysis of all the factors involved in the rehabilitation process.

5. Conclusions

The impact of dry needling therapy highlighted statistically significant differences in terms of passive stretching tolerance values and hamstring flexibility ($p < 0.05$). The results confirm the importance of dry needling therapy as part of a combined treatment in the rehabilitation of athletes with different categories of muscle injuries that cause pain and limitation of functionality in the lower limbs.

The favorable evolution of functional parameters was also confirmed by the Pearson correlation coefficient, which indicated a simultaneous matching of flexibility rehabilitation and pain reduction to minimal values, especially for the group A of subjects.

The statistical interpretation confirmed the fact that the subjects in group A benefited from a superior therapeutic plan as well as the efficiency of the subjects in group B, the latter needing to extend the therapeutic plan by another week. These highlights allow the establishment of very useful future perspectives, since shortening the treatment even by a week or a few days can weigh enormously in the athletes' rehabilitation.

The efficiency of the means of intervention based on a wide spectrum of principles (mechanical, physiological, biochemical) is proven by the optimizing effect of the treatment and predicting a rapid progress in accordance with the principles of rehabilitation. The combined treatment plan based on dry needling therapy can represent a therapeutic option for other categories of patients as well.

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Methodical-Practical Approaches in Functional Re-education after Distal Lower Leg Fractures

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Abstract

Distal lower leg fractures represent a pathology with numerous biomechanical and functional implications with impact on socio-professional life. This type of fractures can generate neurological sequelae through secondary lesions on the peripheral nervous system, such as injuries to the external popliteal sciatic nerve or peroneal nerve.

In our case study, we analyzed the functional recovery process of a sportsman who suffered a fibular and a tibial pillar fracture of the right lower limb.

Complex functional evaluations such as: pain, ankle joint mobility, muscle strength and gait were performed.

Paraclinical investigations were also carried out, such as radiography and computed tomography with 3D reconstruction, as well as functional explorations regarding the integrity and trophicity of the peripheral nervous system of the affected lower limb.

The physiotherapy program consisted in the re-education of functional deficits by using specific techniques and methods, neuroproprioceptive facilitation techniques, as well as manual therapy techniques.

The obtained results emphasize the positive evolution of the values of the functional tests carried out in the case study, as a result of the rehabilitation techniques which we performed.

The study's conclusions highlight the effectiveness of physiotherapeutic programs and manual techniques in the recovery of deficits after a distal lower leg fractures.

Keywords: *bone injuries, tibial pillar, recovery, motor deficit.*

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1. Introduction

Fractures of the distal third of the calf have an increased incidence of 184 cases per 100,000 people per year (Neumann et al., 2016).

The tibia and fibula are the component bony elements of the calf and are responsible for supporting body weight and inserting specific muscles. Among the long bones of the skeleton, the tibia is the most frequently fractured, among its symptoms are strong and immediate pain, the appearance of edema and deformity, functional impotence (Goost et al., 2014; Tengberg et al., 2018).

The mechanism of production of these fractures can be direct trauma with high impact force or indirect trauma through the combination of rotation and compression force. This indirect mechanism can also be found in sports games when the foot is fixed on the ground and the rotational movement occurs in the overlying segments (Feria-Arias et al., 2018).

Orthopedic and surgical management is a challenge for the specialist team, influencing the process of functional re-education, which can be more difficult due to the fact that the distal blood supply is lower. At the same time, the soft tissues in the distal third are vulnerable due to the lack of musculature and the bone healing capacity is lower.

Fractures of the distal third of the calf can be treated with cast immobilization or bleeding reduction and fixation with osteosynthesis materials. If the orthopedic treatment will be conservative, the patient will not be allowed to load the affected lower limb until the fracture heals. This will lead to the hypotonia of the muscles of the affected limb and the installation of joint stiffness, which will negatively influence walking.

Muscle weakness is amplified by immobilization and the lack of loading of the affected limb, studies highlighting the fact that in the case of operated fractures, functional results are faster (Brown et al., 2001).

Depending on the severity and location of the calf fractures, the therapeutic protocol is decided, but the most appropriate treatment modality is surgical intervention with osteosynthesis with plates and screws or centromedullary rods for fracture reduction (Redfern et al., 2004).

Distal calf trauma is known to impact ankle functionality and patients' quality of life (Aydogan et al., 2020; Duckworth et al., 2016; Kent et al., 2020).

Calf fractures have multiple causes from simple falls to road accidents (Toth et al., 2017 and depending on their severity, rehabilitation results can sometimes be delayed.

For an effective management of the post-immobilization fracture, effective communication between the attending physician and the physiotherapist is necessary, in order to establish the phasing of resuming the loading of the affected limb and to determine if orthoses or other elements that can influence the rehabilitation process are necessary. The most important thing is that in the first phase both passive and active joint mobility is assessed and re-educated, then muscle strength and joint stability (Lin et al., 2012).

Functional assessment of the patient after calf fractures is very important and aims to establish the potential for recovery by testing joint mobility, muscle elasticity, muscle strength and endurance of the entire lower limb, balance, proprioception and gait.

After resuming walking without aids, exercises can be added to re-educate balance and joint stability, through dynamic activities that require neuromuscular control. Various unstable surfaces such as balance boards can be used in this sense.

In order to reintegrate into the socio-professional activity, it is necessary for the patient to regain complete mobility of the affected joints, muscle strength, joint stability and the achievement of correct walking from a biomechanical point of view. For the reinsertion in the sports activities, the individual must be able to perform in addition, the correct running, the unilateral support, the jumps and be retrained to the effort in a correct and efficient way.

2. Material and method

The present research is based on the case study of a 26-year-old female performance athlete who sustained a fracture of the tibial pillar and right fibula in the distal third following an avalanche. Following the clinical consultation and paraclinical investigations (radiographs and computer tomograph with 3D reconstruction, fig 1), the orthopedic-surgical treatment consisted in the bleeding reduction of the fracture with a plate locked in "L" and screws (fig 2). Postoperative radiological control revealed a good reduction of the fracture and a correct positioning of the osteosynthesis material.

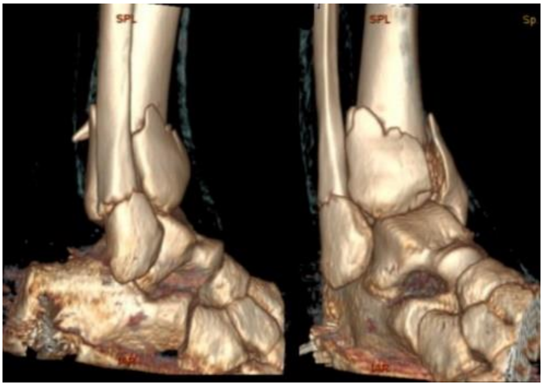


Figure 1. Preop 3D CT

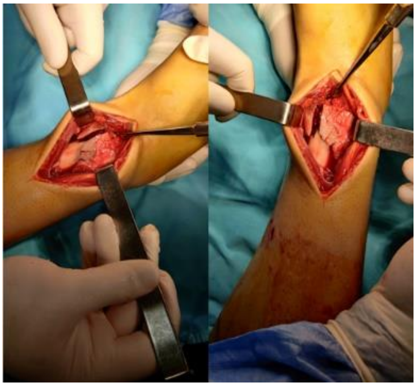


Figure 2. Intraoperative image

The functional evaluation was carried out 30 days postop and consisted in the first stage in the testing of joint mobility and muscle strength, along with the evaluation of pain, trophicity and sensitivity of the affected limb (Figure 3). Following this, important mobility deficits of the talo-crural joint, muscle hypotrophies at the level of the calf and thigh, the presence of algoneurodystrophic syndrome and motor deficit in the territory of the deep peroneal nerve were found. At 105 days postoperatively, gait parameters such as step cadence, step length and distance covered in the 5-minute interval could also be evaluated.

Figure 3. Postop appearance

The physiotherapy plan applied after the first 30 postop days consisted in performing passive mobilizations of the affected ankle with the association of passive stretching on the Achilles tendon in order to increase the range of motion and to relax the sural triceps muscles. Neuroproprioceptive facilitation techniques such as rhythmic initiation, slow inversion and hold-relax technique were also used to promote regaining joint mobility. Active exercises for the affected ankle as well as for the fingers and overlying joints were also performed at this stage. Proprioceptive stimulation exercises using balls and sensory activation objects were introduced to re-educate plantar sensitivity. To facilitate lymphatic drainage, manual pressure techniques were used to stimulate the resorption of the edema and de-tension the plantar aponeurosis.

At 2 months postop elements were added to the program from the previous stage to increase the difficulty of the exercises. Thus, low resistances were used and the number of repetitions was increased, adding other PNF techniques such as slow inversion with opposition and the relaxation-opposition technique, designed to overcome the limitations of joint mobility. Also at this stage, special emphasis was also placed on indirect loading exercises of the ankle joint to prepare for the resumption of walking. Increased attention was also paid to general toning exercises to maintain the athlete's overall tone.

In the 3rd stage, 90 days postop the boot-type orthosis was removed, and the difficulty of the exercises and the degree of loading of the affected lower limb increased, so that 105 days postop, according to the indications of the attending physician, after the control x-rays performed (Figure 4), independent walking resumed. At this stage, the focus was on exercises to re-educate walking and joint stability. From the category of FNP techniques, the active movement of relaxation-opposition and relaxation-contraction were added, to overcome outstanding mobility limitations. To increase joint stability and muscle strength, the rhythmic stabilization technique was used along with alternating isometrics.

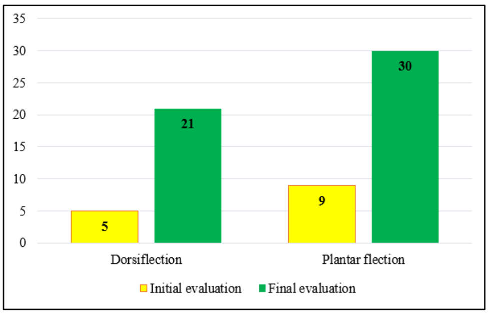
Figure 4. X-ray (105 days postop)

The re-education of walking parameters was achieved both with the help of the treadmill and through specific walking exercises and application routes, which aimed at the biomechanically correct realization of the phases of locomotion.

3. Results and discussions

In order to be able to highlight the progress achieved following the application of the functional re-education programs, we made the graphic interpretation of the values of the functional tests obtained at the initial assessment and at the final assessment.

Figures 1 and 2 show the evolution of joint mobility and muscle strength from the initial evaluation to the final evaluation.



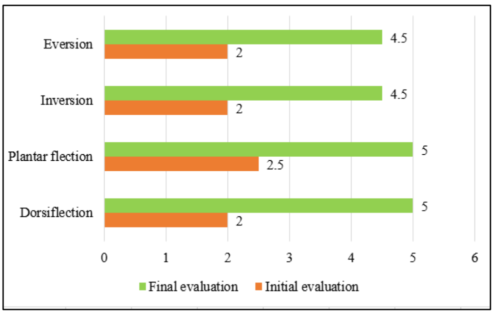


Figure 1. Right ankle joint mobility (degrees) **Figure 2.** Right ankle muscle testing

According to the figures above, joint mobility and muscle strength improved following the application of physical therapy programs and PNF techniques, which aimed to regain maximum ankle range of motion and also increase muscle strength to normal levels. An important role in re-educating the mobility of the right ankle joint was played by passive stretching, which, by stretching the Achilles tendon, favored the regaining of flexibility and muscle-tendinous elasticity. Specific ankle functional rehabilitation methods and techniques must be performed under the guidance of specialists, who will supervise the entire recovery process and monitor the patient's progress (Moseley et al., 2015).

Figures 3 and 4 highlight the evolution of step cadence (fig 3) and step length (fig 4) from the initial assessment to the final assessment.

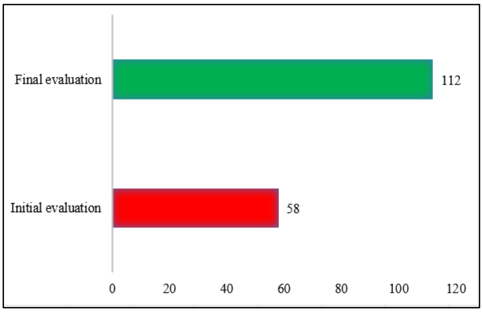


Figure 3. Cadence of steps (steps/minute)

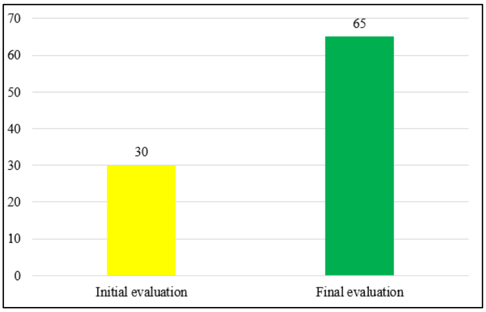


Figure 4. Step length (cm)

Functional re-education programs after fractures of the distal third of the calf also have a positive effect on the correction of walking parameters. In the figures above, the favorable evolution of cadence and step length is highlighted, which was supported by the specific gait re-education exercises. A very important role for the fulfillment of this objective was the realization of the locomotion on the rolling carpet, where by setting the speed and inclination parameters, the correction of the cadence, the length of the step and the average loading time on each lower limb was achieved. Re-education of cadence and step length is important because it contributes to achieving efficient walking with an optimal movement speed, this latter parameter being significantly affected in the case of these fractures (Van Hoeve et al., 2019).

Figure number 5 highlights the evolution of the distance covered in the 5-minute interval, from the initial evaluation to the final evaluation.

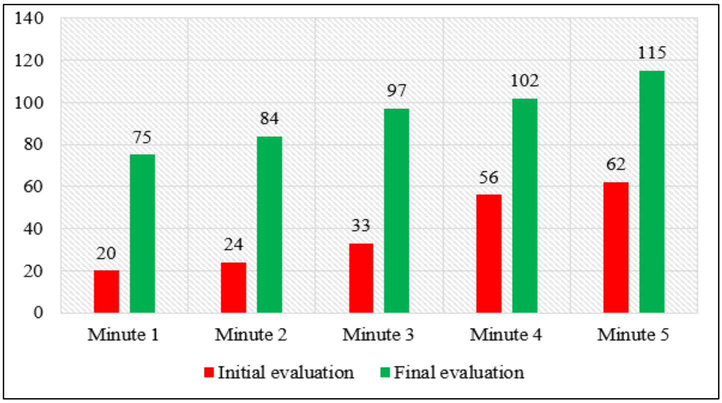


Figure 5. Distance covered in 5 minutes (meters)

The possibility of moving over long distances is conditioned by the integrity of the joint and muscle structures, which must ensure the correct execution of the movements and generate the necessary force for them. The applicative routes used to re-educate long-distance walking have significantly contributed to increasing this potential, a fact that is highlighted in figure number 5, where it can be seen that from a distance of 20 m covered in one minute at the initial assessment, the patient could walk a distance of 75 meters at the final assessment.

Through effective physical therapy management and consistent performance of functional re-education programs, patients can resume normal walking (Bopple et al., 2022).

4. Conclusions

The conclusions of the present research highlight the necessity and importance of physiotherapy programs applied early and customized to the patient's remaining functional for an efficient and correct recovery.

Along with active physical therapy, neuroproprioceptive facilitation techniques, passive mobilizations, tractions, passive stretching of the calf muscles and the Achilles tendon can contribute to the functional re-education of the lower limb and the resumption of daily activities.

Regaining joint mobility, muscle strength, stability, proprioception and re-education of walking parameters can influence the quality of life of patients with fractures of the distal third of the calf.

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Beach Handball – The Effect of The Sand Surface on the Explosive Force in the Training of Handball (Indoor) Players at Junior Level (16-18 Years Old)

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Abstract

Beach sports are widespread (e.g. football, volleyball, handball) and appeal to a wide range of athletes, including professionals. Their purpose is to satisfy the need for socialization, relaxation and at the same time to perform a sports activity in their free time. **Objectives.** The main objective of the study was to outline the level of explosive force of athletes practicing (indoor) handball and the effect of integrating the specific training of the beach handball game, on the sandy surface, regarding the jump level of juniors aged 16-18. **Materials and methods.** The evaluation of the athletes' relaxation was performed with the help of the BTS G-Walk equipment. The Shapiro–Wilk test was used to test the normal distribution, and the variance was tested with the F test. In order to summarize the distribution of quantitative variables, the mean ± sample standard deviation (SD) was used. Student-t, Mann–Whitney (U) or Wilcoxon tests were used to compare quantitative characteristics of two sets of samples. The significance threshold for the tests used was $\alpha = 0.05$ (5%). Statistical data analysis was performed using StatsDirect software (v.2.7.2). Excel application (from the Microsoft Office 2010 package) was used to graphically represent the results. **Results.** In the statistical analysis of the jump values, no statistically significant differences were observed between the two groups at the time of T.I. ($p > 0.05$) but statistically

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significantly higher values were observed in group II compared to group I at the time of T.F. (p = 0.0192). **Conclusion.** Constant training, performed in summer (off-season), on sand field by beach handball specific means, at juniors aged 16-18 years old, showed a statistically significant increase in explosive force (jump) compared to the control group that developed a training plan specific to indoor handball.

Keywords: *beach handball, explosive force, sand field, juniors.*

1. Introduction

Beach sports are widespread (e.g. football, volleyball, handball) and appeal to a wide range of athletes, including professionals. Their purpose is to satisfy the need for socialization, relaxation and at the same time to perform a sports activity in their free time (Gkagkanas et al. 2018). The game of beach handball appeared in the 1990s as a means of training athletes in the summer, its evolution moving away from the discipline of classic handball, despite the fact that today many beach handball players also practice (indoor) handball. (Cobos et al., 2018).

Beach handball is a sport derived from handball indoor and has its specific characteristics. First, beach handball is played on a sandy field, with small dimensions, time per game period, a well as ball size, material and dimensions differing from those in indoor handball. Also, different indood and outdoor weather conditions, like temperature, wind, humidity, factors who plays a role in players performance (Puebo et al., 2017).

The off-season is the time between the last regular season and the start of the next season. It is recommended that players take advantage of this time to recover properly for the coming season. Detraining is a process that can affect performance (Baechle & Earle, 2008; Fleck & Kraemer, 2004).

In sports practice it is well known that the level of development of motor skills is a determining factor in expanding and improving the technical baggage of athletes. The success of some athletes' technical playing actions also largely depends on the strength and power they develop through blocking, pushing, holding or even jumping (Gorostioaga et al., 2005; Granados et al., 2008). In children aged 16-18, attention is focused on the increase of strength-speed indices, this being in accordance with the development of jump level, both vertically and horizontally. (Hantău, 2004).

Explosive force is one of the motor skills approached with great interest among sports, which can be effectively trained through various training methods. This particular quality can be defined as the ability to exert maximum force in a minimum amount of time (Zatsiorsky, 1995). Over time, many coaches have shown interest in discovering various methods of improving explosive force. Although opinions are divided, many of these methods have been shown to make a significant contribution to the rapid mobilization of the force. The ability to generate an explosive force during a dynamic, multi-joint movement is dependent on the nature of the movement involved (Adams et al., 1992; Newton et al., 1996). Therefore, selecting exercises for a muscle strength training program can influence both the level of performance improvement and the type of adaptation.

2. Objectives

The main objective of the study was to outline the level of explosive force of athletes practicing the game of (indoor) handball and the effect of integrating the specific training of the beach handball game, on the sand field, on the jump of juniors aged 16-18.

3. Materials and Methods

3.1. Subjects, duration of study

The study group was composed of 26 sportswomen aged 16-18, without chronic diseases and based on the consent signed by them for voluntary participation in the study. The study group was divided in two, randomly, so the control group was composed of 13 sportswomen, as well as the experimental group.

The duration of the experiment was 3 months, between July 15, 2022 and September 15, 2022. The frequency of participation in training was 3 times a week.

3.2. *Jump level measurement*

The evaluation of the athletes' jump level was performed with the help of the BTS G-Walk equipment, a wireless system, consisting of an inertial sensor, composed of a triaxial accelerometer, a magnetic sensor and a triaxial gyroscope, which is positioned on the L5 vertebra.

This equipment measures the vertical distance of the maximum jump that athletes can achieve using the integrated Jump Squat protocol.

Figure 1. BTS G-Walk equipment

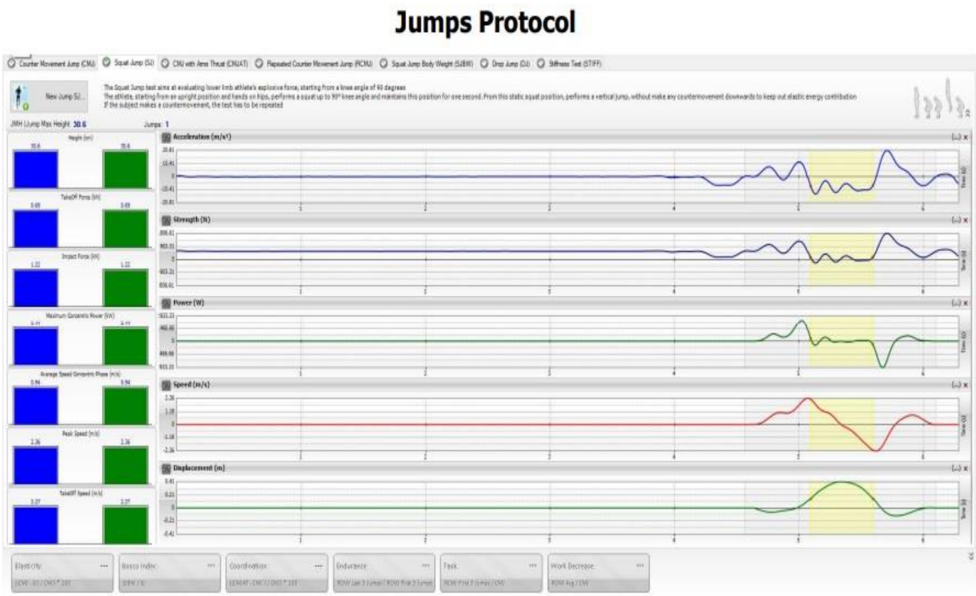


Figure 2. Jumps Protocol.

3.3. Statistical analysis and data processing

The Shapiro–Wilk test was used to test the normal distribution, and the variance was tested with the F test. In order to summarize the distribution of quantitative variables, the mean ± sample standard deviation (SD) was used. Student-t, Mann–Whitney (U) or Wilcoxon tests were used to compare quantitative characteristics of two sets of samples. The significance threshold for the tests used was $\alpha = 0.05$ (5%).

Statistical data analysis was performed using StatsDirect software (v.2.7.2) (StatsDirect Ltd., Birkenhead, Merseyside, UK). Excel application (from the Microsoft Office 2010 package) was used to graphically represent the results.

4. Results

In the statistical analysis of age values, no statistically significant differences were observed between the two groups ($p > 0.05$). In the statistical analysis of the hight values, statistically significantly higher values were observed in group II ($p = 0.0419$).

Table I. Comparative analysis for age and height values in the studied groups and statistical significance

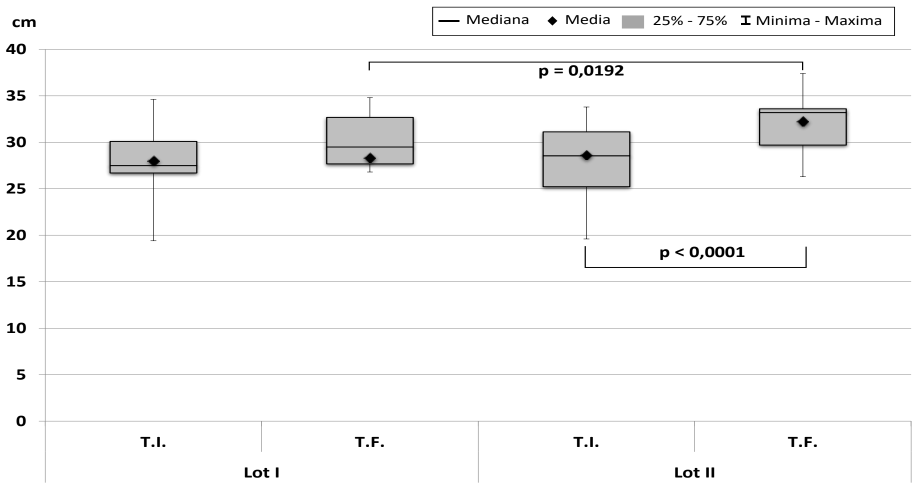
Indicator	Lot	Average	±	DS	*p*
Age	**I**	17,00	±	0,9129	0,8083
	II	16,85	±	0,8006	
H	**I**	169,85	±	6,2829	**0,0419**
	II	175,23	±	5,7613	

In the statistical analysis of the jump values, no statistically significant differences were observed between the two groups at the time of T.I. ($p > 0.05$) but statistically significantly higher values were observed in group II compared to group I at the time of T.F. ($p = 0.0192$).

In the statistical analysis of the jump values in group I, no statistically significant differences were observed between T.I. and T.F. ($p > 0.05$). In the statistical analysis of the detention values in group II, statistically significantly higher values were observed in T.F. compared to T.I. ($p < 0.0001$).

Table II. Comparative analysis for vertical jumps values in the studied groups and statistical significance

Lot	Jump	Average	±	DS	*p*	
I	**I.T.**	28,01	±	4,6668	0,1368	**T.I. I vs II**
	F.T	28,32	±	4,6799		0,7299
II	**I.T.**	28,63	±	4,4259	**< 0,0001**	**T.F. I vs II**
	F.T.	32,26	±	3,1965		**0,0192**



Graph 1. Jump level in the studied groups

5. Discussion

Due to the relatively of playing handball on the beach, few studies have been conducted in its infancy (Becerra et al. 2018). This study aims to determine if there is an effect between basic training in off-season and specific training of beach handball – the sand surface – at juniors handball players and their explosive strength. The primary findings of this study demonstrated that beach handball can be a great solution to maintaining physiological performance as practicing a different sport.

Previous studies shown differences in both body mechanics and energy demands several types of movement on sandy or similar compliant surfaces. In different studies of walking and running on sandy surfaces, researchers have reported some different amount of increase in energy cost and mechanical work (Davies & Mackinnon, 2006; Pinnington & Dawson, 2001).

Several studies have investigated differences in explosive strength or landing on dissimilar surfaces (Peikenkamp et al., 2001; Giatsis et al., 2004; Muramatsu et al., 2006) even in a theoretically form (Tilp, 2006). Researchers have reported that jumping on sand surfaces is significantly smaller jumping heights during squat jumps (Bishop, 2003; Tilp, 2006) as well as during CMJ, volleyball movements as spikes and block jumps.

Different studies about dynamic, kinematic, walking, running and jumping suggested that movements on a sandly surfaces, can influence the technique considerably.

Based on data in the literature and subjective observations, we demonstrate that: beach handball can contribute to improve a good explosive strength in off-season at juniors handball players; we could observ the yield that the two groups obtained during training period.

6. Conclusions

Following this study, we notice a good index of jump level that the two groups have in the initial tests.

Constant training, performed on the sand surface by means specific to the game of beach handball in summer (off-season), at juniors aged 16-18 years, showed a statistically significant increase in explosive force (jump) compared to the control group that developed a training plan specific to indoor handball.

This study can be an indicator of performance for coaches who prepare handball teams for the competition season, including beach handball competitions that take place during summer, observing among players a much better mental state during the most difficult training period.

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Reaction Times, Agility and Body Mass Index: Differences Between Boys and Girls in Multisport

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Abstract
Background: Children who practice multiple sports in an organized form demonstrate higher levels of motor coordination when compared to children who regularly practice only one sport. In sporting and non-sporting situations, the ability to react in the shortest time to external stimuli, agility in changes of direction and physical characteristics, are important qualitative aspects that affect performance and success in growing boys and girls. **Aim:** The purpose of this study is to compare whether the multi-sport activity carried out for several years, may have created significant differences between males and females aged 11-12 years on agility, simple reaction times to visual stimuli and body mass index (BMI). **Materials and methods:** In the present study 96 students participated, of which 49 girls (age: 11.52 ± .51 years) and 47 boys (age: 11.48 ± .51 years) practicing different sports disciplines (football, athletics, basketball, volleyball). Agility was assessed through the hexagon agility test (HAT). The measurement of simple reaction times to visual stimuli for the dominant upper and lower limb was carried out through the tests: Reaction Time simple upper limb dominant (RTs UL) and Reaction Time simple lower limb dominant (RTs LL) using mobile instrumentation with led light discs and tablets (FITLIGHT Trainer ™ Sports Corp, Canada). Height and weight were measured for the BMI calculation. The Student's t test for independent samples was used to determine if there is a statistically significant difference between the means of the two groups (male and female) independent of each other in each test administered. Statistical analyzes were performed using IBM SPSS vers. 25 for Windows. **Results:** In the comparison of the

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means of the results in all the tests administered and in the calculation of the BMI, no statistically significant difference was found for both sexes. **Conclusion and recommendations:** Boys and girls between the ages of 11 and 12 who regularly practice multi-sport have high levels of motor performance and a good state of physical fitness but it must be specified that the ability to react to visual stimuli in the shortest possible time and that of being more agile does not seem to depend on gender at this stage of growth. These indications are useful for implementing methodological interventions aimed at improving the ability to process information and more performing motor responses with similar interventions without distinction of gender.

Keywords: *agility, reaction time, BMI, gender, multisport.*

1. Introduction

Children who regularly practice sport or organized physical activity have better motor coordination, better levels of physical activity, greater motor competence especially when compared with children who do not play sports or who are sedentary (Fransen et al., 2012; Lai et al., 2014; Vandorpe et al., 2012). Physical activities based on the variability of the practice should be proposed to the very young as it is amply demonstrated that these have positive repercussions on long-term sports practice and also on future performance in elite athletes (Côté et al., 2003, 2007; Ford et al., 2009). Premature sports specialization is defined as mono-disciplinary sports practice carried out from childhood through many hours of deliberate practice with the aim of improving sports performance (CôTé et al., 2009), this anticipated start towards a single sporting discipline consequently involves an early involvement in high intensity sports training and a premature start to agonistic competition (Baker et al., 2009). In children, interventions focused on multi-sport lead to improved motor skills and perceptions of motor skills, which are essential for regular participation in health-related physical activity (Kirk, 2005). Recent systematic reviews and meta-analyzes have shown that regular physical and sporting activity has beneficial effects on the body max index (BMI), fitness and metabolic profile of children and adolescents (Bangsbo et al., 2016; Milanović et al., 2015, 2019), as well as their quality of life related to health, social and psychological well-being and academic performance (Jones et al., 2010). Children who practice multisport activities have higher levels of motor coordination than children who practice monodisciplinary activities (Sekulic et al., 2017). Among the many coordinating factors, the capacity to react in the shortest time, the speed of decision-making and agility in changing directions are important qualities for performance in many sports games and in multi-directional sports (Jakovljevic et al., 2012). Agility (or coordination) is a complex, specific and transversal quality that is closely connected with the speed, motor creativity and speed of information processing processes (Bernshteĭn & Feĭgenberg, 1991). In sport, agility has been defined as a rapid movement of the whole body with a change of speed or direction in response to a stimulus (Sheppard & Young, 2006) and it is therefore an important quality that contributes significantly to success in sports results (Sekulic et al., 2017; Young et al., 2015). Some authors have highlighted the lack of literature examining the development of agility during childhood and adolescence and have pointed out the current lack of understanding of the effects of maturation on its performance (Lloyd et al., 2013). It has been shown that physical activity and sport can be related to the improvement of motor reaction times (Jain et al., 2015; Okubo et al., 2017; van de Water et al., 2017; Walton et al., 2018; Yildirim et al., 2010) and agility (Sheppard & Young, 2006), although they are distinct physical qualities; however the reaction time (RT) is the first important step in performing agility tasks more effectively. There are many sports disciplines in which reacting as quickly as possible is essential in more diversified situations, because athletes must make quick decisions to be more likely to be successful in their actions (Mudric et al., 2015; Ruschel et al., 2011; van de Water et al., 2017). The simple reaction time (RTs) can be defined as the time that elapses from when a stimulus (signal) appears until a response is given and is considered a good measure for assessing the cognitive system's ability to process information (Jensen, 2006; Magill, 2007; Kuang, 2017). In sport, RT is often recognized by an identifiable total time as that necessary to perceive, identify, process an external stimulus and respond with movement, and has two partial components which are the reaction time and the movement time. In the present study, the RTs is considered as the time required from the presentation of the visual stimulus (LED light on) to its achievement (LED light off) through a rapid movement of the upper (hand) or lower (foot) limbs: RTs = Reaction time + Movement time.

It should also be emphasized that the relationship between agility and reaction times has not been extensively studied in the literature, especially in the gender differences in young athletes. Many authors have conducted studies on children, from infancy to adolescence, in which they show that due to the increase in the capacity and speed of information processing that the central nervous system is able to manage, the motor reaction times tend gradually to diminish (Nicolson, 1982; Sugden, 1980). Generally women have longer reaction times than male peers (Henry & Rogers, 1960). However, one study (Silverman, 2006) in which a 72-dimensional meta-analysis of the effect from 21 studies (n = 15,003) was published over a 73-year period, the author reported that male advantage in Visually stimulated RTs are decreasing (especially outside the United States), likely because more women are involved in driving and fast-acting sports. In this study we want to examine whether the multi-sport activity carried out for several years may have created significant differences between males and females aged 11-12 years in agility, simple reaction times to visual stimuli and body mass index (BMI). It has been hypothesized that giving children multidisciplinary sports opportunities would optimize the development of agility and motor reaction times without distinction of gender, also considering the possibility of variation in individual development typical of the age group considered.

2. Materials and methods

2.1. Participants

In the present study 96 children participated, of which 49 girls (age: 11.52 ±.51 years) and 47 boys (age: 11.48 ± .51 years) practicing different sports disciplines (football, athletics, basketball, volleyball) in different sports clubs in the city of Foggia (Italy).

2.2. Measures and Instruments

Anthropometry and Body Composition

The height (cm) of the subjects was measured to the nearest 0.1cm using a portable stadiometer Seca, Hamburg, Germany, the mass (kg) was measured to the nearest 0.1kg, using a Seca digital scale with shoes and bulky clothing removed. Two measurements were recorded for both height and weight for each participant, the results representing the average of the 2 measurements. The BMI for each subject was calculated using a spreadsheet set on Excel (office 2007) according to the summary report (Barlow & Committee, 2007).

Hexagon Agility Test (HAT)

L'Hexagon agility test (HAT) is described as "a measure of agility and speed of the feet involving balance and coordination capacity" (Baechle et al., 1994; Roetert et al., 1992). It has been shown that the HAT, as a field test, has excellent test-retest reliability when rigorous test procedures are followed (Beekhuizen et al., 2009; Pauole et al., 2000). In this study, a modified version of the original HAT was used (Beekhuizen et al., 2009) for example, including two sequences instead of three and using a light signal for starting. The test involves the subject facing forward, in the center of a hexagon drawn on the ground with adhesive tape. The length of each side is 24 inches (60.96 cm), each inner angle is 120 degrees. At the center of the hexagon is positioned solidly on the ground, a conductance platform connected to a chronometric detection system (Chronojump system, Barcellona, Spain). The platform is connected directly to a portable PC, all managed by a software (Chronojump software 2.2, Barcellona, Spain) which allows to detect the times in thousandths of a second. Starting from the center of the hexagon, the test involves 6 subsequent round-trip jumps, successively overcoming each side, the first jump is towards the front line, then the lateral one and so on. The test is performed both clockwise and counterclockwise. A 1 minute pause was performed between one round and the next. The average time is calculated as a score, given by the sum of the total times of the hourly and anticlockwise lap divided by 2. Two total trials were administered for each participant interspersed with 2 minutes rest. The best average time between the two tests was taken into consideration.

Test: Reaction Time simple upper (RTs UL) and lower (RTs LL) limb dominant

The measurement of the simple reaction times for the dominant upper and lower limbs respectively was carried out through the use of 2 tests: Reaction Time simple upper limb dominant (RTs UL) and Reaction Time simple lower limb dominant (RTs LL), (Wilke et al., 2020). Both tests use a mobile equipment (Fitlight Trainer ™ Sports Corp, Canada) consisting of a control tablet and moving discs, each disc (diameter: 10 cm) in relation to the program used, emits light signals through LED lights or sound and it is also equipped with proximity sensors. The system allows you to measure and record times in thousandths of a second at each contact. RTs UL (Wilke et al., 2020) is a test that evaluates the simple reaction times (ICC/Rho: 0.81* (95% CI: 0.48-0.94), $p < .001$), of the upper limbs. The subject standing, is positioned with the palm of the dominant hand (defined as the hand that he uses intuitively for sports activities, eg. throwing, pushing) resting on a table adjusted at the elbow. A sensor is positioned on the same table at a distance from the subject, equal to the length of the forearm. RTs LL (Wilke et al., 2020) evaluate the simple reaction times of the lower limbs (ICC/Rho: 0.89* (95% CI: 0.67-0.97), $p < .001$). The subject is standing, feet parallel (distance between the feet equal to the width of the shoulders), a sensor has been placed in front of the participant's feet. The sensor distance is normalized to the length of each participant's dominant foot, which is measured as the distance from the apex of the big toe to the heel. For both tests the task is to deactivate the sensor as soon as it lights up, as quickly as possible by swiping over it with the dominant hand (RTs UL) or with the dominant foot (RTs LL), contact with the sensor was not required. Each test for each test consists of a total of 20 led switching on with variable (random) intermediate time intervals. The response time in seconds, thousandths is measured on all repetitions. The result of the test is given by the average of the reaction times. Each participant for each test is given two tests with a 3 minute break in between, the shortest mean time in seconds of the two tests for each test was recorded and used in the analysis.

3. Procedures

The data was collected on the occasion of a summer sports meeting in Italy in which young athletes who had been participating for 2 years in a national project called "Educamp - Multidisciplinary Sports Centers" by Italian National Olympic Committee (CONI), a project that favors the practice of multisport.

During each sporting year, boys and girls from 7 to 14 years of age registered with the companies participating in the multisport project, practice recreational and sporting activities for 10 months, from September to June, introducing the most important elements of at least 3 sports team or individual, with frequency 3-4 times a week, under the guidance of qualified technicians from the Italian sports federations and doctors in physical and sports sciences.

On this occasion, the companies participating in the rally were contacted and permission was asked to let their athletes participate in this study.

Through the proposal of a cognitive questionnaire, the inclusion criteria were considered: (i) aged between 11 and 12, (ii) adherence to the "Multidisciplinary Sports Centers - CONI" project for 2 years, (iii) knowledge and practice of at least 3 sports disciplines, (iiii) regular participation in physical education classes at school (2 hours per week); and the exclusion criteria: (i) any recent injury requiring medical attention, (ii) neurological adverse events for example seizures, (iii) having had Covid 19 infection.

The objectives of the study and the effects of the results for the improvement of sports performance were communicated to the responsible technicians of the respective companies, to the participants and to their parents. Informed consent was requested for data collection.

All procedures conformed to the directives of the Declaration of Helsinki (2013).

3.1. Statistical analysis

Data are reported as mean ± standard deviation (SD).

Before using the parametric tests, the hypothesis of normality was tested using the Shapiro-Wilk test.

The Student's t test for independent samples was used to determine if there is a statistically significant difference between the means of the two groups (boys and girls) independent of each other in each test administered.

Statistical analyzes were performed using IBM SPSS vers. 25 for Windows.

4. Result

No discomfort or adverse effects during test were noticed or reported.

4.1. Anthropometry and Body Composition

The distinction of the characteristics of age, height, mass, BMI between boys and girls are summarized in the tables (Table 1, Table 2).

Table 1. Characteristics of the groups: Boys (mean ±; N = 47) and Girls (mean ±; N = 49)

Parameter	Boys	*p* value	Girls	*p* value
Age (year)	11.48 ±.51	< .0001	11.52 ±.51	< .0001
Height (cm)	147.30 ±7.05	.0603	147.67 ±4.84	.4480
Body mass (kg)	39.99 ±4.92	.5538	42.33 ±3.32	.7310
BMI (kg)	18.38 ±1.30	.0465	19.40 ±1.02	.2726

Values are expressed in mean ± standard deviation; Body Max Index (BMI).

Table 2. Characteristics of groups by gender with reference to percentiles (Barlow & Committee, 2007)

	Boys	Girls	Totals
Number of children evaluated	47	49	96
Underweight (<5th% ile)	0%	0%	0%
Normal BMI (5th - 85th %ile)	96%	95%	95%
Overweight or obese (≥ 85th% ile) *	4%	5%	5%
Obese (≥ 95th% ile)	0%	0%	0%

Body Max Index (BMI)

* Terminology based on: Barlow SE and Committee of Experts. Recommendations of the Expert Committee on the Prevention, Assessment and Treatment of Overweight and Obesity in Children and Adolescents: Summary Report (Barlow & Committee, 2007).

The data in table 2 show that 96% of the boys and 95% of the girls examined have normal BMI values, therefore no particular gender differences are highlighted.

4.2. Hexagon Agility Test (HAT), Reaction Time simple upper (RTs UL) and lower (RTs LL) limb dominant test

The preliminary analyzes conducted through the construction of the boxplots (Figures 1) in which the averages of the results of each test (HAT, RTs UL dominant and RTs LL dominant) of the boys and girls were compared, did not show the presence of outliers between groups.

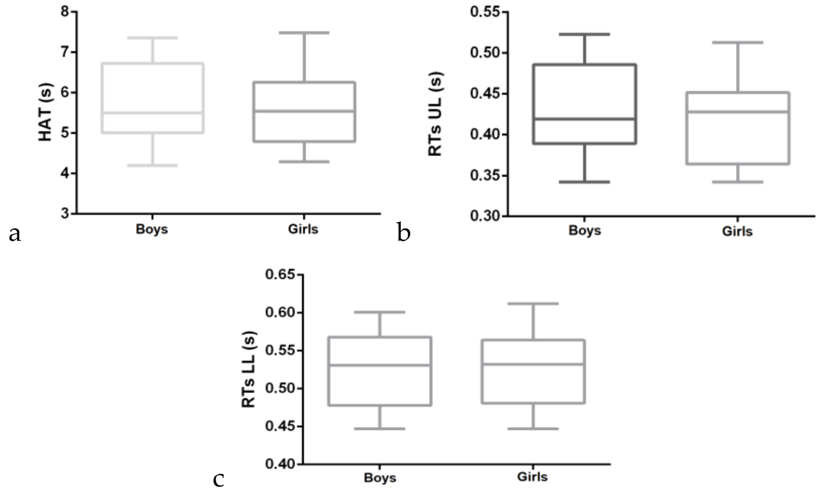

Figure 1. Comparison between boys and girls of the means time (s) in (a) Hexagon Agility Test (HAT), (b) Reaction Time Simple Upper Limb dominant (RTs UL) and (c) Reaction Time Simple Lower Limb dominant (RTs LL) test

Table 3. Hexagon Agility Test (HAT), Reaction Time Simple Upper Limb dominant (RTs UL), Reaction Time Simple Lower Limb dominant (RTs LL): means, standard deviations (SD) and p-value (Shapiro-Wilk Test; p> 0.05) between boys and girls.

	N	Mean (s)	SD	p-value
HAT boys	47	5.824	.962	p>.05
HAT girls	49	5.599	.921	p>.05
RTsUL boys	47	.429	.053	p>.05
RTs UL girls	49	.416	.050	p>.05
RTsLL boys	47	.525	.050	p>.05
RTs LL girls	49	.524	.046	p>.05

Student's t test for independent samples was used to determine if there is a statistically significant difference between the means of two independent groups (boys and girls) in each test administered. In the HAT, RTs UL and

RTs LL tests, the Levene test for assumed equal variances was significant for all tests, therefore the null hypothesis, ie that there is equality of variances, is discarded. Therefore, having accepted the hypothesis of non-equality of the variables, the results in table 4 show that for the tests HAT (p = .431), RTs UL (p = .431) and RTs LL (p = .921) there are no differences significant among the averages of boys and girls.

Table 4. T-test for the equality of means between boys (N = 47) and girls (N = 49) in the Hexagon Agility Test (HAT), Reaction Time Simple Upper Limb dominant (RTs UL), Reaction Time Simple Lower Limb dominant (RTs LL).

		t	gl	Sign. (two-tailed)	Difference of the mean	Standard error difference	Confidence Interval of 95% difference Inferior	Superior
HAT (s)	Equal variances not assumed	-.795	41.897	**.431**	-.225	.284	-.799230	.347416
RTs UL (s)	Equal variances not assumed	-.827	41.911	**.413**	-.013	.016	-.044407	.018585
RTs LL (s)	Equal variances not assumed	-.100	41.998	**.921**	-.001	.014	-.030816	.027913

In the HAT test, the average time in the boys group (5.824 ±.962 s) is higher than in the girls group (5.599 ±.921 s), with a difference equal to -.225 s, therefore there is no statistically significant difference between the two groups (p =.431). In the RTs UL test the average time in the boys group (.429 ±.053 s) is slightly higher than the girls group (.416 ±.050 s), in fact the difference is equal to -.013 s, there is no statistically significant difference between the two groups (p = .413). In the RTs LL test, the difference in the mean times in the group of boys (.525 ±.050 s) and girls (.524 ±.046 s) is minimal (diff. = -.001 s), so much so that it is considered negligible, also in this case we did not have a statistically significant difference between the two groups (p = .921).

5. Discussion

The ability to quickly and accurately execute movements in response to external stimuli is a key factor in athletic performance (Galpin et al., 2008). Variability in task and context is deemed crucial in basic research on learning and brain plasticity (Green & Bavelier, 2008). There are many studies that have shown the existence of significant relationships between agility and reaction tests to visual stimuli both for the use of the upper and lower limbs (Fiorilli et al., 2017; Homoud, 2015; Horicka et al., 2018; Moradi & Esmaeilzadeh, 2015), but few that show gender differences in pre-pubertal age. Physical exercise and motor and sports practice have positive effects on the reaction times of the upper and lower limbs (Akarsu et al., 2009). The objective of the present study is to verify whether there are differences in performance on simple motor reaction times to visual stimuli, agility and BMI, between boys (N = 47) and girls (N = 49) aged 11-12. years, practicing multi-sport activities. Adult men generally have shorter and less variable motor reaction times than women. One hypothesis could be that gender differences in the variability of motor reaction times may originate from the effects of sex hormones on the central nervous system and therefore can consequently be predicted in adults but not in pre-adolescents (Der & Deary, 2006).

There are few studies that deal with the development of responsiveness in the pre-pubertal period, while there are similar studies in boys and girls up to ten years of age (Feč, 2010) or adults (Der & Deary, 2006; Luchies et al., 2002).

A study conducted on boys and girls between the ages of nine and twelve demonstrated a significant relationship between agility and motor reaction times (Moradi & Esmaeilzadeh, 2015).

In the present study in the analyzed sample (boys; N = 47 and girls; N = 49) the t-test for the equality of means (Table 4) shows that there are no significant differences between gender and in UL dominant RTs (mean difference of times = -.013 s; p = .413) that RTs LL dominant (mean difference of times = -.001 s; p = .921), this is equivalent to saying that the reaction times for this age group 11-12 years do not depend on the gender; a probable explanation could be that the rates of reaction times are determined by predominantly cognitive processes in which there are no sex differences. The results obtained are however consistent with the hypothesis that the sex differences in the variability of the UL RTs and the dominant LL RTs, may be attributable to the effects on the central nervous system (CNS) of sex hormones, in particular of estrogens, whose receptors are present in different regions of the brain involved in information processing and attention, systems that are involved in regulating variability in information processing. Therefore, according to this hypothesis, gender differences in reaction times should be present after puberty, but not in pre-pubertal children (Ghisletta et al., 2018) such as those present in this study.

A hypothesis to consider is that from an anatomical-physiological point of view in pre-adolescent age girls are naturally disadvantaged compared to boys in simple reaction times, as the neural impulses involved in the production of a motor response must travel a longer path. long from the brain to the muscles recruited, this is because from about 2 to 14 years old girls are on average taller than boys (Tanner & Tanner, 1990). In the analyzed sample, the measured values of average height in boys (147.30 ±7.05 cm) and in girls (147.67 ±4.84 cm) are almost the same (Table 1), therefore this hypothesis in this case is null.

Conditions similar to the results of the tests described above were also found in HAT, i.e. that statistically there are no significant differences between boys and girls (mean difference of times =-.225 s; p =.431), therefore similarly to what was stated for the tests of motor reaction, agility performances for this 11-12 year age group do not depend on gender. However, it should be noted, as can be seen in the data in table 3, that in the agility test the average time recorded in girls (5.599 ± .921 s; p>.05; N = 49) is in any case lower than that of boys (5.824 ± .962 s; p>.05: N = 47) despite statistical insignificance; this aspect could have a matrix of mere randomness also linked to the small number of subjects examined. In fact, it is known that up to the age of twelve, girls and boys do not have great differences from a coordinative and conditional point of view, in particular related to muscle strength.

The values of the anthropometric factors (weight, height) in this study were used to determine the BMI of boys and girls, assuming that theoretically, factors such as body fat and lengths of body segments can particularly affect performance of agility. The data show that 96% of the boys (N = 47) and 95% of the girls (N = 49) examined fall within normal BMI values (Table 2) therefore, given the low number of the sample analyzed (N = 96), there are no particular differences between the two groups. The estimated BMI was however taken into consideration to verify the homogeneity of the reference sample in each group.

6. Conclusions and recommendations

Boys and girls between the ages of 11 and 12 who regularly practice multisport have high levels of motor performance and good physical fitness. Studies have already shown for some time that groups of young people who practice multidisciplinary and multilateral sports activities have statistically significant improvements compared to groups who practice only one sport and sedentary (Massacesi et al., 1996). A hypothesis to be confirmed for coaches or teachers is whether specific motor exercises or tasks on the development of agility and motor reaction times in pre-pubertal children should be differentiated by gender. The present study, within its limits, confirms how in children who practice multisport, reacting to visual stimuli in the shortest possible time and being more agile, does not seem to depend on gender. The development of the ability to react improves with increasing age, it is therefore known that the phase ranging from seven years up to the pre-pubertal and pubertal (11-12 and 13-14 years) is considered a sensitive period for development of these skills (Horníková et al., 2019). These indications are useful for implementing methodological interventions aimed at improving the ability to process information and more performing motor responses with interventions without gender distinction in pre-pubertal age. Physical exercise and sports practice have positive effects on the reaction times of the upper and lower limbs (Akarsu et al., 2009) and therefore on the closely related agility, it is still necessary to reflect and develop subsequent research programs aimed at analyzing which types of activities have the greatest influence on children.

Disclosure statement

The authors report no conflicts of interest.

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The Impact of COVID-19 Pandemic on Physical Activity in Sighted and Visually Impaired Children

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Abstract
The introduction of restrictions due to Covid 19 as well as the closing of schools has considerably influenced the participation in physical activities of both sighted and blind children.
The purpose of this study was to investigate the effects of the COVID 19 restrictions on the participation in physical activities in sighted and blind children.
Physical activity level was measured with the Physical Activity Index (PAI), before, during and after pandemic. 79 sighted students and 34 visually impaired students aged 13-15, from 2 local schools participated in the study.
COVID-19 pandemic restrictions such as closing schools, restricting access to gyms, parks, playgrounds had a negative impact on the participation in physical activities for both groups.
During the pandemic lockdown the Physical Activity Index showed significantly lower scores for both of the groups, p≤0, 05.

Keywords: *COVID-19 pandemic, physical activity index, sighted and visually impaired children.*

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1. Introduction

Physical activity defines any form of body movement produced by skeletal muscles that uses energy. Physical activity is a scientifically proven source of health benefits. By physical activity we mean any type of movement, from exercise and sports to recreational activities such as walking, cycling, dancing or ordinary household activities such as gardening, cleaning the house (WHO, 2020).

According to the World Health Organization (WHO), globally, one in four adults and more than 80% of adolescents have an insufficient level of physical activity. Nearly 5 million deaths could be avoided annually if the world's population were more physically active. People who are insufficiently physically active have a 20 to 30% higher risk of death compared to people who have an appropriate level of physical activity (WHO, 2020). According to the Romanian National Institute of Public Health, at least 25 diseases of the body and nervous system can be prevented, improved or treated through physical activity.

The COVID-19 pandemic has brought many challenges to our health and the activities that support a healthy lifestyle. During the pandemic, participation in physical activities was limited due to restrictions. For people with visual impairments, participation in physical activities was almost impossible due to the lack of accessibility to public areas such as parks, outdoor sports fields, mountain trails, etc. (Tison et al., 2020).

Sedentary behaviours and lack of physical activity have become more widespread during the COVID-19 pandemic. The studies reviewed showed significant increases in time spent in inactivity (Srivastav et al., 2021; Ruiz-Roso et al., 2020; Biviá-Roig et al., 2020; Dunton Do B & Wang, 2020; Romero-Blanco et al., 2020; Castañeda-Babarro et al., 2020; Ammar et al., 2020), screen time (eg, video games, television viewing, and computer use) (Elran-Barak, Mozeikov, 2020; Pietrobelli, 2020; Majumdar, 2020; Zheng et al., 2020; Pišot et al., 2020; Azizi et al., 2020), time spent on social networks (Sun et al., 2020; Elran et al., 2020), total sedentary time (Zheng et al., 2020; Pišot et al., 2020), duration of time spent at home (Sun et al., 2020) and online work time (Zheng et al., 2020).

The purpose of this study was to investigate the effects of the COVID 19 restrictions on the participation in physical activities in sighted and blind children.

2. Material and methods

2.1. Study group

The study included 79 sighted students (46 girls and 33 boys) and 34 visually impaired students (14 girls and 20 boys) aged 13-15, from 2 local schools.

2.2. Measurements

Physical activity level was measured with the Physical Activity Index.

The physical activity index contains 3 parameters regarding the intensity (Effort that leads to rapid breathing ang sweating, Effort increasing the respiratory rate and sweating, Effort above average, Moderat effort, Easy effort) duration (over 30 min, 20-30 min, 10-20 min, below 10 min) and frequency (Daily or almost daily, 3-5 times weekly, 1-2 times weekly, several times monthly, less than once monthly) of physical activity. PAI is obtained by multiplying the scores of each parameter.

The interpretation is as follows:

- 80-100 points very active lifestyle, superior physical condition category,
- 60-80 points active and healthy person, very good physical condition category,
- 40-60 points acceptable, reasonable physical condition category,
- 20-40 points insufficiently active, relatively sedentary, poor physical condition category, below 20 sedentary, very poor physical condition category.

Statistical analysis

Statistical analysis was performed using MedCalc Statistical Software version 20.111 (MedCalc Software bv, Ostend, Belgium; https://www.medcalc.org; 2022). Continuous data were tested for normality of distribution using the Shapiro-Wilk test and characterized by the median and the 25th and the 75th percentiles. Qualitative data were expressed as absolute and relative frequency. We used the t-test for paired values, differences between measurement were verified with the ANOVA for repeated measurements test or two-way ANOVA for repeated measurements, whenever appropriate. A p value of <0.05 was considered statistically significant.

3. Results

3.1. Physical Activity Index for the sighted group. Comparation between the COVID 19 lockdown and before and after COVID 19 PAI values.

Table 1. Physical Activity Index for the sighted group

		Before COVID 19	COVID 19 lockdown	After COVID 19
N	Valid	79	79	79
	Missing	0	0	0
Percentiles	25	36.00	8.00	30.00
	mediana	48.00	27.00	48.00
	75	80.00	60.00	80.00

Following the data analysis, we observed statistically significant differences in the PAI values before the COVIDX 19 pandemic and during the pandemic. We also observed statistically significant differences in PAI values during the pandemic and after the pandemic, p≤0, 05 for the sighted group. We did not observe significant differences between PAI values before and after the pandemic (table 1, 2).

Table 2. PAI for the sighted group. Comparation between the COVID 19 lockdown and before and after COVID 19 PAI values.

Pairwise Comparisions						
Sample 1	Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
COVID 19 lockdown	before COVID 19	-.734	.159	-4.614	.000	.000
COVID 19 lockdown	after COVID 19	.861	.159	5.410	.000	.000
Before COVID 19	after COVID 19	.127	.159	.796	.426	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
[a]Significance values have been adjusted by the Bonferroni correction for multiple tests.

3.2. Physical Activity Index for the visually impaired group. Comparation between the COVID 19 lockdown and before and after COVID 19 PAI values.

Table 3. Physical Activity Index for the visually impaired group

		Before COVID 19	COVID 19 lockdown	After COVID 19
N	Valid	34	34	34
	Missing	0	0	0
Percentiles	25	20.00	1.00	30.00
	mediana	38.00	20.00	56.00
	75	80.00	48.00	85.00

Following the data analysis, we observed statistically significant differences in the PAI values before the COVIDX 19 pandemic and during the pandemic. We also observed statistically significant differences in PAI values during the pandemic and after the pandemic, $p \leq 0, 05$ for the visually impaired group. We did not observe significant differences between PAI values before and after the pandemic (table 3, 4).

Table 4. PAI for the visually impaired group. Comparation between the COVID 19 lockdown and before and after COVID 19 PAI values.

Pairwise Comparisons					
Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.[a]
COVID 19 lockdown – before COVID 19	.868	.243	3.577	.000	.001
COVID 19 lockdown – after COVID 19	-1.118	.243	-4.608	.000	.000
Befor COVID 19 – after COVID 19	-.250	.243	-1.031	.303	.908

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

3.3. The influence of gender on Physical Activity Index

Taking into account the influence of the gender variable, we did not observe statistically significant differences between boys and girls in the values of the PAI questionnaire before, during and after the pandemic for both of the groups (table 5, 6).

Table 6. The influence of gender on Physical Activity Index for the sighted group

Multivariate Tests[a]								
Effect		Value	F	Hypothesis df	Error df	Sig.	Noncent. Parameter	Observed Power[c]
factor1	Pillai's Trace	.363	21.668[b]	2.000	76.000	.000	43.336	1.000
	Wilks' Lambda	.637	21.668[b]	2.000	76.000	.000	43.336	1.000
	Hotelling's Trace	.570	21.668[b]	2.000	76.000	.000	43.336	1.000
	Roy's Largest Root	.570	21.668[b]	2.000	76.000	.000	43.336	1.000
factor1* gender	Pillai's Trace	.031	1.210[b]	2.000	76.000	.304	2.420	.257
	Wilks' Lambda	.969	1.210[b]	2.000	76.000	.304	2.420	.257
	Hotelling's Trace	.032	1.210[b]	2.000	76.000	.304	2.420	.257
	Roy's Largest Root	.032	1.210[b]	2.000	76.000	.304	2.420	.257

a. Design: Intercept + gen Within Subjects Design: factor1; b. Exact statistic; c. Computed using alpha = .05

Table 6. The influence of gender on Physical Activity Index for the visually impaired group

Multivariate Tests[a]								
Effect		Value	F	Hypothesis df	Error df	Sig.	Noncent. Parameter	Observed Power[c]
factor1	Pillai's Trace	.512	16.294[b]	2.000	31.000	.000	32.588	.999
	Wilks' Lambda	.488	16.294[b]	2.000	31.000	.000	32.588	.999
	Hotelling's Trace	1.051	16.294[b]	2.000	31.000	.000	32.588	.999
	Roy's Largest Root	1.051	16.294[b]	2.000	31.000	.000	32.588	.999
factor1* gender	Pillai's Trace	.061	1.010[b]	2.000	31.000	.376	2.021	.210
	Wilks' Lambda	.939	1.010[b]	2.000	31.000	.376	2.021	.210
	Hotelling's Trace	.065	1.010[b]	2.000	31.000	.376	2.021	.210
	Roy's Largest Root	.065	1.010[b]	2.000	31.000	.376	2.021	.210

a. Design: Intercept + gender Within Subjects Design: factor1; b. Exact statistic; c. Computed using alpha = .05

3.4. The influence of age on Physical Activity Index

Taking into account the influence of the age variable, we did not observe an influence of age upon the PAI questionnaire values before, during and after the pandemic for both of the groups (Table 7, 8).

Table 7. The influence of age on Physical Activity Index for the sighted group.

Multivariate Tests[a]								
Effect		Value	F	Hypothesis df	Error df	Sig.	Noncent. Parameter	Observed Power[d]
factor1	Pillai's Trace	.327	18.243[b]	2.000	75.000	.000	36.486	1.000
	Wilks' Lambda	.673	18.243[b]	2.000	75.000	.000	36.486	1.000
	Hotelling's Trace	.486	18.243[b]	2.000	75.000	.000	36.486	1.000
	Roy's Largest Root	.486	18.243[b]	2.000	75.000	.000	36.486	1.000
factor1* age	Pillai's Trace	.102	2.047	4.000	152.000	.091	8.189	.601
	Wilks' Lambda	.898	2.072[b]	4.000	150.000	.087	8.289	.607
	Hotelling's Trace	.113	2.096	4.000	148.000	.084	8.383	.612
	Roy's Largest Root	.111	4.207[c]	2.000	76.000	.019	8.413	.722

a. Design: Intercept + age Within Subjects Design: factor1; b. Exact statistic; c. The statistic is an upper bound on F that yields a lower bound on the significance level; d. Computed using alpha = .05

Table 8. The influence of age on Physical Activity Index
for the visually impaired group

Multivariate Tests[a]								
Effect		Value	F	Hypothesis df	Error df	Sig.	Noncent. Parameter	Observed Power[d]
factor1	Pillai's Trace	.497	14.323[b]	2.000	29.000	.000	28.647	.997
	Wilks' Lambda	.503	14.323[b]	2.000	29.000	.000	28.647	.997
	Hotelling's Trace	.988	14.323[b]	2.000	29.000	.000	28.647	.997
	Roy's Largest Root	.988	14.323[b]	2.000	29.000	.000	28.647	.997
factor1* age	Pillai's Trace	.194	1.076	6.000	60.000	.387	6.455	.391
	Wilks' Lambda	.806	1.100[b]	6.000	58.000	.374	6.598	.399
	Hotelling's Trace	.240	1.120	6.000	56.000	.363	6.717	.404
	Roy's Largest Root	.238	2.377[c]	3.000	30.000	.090	7.130	.538

a. Design: Intercept + age Within Subjects Design: factor1; b. Exact statistic; c. The statistic is an upper bound on F that yields a lower bound on the significance level; d. Computed using alpha = .05

4. Discution

People's everyday movement and physical activity routines were significantly changed by COVID-19. In comparison to pre-COVID eras, people all throughout the world reported decreases in daily physical activity and increases in sedentary time (such as watching TV or using electronic devices) and time spent at home. During the COVID-19 pandemic, sedentary behaviour and lack of physical activity increased. (Park et al., 2022).

In general, there was a significant decline in physical activity levels during COVID-19, with reductions in light (Di Sebastiano, 2020), moderate and/or vigorous (Srivastav, 2021; Ruiz-Roso, 2020; Biviá-Roig, 2020; Di Stefano, 2021; López-Sánchez, 2021; Castañeda-Babarro, 2020) and total physical activity (Elran-Barak, 2020, Dunton, 2020; Amar, 2020; López-Sánchez, 2021) occurring, though one study found that university students engaged in more moderate, vigorous, and total physical activity while confined (Romero-Blanco, 2020). Other studies supported the significant effect of COVID-19 on public health, showing a significant decline in the proportion (Gallo, 2020) or number (López-Bueno, 2020) of participants who met the advised physical activity level (for adults, at least 150 minutes of moderate-intensity aerobic activity, according to the Centers for Disease Control and Prevention) during the pandemic.

Additionally, COVID-19 has caused significantly lower daily step counts (Hemphill, 2020; Vetrovsky, 2020), lower levels of outdoor physical activity and play (De Lannoy, 2020), and lower levels of exercise and sports (Assaloni, 2020; Pietrobelli, 2020), whereas several studies have shown significantly higher levels of physical activity with family (Azizi, 2020), labor/physical work (such as gardening) (Pišot, 2020), and leisure time (Bourdas, 2020). Two investigations found conflicting effects of COVID-19 on outdoor leisure activities. While a European study found a considerable rise in outdoor recreational activity during the pandemic (Venter, 2020), a US study found a significant decline in outdoor recreation participation (Rice, 2020).

Despite the fact that many people struggle to exercise for a number of time, economical, and motivational reasons (Ebben & Brudzynski, 2008; Tappe et al., 1989), people who are blind or have visual impairments confront additional obstacles to exercise (Capella-McDonnall, 2007; Matoso & Portela, 2020). Sports participation among visually impaired youngsters who are sedentary needs to be promoted. Children who are visually impaired should practice sport more than once or twice a week in order to achieve normal physical parameters (Maniu et al., 2018).

According to studies conducted around the world, people with disabilities have been particularly negatively impacted by lockdowns and social exclusion (Jalali et al., 2020; Mbazzi et al., 2020; Safta-Zecheria, 2020).

In our study the physical activity level showed a significant decrease during the pandemic for both of the studied groups. After the pandemic the physical activity levels have returned to pre-pandemic values.

5. Conclusions

The COVID 19 pandemic negatively influenced the physical activity levels of sighted and visually impaired children.

Physical activity levels are similar before and after COVID 19 lockdown.

Age doesn't influence the physical activity levels before, during and after pandemic for sighted and visually impaired children.

Gender doesn't influence the physical activity levels before, during and after pandemic for sighted and visually impaired children.

In our study the physical activity level showed a significant decrease during the pandemic for both of the studied groups. After the pandemic the physical activity levels have returned to pre-pandemic values.

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Increasing Exercise Capacity in Patients With Hypertension - A Dual Perspective: Interval Training *vs.* Continuous Training

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Abstract
High blood pressure is a global health challenge because of its high prevalence and main risk factor for death. The aim of the present study was to determine the effectiveness of interval and continuous cycle ergometer training programs to improve health. The research was carried out on a sample of 20 patients, with the main diagnosis of grade 3 hypertension, male, aged 55 - 75 years old. Parameters aimed at analysing exercise capacity were: blood pressure, heart rate and SpO_2. The recovery programme consisted of endurance training on the cycle ergometer and medical gymnastics exercises. Research results. In this study both types of training led to significant increases in exercise capacity and improvements in blood pressure values, but interval training on the cycle ergometer led to decreases in systolic blood pressure values by 7.6 mmHg and diastolic blood pressure by 1.9 mmHg, compared to continuous training where decreases of only 4.7 mmHg in systolic blood pressure and 1.4 mmHg in diastolic blood pressure were recorded. Improvements were also found in the other parameters analysed, with the mention that the results were superior when interval training was used.

Keywords: *cardiac rehabilitation, high blood pressure, physical exercise, ergometer bike.*

1. Introduction and literature review

In 2021, cardiovascular disease has accounted for the main mortality cause worldwide, namely at least a third of all the deaths across the Globe

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and around 50% of all deaths in Europe. World Health Organisation predicts an increase of the figures in the next ten years.

Cardiac rehabilitation comprises long-term comprehensive programs that include medical evaluation, physical activity, modification of risk factors, education and recommendations by specialist physicians. The purpose of these programs is to limit the physiological and psychological effects of cardiac disease, reduce mortality, control cardiac symptoms, stabilise or regress atherosclerosis and improve the psychosocial and vocational status of patients (Aursulesei, Mitu & Alexa, 2015). This definition shows the fundamental role of physical exercise in the global recovery program applied to cardiovascular patients in general (hypertensive patients in particular).

Cardiovascular recovery presents a set of procedures designed to mitigate the cardiovascular risk factors and limit or stop disease progression. The beneficial effects of including physical exercises in the recovery programs for patients suffering from high blood pressure (HBP) are proven by the increase in the cardiovascular functional capacity, in the quality of life, in the improvement of the psychological condition and mortality reduction, implicitly.

Physical therapy, through physical exercise, contributes fundamentally to the patient's health state improvement through an increase in the exercise capacity and an improvement in the functional state. It is relevant to note that the elaboration of programs should consider both the individual characteristics of the patient and the evolution stage of the disease.

The programs of exercises for patients with cardiovascular pathology include, usually, a continuous low- or moderate-intensity aerobic routine; it is worth noting that the main benefits are represented by an increase in the maximum oxygen volume (Mezzani et al., 2013).

Studies have shown that the continuous aerobic training involves longer intervals with moderate intensity (60-80% of VO2max) **(**Rojhani-Shirazi et al., 2018**)** compared to high-intensity interval training, consisting of high-intensity, intermittent, short intervals (85–100% of VO2max) alternated with relative periods of rest (Villelabeitia-Jaureguizar et al., 2017).

Other studies demonstrate the direct relationship between the intensity of physical training and the cardio-protecting benefits of that training (Beckie et al., 2014).

In what concerns hypertensive patients, current research recommends for exercise intensity to be around 60% from the peak cardiac level on 12-13 on the Borg scale. Upper limits should not exceed the intensity of 85% of the peak cardiac rate on 15 – 16 on the Borg scale (Prescott, 2020).

Furthermore, high-intensity interval training determines an increase in the exercise capacity compared to moderate-intensity continuous training (Tamburús et al., 2015).

A recent study has noted more significant improvements of peak aerobic capacity after a high-intensity interval training compared to moderate-intensity continuous training (Mitchell et al., 2018). However, the debate concerning the optimal intensity of physical exercises among patients with HBP is still an open matter.

The importance of cardiovascular recovery in general and physical exercise in particular is highlighted by the conclusion that a reduction of systolic blood pressure by 10 mmHg may decrease mortality by 20 – 40%, while a reduction of diastolic blood pressure by 5 – 6 mmHg decreases the risk of myocardial infarction by 42% and the incidence of coronary disease by 15% (Campbell, Lackland & Lisheng, 2015).

The Treatment of Mild Hypertension Study (TOMHS) conducted by World Hypertension League in 1991 has demonstrated that a modification of the lifestyle, including weight loss and increase in exercise capacity contributes significantly to blood pressure control.

Recent research suggests that the aerobic exercises contribute to a modification of coronary risk factors. For instance, following an acute myocardial infarction, aerobic exercises favour a decrease in the body fat percentage (Kingwell & Jennings, 2015), reduce blood pressure (Bauman & Owen, 2014), lead to a reduction of triglyceride values and increase in the HDL cholesterol level (Ornish et al., 2018).

Pollock et al. (2000) have highlighted the relevance of physical training in the cardiovascular recovery among the hypertensive patients. They were among the first who pointed out the introduction of resistance training, effective in the improvement in strength and muscle endurance.

Cardiac rehabilitation has a positive influence on clinical findings concerning the patients with cardiovascular disease, but it is worth mentioning that such exercises are underused in the case of women (Supervıa et al., 2017).

During cardiovascular rehabilitation, risk factors may be mitigated in both male and female patients. Scientific literature underlines significant differences between the results obtained for women compared to men. Hence, authors noted improved blood pressure values and higher cholesterol values in men compared to women. In addition, women record higher scores concerning depression and anxiety, at the end of the recovery program, compared to men (Hartel, 2018).

According to Grande et al. (2017), women experience higher mental stress and sometimes they have different expectations regarding the results of the treatment than men. Differences also persist concerning the satisfaction degree due to the implementation of the recovery program, both on the short and the long term, and the perceived benefits (Samayoa et al., 2014).

2. Materials and methods

The purpose of this study was to determine the capacity of interval and continuous training programs on the bicycle ergometer and improve health through the parameters studied and the identification of the most effective recovery methods between the two.

The study objectives concern the reduction of blood pressure values to a level minimising the cardiovascular risk of the disease, namely the enhancement of heart activity by reducing heart rate at rest and during effort, SO_2, even the exercise capacity.

The study comprised **20 male subjects (n=20)** randomly divided into two groups, the first performing **continuous training on the bicycle ergometer (n=10)** and **the second undergoing interval training on the bicycle ergometer (n=10).** The average age of the subjects was aprox. 64 years old. The main inclusion criteria were the grade 3 high blood pressure diagnosis and male gender. Secondary inclusion criteria included sedentariness and being retired.

The GC group included patients with: overweight (10), type 2 diabetes (3), dyslipidemia (7). Furthermore, two of them suffered from scapulohumeral periarthritis and one suffered from vertigo.

The GI group included patients with: overweight (10), type 2 diabetes (4), dyslipidemia (9). Also, three of them suffered from epicondylitis and two suffered from cervical spondylosis.

Taken into perspective, we consider that the above mentioned diagnostics had little to no effect on the outcome of our study. Moreover, overweightness, type 2 diabetes and dyslipidemia closely linked with a number of cardiovascular diseases, including high blood pressure. Scapulohumeral periarthritis and epicondylitis are specific to elderly people (above 65 years old). The patient suffering from vertigo was kept in the study, even though his impairment led to him pausing several times during the training. In spite of this, he managed to finish the two week training, displaying good results.

All of them took anti-hypertensive medication and most of them, beta-blockers and diuretics. The duration of the recovery program was two weeks. The investigation took place from February to September 2022.

Within the study, we will use the bicycle ergometer Ergoline Ergoselect200, this being one of the most significant tools in the recovery of cardiovascular patients. It allows the appreciation and accurate measurement of cardiorespiratory parameters – blood pressure, heart rate, oxygen saturation and electrocardiogram.

The software used is ERS2, which:

- Allows group preparation in cardiac rehabilitation with up to 16 patients.
- Displays and stores in real time all ECG signals and training parameters BP, HR, SpO_2, MET.
- Allows the individualisation of cardiac rehabilitation practices, depending of the cardiac pathology of the patient and their adjustment

throughout training when detecting rhythm disorders and/or BP value increases.

Table 1. Characteristics of patients in the initial phase
(the first training session during exercise)

CHARACTERISTICS	GC	GI
Age (years)	64.0 ± 3.62	64.2 ± 5.05
Gender	MALE	MALE
Body mass index (kg/m^2)	28.10 ± 1.63	28.03 ± 1.61
Smokers	2/10	3/10
Systolic blood pressure (mmHg)	146.2 ± 7.42	147.9 ± 3.78
Diastolic blood pressure (mmHg)	88.3 ± 4.97	90.4 ± 4.72
Heart rate (bpm)	91.3 ± 2.45	92.5 ± 3.89
Oxygen saturation (%)	96.5 ± 1.08	97.0 ± 1.05
Medication	**YES**	**YES**
Antihypertension treatment	10/10	10/10
Beta-blocker	10/10	8/10
Diuretics	9/10	9/10

Note: The values calculated are means ± standard deviation; GC – Continuous training group; GI – Interval training Group

3. Cardiac rehabilitation program

The cardiac recovery program was preceded by a specialty consult by the cardiologist involving both clinical and paraclinical investigations. They included anamnesis, EKG exam, echocardiography and blood works. The program took two weeks, in the gym, carried out under the supervision of a physical therapist. Every session took from 20 minutes initially, to 60 minutes (last sessions), in accordance to the rise of the effort capacity of every patient individually. The training sessions were comprised of medical gymnastics and endurance training on the bicycle ergometer. Gymnastics training consisted of warm-up, followed by joint mobility exercises, strength exercises, muscle endurance and stretching, followed by a period of cooldown.

Aerobic training used the bicycle ergometer and it included two different training ways: **high-intensity interval training** or moderate-intensity **continuous training**. Hence, we divided the subjects into two groups: **the first group** performed **continuous training on the bicycle ergometer (n=10)** and **the second** performed **interval training on the bicycle ergometer (n=10).**

Continuous training was preceded by a 2 – 4-minute warm-up, the training per se was performed at an intensity between **25W – 50W**, followed by a 2 – 4-minute cooldown. The total duration of a training session was between 10 - 30 minutes (it grew in time in accordance with the patient's effort capacity). The training was individualised in real time; the intensity increase was dictated by blood pressure values, heart rate and SpO_2.

Interval training consists of the execution of 6 rounds of 2 – 4 minutes of effort at an intensity of **25W,** alternating with 5 rounds of 2 – 4 minutes of effort at an intensity of **35W** (first sessions) - **75W** (last sessions). Again, wattage was dictated by the effort capacity. The physical effort per se was preceded by a warm-up of 2 – 5 minutes and followed by a cooldown of 2 - 4 minutes. The total duration of a training session is 15 - 30 minutes. As in the case of continuous training, it was individualised in real time, the increase in intensity was dictated by blood pressure values, heart rate and SpO_2.

In the case of both groups, subjects were instructed to pedal at a frequency of 54 – 64 pedal beats/minute, throughout the training. Similarly, in the case of all the patients, both training intensity and duration were increased, in general, in comparison with the previous session.

The results below represent means of the BP, HR and SpO_2 measured constantly throughout the entire training using the ERS2 software program.

4. Results

Table 2. Continuous training results

Subjects	Blood Pressure						Heart Rate			Oxygen Saturation		
	SBP initial	DBP final	%	DBP initial	DBP final	%	HR initial	HR final	%	SpO_2 initial	SpO_2 final	%
1	142	136	-4.23%	87	85	-2.30%	94	96	2.13%	96	97	1.04%
2	137	133	-2.92%	83	82	-1.20%	89	92	3.37%	97	97	0.00%
3	145	141	-2.76%	93	91	-2.15%	95	98	3.16%	98	98	0.00%
4	138	133	-3.62%	87	85	-2.30%	91	94	3.30%	97	98	1.03%

Subjects	Blood Pressure						Heart Rate			Oxygen Saturation		
	SBP initial	DBP final	%	DBP initial	DBP final	%	HR initial	HR final	%	SpO_2 initial	SpO_2 final	%
5	152	146	-3.95%	97	94	-3.09%	89	91	2.25%	96	97	1.04%
6	158	150	-5.06%	95	95	0.00%	93	97	4.30%	97	96	-1.03%
7	148	145	-2.03%	84	83	-1.19%	92	95	3.26%	95	96	1.05%
8	156	150	-3.85%	85	85	0.00%	89	92	3.37%	98	98	0.00%
9	147	144	-2.04%	88	86	-2.27%	93	100	7.53%	95	97	2.11%
10	139	137	-1.44%	84	83	-1.19%	88	89	1.14%	96	96	0.00%
	Mean change		**-3.19%**	**Mean change**		**-1.57%**	**Mean change**		**3.38%**	**Mean change**		**0.52%**

Table 3. Interval training results

Subjects	Blood Pressure						Heart Rate			Oxygen Saturation		
	SBP initial	DBP final	%	DBP initial	DBP final	%	HR initial	HR final	%	SpO_2 initial	SpO_2 final	%
1	148	141	-4.73%	96	94	-2.08%	89	93	4.49%	97	98	1.03%
2	145	138	-4.83%	83	80	-3.61%	95	99	4.21%	98	99	1.02%
3	152	142	-6.58%	92	91	-1.09%	92	95	3.26%	96	98	2.08%
4	142	134	-5.63%	84	84	0.00%	94	96	2.13%	97	98	1.03%
5	150	135	-10 %	94	91	-3.19%	99	102	3.03%	98	99	1.02%
6	154	150	-2.60%	95	92	-3.16%	89	94	5.62%	98	98	0.00%
7	149	141	-5.37%	89	87	-2.25%	87	91	4.60%	96	97	1.04%
8	143	141	-1.40%	87	87	0.00%	96	99	3.13%	95	97	2.11%
9	147	139	-5.44%	95	93	-2.11%	95	97	2.11%	97	98	1.03%
10	149	142	-4.70%	89	86	-3.37%	89	94	5.62%	98	98	0.00%
	Mean change		**-5.13%**	**Mean change**		**-2.09%**	**Mean change**		**3.82%**	**Mean change**		**1.04%**

5. Interpretation of the results

On a general note, the cardiovascular recovery program, the aetiology of conditions and the medication were similar for both groups. The total number of patients included in the study was 20, wand they were distributed randomly into two groups (GC=10 and GI=10). We extracted the results obtained by comparing the values measured in the first and the last training session.

The participants of both training groups (continuous and interval) recorded improvements concerning systolic and diastolic blood pressure after two weeks of training.

The GC and GI groups improved their systolic blood pressure in average by 3.19% and 5.13%. It translated into better systolic blood pressure by 4,7 mmHg on average for the group with continuous training compared an improvement by 7,6 mmHg for the group with interval training.

Concerning diastolic blood, the GC group recorded a 1.57% improvement on average, while the GI group recorded an average improvement by 2.09%. In other words, for the GC group, diastolic blood pressure lowered by 1.4 mmHg on average, while in the GI group, it decreased by an average of 1.9 mmHg.

Following the two weeks of training, heart rate increased for both groups. More precisely, the heart rate of the GC group increased by 3.38% (on average), namely 3.1 beats/minute. The analysis of the results of the GI group has shown a reduction by 3.82% (on average), accounting for 3.5 beats/minute.

SpO_2 measurements have not highlighted significant modifications of this parameter in any of the two groups. On average, increases of 0.52% were recorded for the GC group, while an increase of 1.04% can be highlighted in the case of the GI group.

6. Discussions

The purpose of this study was to analyse, using the BP, HR and SpO_2 parameters, two types of training specific to cardiac rehabilitation, namely: continuous training and interval training. The results obtained after the two weeks of training have highlighted a significant improvement in the health state of subjects by enhancing the parameters mentioned above.

Hence, both types of training have shown beneficial effects on blood pressure and SpO_2. In the case of the latter, unlike other studies (Sorace et al., 2008; Spencer, 2007; Weston et al., 2014), we have not highlighted significant improvements in the parameter, which is due to it's high values recorded in all the subjects, at the beginning of our study.

The heart rhythm of subjects who performed continuous training increased, on average, by 3.1 beats/ minute. The group performing interval training recorded average increases of 3.5 beats/ minute. Our conclusions are supported by Trachsel et al. (2020) and Reer et al. (2021).

Regarding the adverse effects of the two types of training, scientific literature has failed to report the emergence of major incidents related to their enforcement. Hannan et al. (2018) investigated the topic and has shown a small number of such events. Most of them had musculoskeletal and digestive impairments. Both training methods entail a very low cardiovascular risk. (Rognmo et al., 2018)

Concerning the equipment used, most studies used the treadmill, followed by the bicycle ergometer, or a combination of stepper, treadmill and bicycle ergometer. It sets a reliable foundation for choosing the bicycle ergometer as a training and recovery method (Biddle S.J., Batterham A.M., 2015).

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Correlations Between Speed, Agility and Strength in U15 Rugby Players - Pilot Study

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Abstract

The aim of this paper was to highlight the relationships between speed, agility and strength in U15 rugby players. In this regard, 22 male rugby players from the U15 category (67.77± 13.8 kg, 169.95± 6.99 cm), registered at the CSS Bârlad club, were evaluated. The sprint was determined over the distance of 10 m (2.06± 0.16s), 20 m (3.53± 0.30 s), 40 m (6.43± 0.65 s) and 60 m (9.37± 1.03 s), to evaluate the explosive strength of the lower limbs, we used 3 tests, Squat Jump (1376± 2.27 cm), Countermovement Jump (15.11± 2.61 cm) and Free Jump (17.20± 2.9 cm) and to evaluate agility we used the 505 test (2,82± 0.16 s). The statistical analysis (using IBM SPSS Statistics 2- Pearson correlation) reveals a strong link between speed, agility and strength (p=0.00 and r is between 6.87 and 9.97).

Keywords: *rugby, speed, agility, strength.*

1. Introduction

Sports studies have focused on identifying the most appropriate training methods that can influence the physical ability of performance athletes (Loturco et al., 2015; Loturco et al., 2013). Numerous specialized works try to identify the most important biomotor indicators that influence the level of play and that are associated with performance (Da Cruz- Ferreira

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& Ribiero, 2013; Lombard et al., 2015; Bradley et al., 2015; Green et al., 2011; Gabbett & Seibold, 2013; Gabbett et al., 2011; Smart et al., 2014; Till et al., 2016).

The game of rugby is considered a sport of individual attributions and skills, due to the demands of each field position, but team unity is essential in achieving goals (Oprean, 2012). Due to the nature of its complexity, this sport makes intense demands on the athletes' energy resources, their optimization representing a conditioning factor of sports performance (Oprean et al., 2017).

Rugby players need a large motor package, and its assessment must provide us with objective data on the adaptation of the players to the demands of the game and the adaptation of the body to the training programs, but also data to provide information on the monitoring of the development of the athletes, to predict talent identification and player selection.

In team sports, the essential factors in achieving sports performance are represented by speed and agility, expressed at maximum intensity (Nichifor et al., 2021). The improvement of the force-speed couple can be considered an essential factor in achieving high performance in sports games due to the fact that the current game requirements are based on its evolution and are characterized by complex qualities of the players such as speed, reaction, execution, agility, quick thinking and others (Argus et al., 2012; Barnes et al., 2014).

Speed and acceleration capacity are frequently assessed qualities among rugby players (Till et al., 2017), being considered essential components in player performance.

At the same time, changes of direction are considered decisive efforts in the game of rugby due to the fact that the rapid change of the direction of travel can lead to a finality that will influence the outcome of the match (Nimphius et al., 2018).

In this regard, some studies have shown that there are positive correlations between the forms of manifestation of speed and changes of direction or agility of athletes (Condello et al., 2013; Freitas et al., 2019;

Loturco et al., 2019; Pereira et al., 2018), and other studies have shown no links between maximal force and changes in direction (Loturco et al., 2018).

The choice of the most suitable tests and measurements that can be used both in the selection and in the verification of the level of rugby players is a current issue and is debated more and more often in the specialized literature (Chiwaridzo et al., 2017, Chiwaridzo et al., 2018, Oorschot et al., 2017, Chiwaridzo et al., 2021, Dobbin et al., 2018, Dobbin et al., 2019).

Therefore, the aim of this paper was to highlight the relationships between speed, agility and strength in U15 rugby players.

2. Methods

In carrying out this research, we started from the premise that there are certain associations between speed, strength and agility, among rugby players, associations demonstrated in the specialized literature. Thus, we assume that there are certain associations between speed, strength and agility in U15 rugby players.

In this regard, 22 male rugby players from the U15 category (67.77± 13.8 kg, 169.95± 6.99 cm), registered at the CSS Bârlad club, were evaluated.

The sprint was determined over the distance of 10 m, 20 m, 40 m and 60 m and to evaluate agility we used the 505 test, all applied using the automatic timing system. To evaluate the explosive strength of the lower limbs, we used 3 tests, Squat Jump, Countermovement Jump and Free Jump, applied using the Just Jump Platform.

Statistical analysis was performed using the IBM SPSS Statistics V20 program, applying the Pearson correlation.

3. Results and discussions

Table 1 shows the average (± standard deviation) results obtained by the players in the evaluation tests of speed over the 4 distances, of agility and explosive force of the lower limbs evaluated through the 3 tests.

Table 1. The average results of the subjects

	Mean		Std. Deviation
Squat Jump (cm)	13,76	±	2,27
Countermovement Jump (cm)	15,11	±	2,61
Free Jump (cm)	17,20	±	2,98
Speed 10 m (s)	2,06	±	0,16
Speed 20 m (s)	3,53	±	0,30
Speed 40 m (s)	6,43	±	0,65
Speed 60 m (s)	9,37	±	1,03
Agility (s)	2,82	±	0,16

Table 2 highlights the values of the correlation coefficient and the significance threshold obtained after applying the Pearson Correlation statistical test. We thus observe that there are good (r>0.5) and high (r>0.75) associations between the investigated variables, in all cases the significance threshold having a value equal to 0.000.

Table 2. Corelations

	r value							
	SJ	**CMJ**	**FJ**	**10 M**	**20 M**	**40 M**	**60 M**	**505**
SJ	-	0,886**	0,878**	-0,824**	-0,903**	-0,921**	-0,935**	-0,871**
CMJ	0,886**	-	0,918**	-0,795**	-0,863**	-0,855**	-0,870**	-0,796**
FJ	0,878**	0,918**	-	-0,687**	-0,789**	-0,784**	-0,799**	-0,730**
10 M	-0,824**	-0,795**	-0,687**	-	0,970**	0,913**	0,912**	0,765**
20 M	-0,903**	-0,863**	-0,789**	0,970**	-	0,976**	0,975**	0,833**
40 M	-0,921**	-0,855**	-0,784**	0,913**	0,976**	-	0,997**	0,860**
60 M	-0,935**	-0,870**	-0,799**	0,912**	0,975**	0,997**	-	0,864**
505	-0,871**	-0,796**	-0,730**	0,765**	0,833**	0,860**	0,864**	-

**p=0,000

SJ= Squat Jump, CMJ= Countermovement Jump, FJ= Free Jump, 10 M= Speed 10 m, 20 M= Speed 20 m, 40 M= Speed 40 m, 60 M= Speed 60 m, 505= agility

At the same time, we notice that there are certain links between the speed evaluated on the 4 distances and the agility of the athletes, but also associations between the speed and the explosive force of the lower limbs evaluated through the 3 tests. Also, the statistical results reveal high associations between agility and the explosive strength of the lower limbs of the athletes.

These associations can be explained by the fact that in performing speed running, the explosive force has an essential role both in the impulse of the running step and in making changes of direction, thus, we can deduce from here that the training programs to which the athletes are subjected have an influence on both muscle strength, speed and agility of athletes. In rugby these qualities are highlighted in most phases of the game, especially in attacking phases, accelerations, kicking or conversions, or even taking the touchline. At the same time, the strength of the lower limbs also plays an essential role in maintaining the stability of the body in motion.

Regarding the correlation of speed tests with the results of the agility test, it is obvious that the latter involves the speed, and this can be highlighted in the game of rugby in the changes of direction.

Specialists in the field have identified in their research that in relation to rugby players, there are certain associations between speed and agility (Nichifor et al., 2021; Freitas et al., 2021; Freitas et al., 2019), but also between lower limb explosive strength, speed and agility (Loturco et al., 2017). Thus, we note that the results obtained in the present study are in agreement with the specialized literature, but, at the same time, we must specify the fact that there are also studies that do not agree with the results obtained by us.

4. Conclusions

The statistical analysis reveals a strong link between speed, agility and strength in U15 rugby players. The results obtained by us are in agreement with the specialized literature in the sports field, but these obtained associations may also exist as a result of certain factors that can influence these skills of the players, aspects that should be discussed in further research by specialists in the field.

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Using Virtual Reality for Motor and Psychomotor Skill Development: A Systematic Review

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Abstract

The properties of a virtual reality training program can take many forms. The program can present a digital environment on a computer monitor and participants can interact with this environment using a keyboard and mouse. Alternatively, participants can wear an HMD using motion sensors that track human body movements.

The purpose of this review is to synthesize the evidence for the effectiveness of virtual reality as a tool for developing motor and psychomotor skills. The studies that were included in the systematic review were searched in August 2022, on the following specialized literature platform: PubMed, ScienceDirect, Google Scholar. The initial search identified 451 articles, but only 9 of these articles met inclusion and exclusion criteria. Six studies used VR HMD (head-mounted display) and that made VR interventions more immersive, three studies used less immersive VR devices.

The findings from these 9 articles are encouraging and provide initial support for the notion that motor and psychomotor skills can be improved with a VR training programme. The short number of studies included in this review suggests that is a great need of research who investigates the capability of VR technology to improve motor or psychomotor skills.

Keywords: *virtual reality, HMD, reaction time, motor skills, psychomotor skills.*

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1. Introduction

Since the 1960s, the term virtual reality (VR) has been used to describe a number of very different technologies, both software and hardware, such as the Sensorama Simulator, online virtual light (e.g., Second Life), multiplayer online games (MMORPGs such as World of Warcraft), surgery simulators, Cave Automatic Virtual Environments (CAVEs), as well as head mounted headsets (HMDs). (Jensen & Konradsen, 2017; Howard, Gutworth & Jacobs, 2021)

VR is defined as the three-dimensional digital representation of a real or imaginary space with interactive capabilities (Zyda, 2005). A few additions should be made to this definition.

First, users navigate their digitally represented three-dimensional digital environments called avatars. Users can view their avatar from a third-person perspective or be completely unaware of their avatar's appearance, taking a first-person perspective (Didehbani, Allen, Kandalaft, Krawczyk & Chapman, 2016).

Second, VR programs can be used for training, gaming, telecommunications, or any other purpose (Howard et al., 2021).

VR programs can be relatively simple. These may include unrealistic graphics, few interactive opportunities, and typical computer hardware (monitor, keyboard, and mouse). However, VR programs can also be extremely complex. These may include real graphics, an interactive world, and advanced computer hardware (eg, head-mounted-display (HMD), motion sensors) (Howard et al., 2021).

For decades it has been debated whether virtual reality has the potential to revolutionize education. The argument is that VR can be used for simulation-based education, where students can practice new skills in a simulated environment that allows for correction, repetition and eliminates risk. Despite high hopes, these ideas were based more on speculation than practice, and outside of dedicated training simulators for surgeons, pilots and military personnel, VR technology has not been used to a level where it could be applied in education and training in general (Jensen & Konradsen, 2017).

This changed in 2013, when the first versions of an HMD from the company Oculus Rift introduced a new generation of VR technology at a price accessible to the general public.

Over the next few years, a host of competitors released their own HMD, making this new technology even more accessible to the public for both research and educational purposes (Ragan et al, 2015).

The properties of a virtual reality training program can take many forms. The program can present a digital environment on a computer monitor and participants can interact with this environment using a keyboard and mouse. Alternatively, participants can wear an HMD using motion sensors that track human body movements. Participants may even use a combination of immersive and non-immersive hardware, such as using a computer monitor to view their environment and custom input devices to provide input (eg, surgical instruments with sensors). (Howard et al., 2021).

In all of these applications, researchers have shown that VR training programs offer promising results (Moglia et al., 2016; Vaughan, Dubey, Wainwright, & Middleton, 2016)

The purpose of this review is to synthesize the evidence for the effectiveness of virtual reality as a tool for developing motor and psychomotor skills. It is necessary to first determine whether VR is an effective tool to improve real-world skills by reviewing articles that demonstrate real-world transfer.

2. Methods

2.1. Search strategy

The studies that were included in the systematic review were searched in August 2022, on the following specialized literature platform: PubMed, ScienceDirect, Google Scholar. To search for these studies, we used the following terms, but also combinations between them: "virtual reality", "head-mounted display", "motor skills", "psychomotor skills", "reaction time", "eye-hand coordination".

Included studies are in English only. The publication date we have chosen for these studies is the range 2015-2022. The criteria according to which the studies were included are the following: the included studies must be experimental or quasi-experimental; studies published in English; each study must include a healthy population; The criteria according to which the studies were excluded are as follows: studies that do not refer to the development of motor or psychomotor skills; studies that refer to rehabilitation.

2.2. Article selection

After searching the above-mentioned specialist platforms and using the keywords and their combinations, 451 studies were found. After the duplicates were eliminated, 442 remained. After going through the abstract, 20 studies remained, which were read entirely. Of these, 11 were excluded because they did not fit the inclusion criteria (did not include healthy population, did not develop motor or psychomotor skills). Finally, 9 studies were included to be analyzed and discussed later.

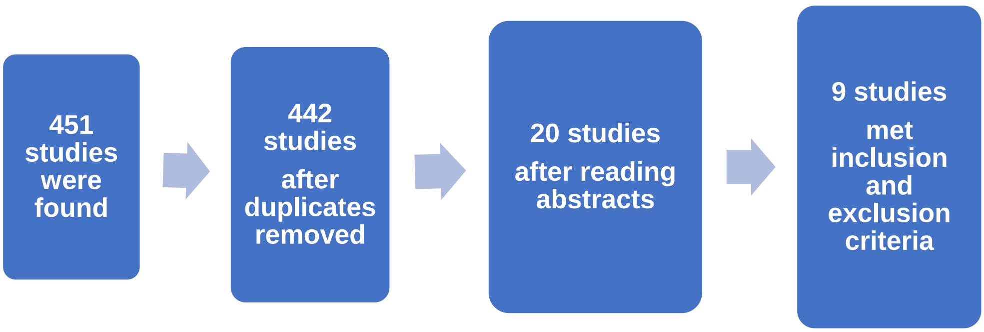

Figure 1. Selection process of the study

3. Results and discussion

3.1. Descriptions of studies

Eleven out of twenty were excluded because they did not met the inclusion and exclusion criteria such as: they did not develop motor or psychomotor skills, they did not use a healthy population. Out of the nine studies there is a combined total numer of 552 participants. The studies were published between 2015 and 2021. In the nine studies included in this review, sample sizes ranged from 6 to 24. The length of the VR intervention was between one day session to 9 months.

Six studies out of nine used intervention and control group. Barbosa (2020), Rutkowski et al. (2021) and Tharani, Shah, Kothari & Shah (2020) implemented a single-group pre-post study design. Three studies used athletes in their studies (Amprasi, Vernadakis, Zetou & Antoniou, 2021; Gray, 2017; Petri, Bandow, Masik & Witte, 2019) the other six studies used students.

The shortest intervention was only one session long (Drew et al., 2020) and verified if participant who train dart throwing abilities in a VE will improved real world dart throwing abilities. The longest intervention was nine months long and verified potential improvement in motor skill competence after a VR programme (Sunyue ye, Lee, Stodden & Gao, 2018).

Six studies used VR HMD (head-mounted display) and that made VR interventions more immersive, three studies used less immersive VR devices.

Table 1. Summary of included articles.

Authors	Participants	Intervention design	Evaluation	Results
Amprasi et al. (2021)	n=48 Age=8-10 Sex: Male=0 Female=48	Three groups: FIVE, TT, CG Duration:6 weeks, biweekly, 24 minutes each time	WBRT Tests and instruments:WBRT(Takei Instruments)	WBRT improved in both FIVE and TT group compared to CG.
Barbosa (2020)	n=17 Age=9-13 Sex: N/A Male= N/A Female= N/A	Single group, Duration: one exergames session	SRT CRT Tests and instruments: Reaction Time® v. 2. 0 software	Children reduced SRT after exergames session.
Drew et al. (2020)	n=41 Age=18-N/A Sex: Male= 22 Female= 19	Two groups: VR ,RW Duration: one session	Dart throws Tests and instruments: 100 dart throws	VR training was not effective for real world performance.
Gray (2017)	n=80 Age=17-18 Sex: 80 Male= 80 Female=	Four groups: VE, VE+extra sessions, extra	Baseball batting Tests and instruments: 8 batting test	Players in the VE adaptive group showed significant

Authors	Participants	Intervention design	Evaluation	Results
		sessions RBT, NT Duration: 6 weeks, 2 ses/week, 45 minutes each		improvements for 7/8 of the batting performance.
Petri et al. (2019)	n=15 Age=13-17 Sex: Male=10 Female=5	Two groups: VR, CG Duration:8 weeks, 10 minutes, once a week	Reaction time Tests and instruments: (Contemplas, Kempten, Germany, 100 Hz).	VR training improved participants anticipation.
Rutkowski et al. (2021)	n=14 Age=14-19 Sex: Male=6 Female=8	Single group Duration:once a day for 5 days, 15 minutes each time	Reaction time Hand-eye coordination Tests and instruments:PTT Ruler-drop test TMT test	Hand–eye coordination and reaction time showed significant improvement.
Sunyue ye et al. (2018)	n= 261 Age=7-9 Sex: Male=127 Female:134	Two groups:IG, CG Duration: 9 month, biweekly, 25 minutes each	MSC	CG demonstrating greater improvement, compared to the IG at MSC tests.
Tharani et al. (2020)	n=10 Age=18-24 Sex: Male=N/A Female=N/A	Single group Duration:4 weeks, 3 days/week, 20 minutes per session	Auditory and Visual reaction time Tests and instruments: Inquisit 5.0v software was used on a laptop.	Auditory and Visual reaction time reduced post-intervention.
Vernadakis et al. (2015)	n=66 Age=6-7 Sex: Male= 36 Female: 30	Three groups: XBOX, TA, CG Duration: 8 weeks, biweekly, 30 minutes each.	FMS Tests and instruments: TGMD-2	Post-test FMS scores for both experimental groups are higher compared to control group.

n- number
FIVE- full immersvive virtual environment
TT- typical training
CG- control group
WBRT- whole body reaction time
SRT- simple reaction time
CRT- complex reaction time
RW- real world
VE- virtual environment
RBT- real batting practice
NT- normal training
VR- virtual reality
IG- intervention group
MSC- motor skill competence
PTT- plate-tapping test
TMT- trial-making test
N/A- not available
TA- traditional aproach
FMS- fundamental motor skills
TGMD-2- test of gross motor development 2

3.2. Findigs

The study of Amprasi et al. (2021) suggests methods to improve reaction time, providing a useful tool for Physical Education teachers and coaches in order to improve reaction time in a different way. The study revealed that, regardless of whether it was full immersive virtual environment(FIVE) or traditional training (TT), reaction time improved and retained in in comparison to a control group receiving no-training (Amprasi et al., 2021).

Barbosa (2020) intervention reduced SRT, showing an improvement on visual perception and action. Moreover, activities increased HR in relation to rest, which could be used to break sedentarism.

VR training programme of Rutkowski et al. (2021) improved the hand–eye coordination and reaction time of musicians, which may lead to the faster mastering of a musical instruments.

Gray (2017) demonstrated that training in VR can be good not only for the musicians but for athletes also: ′′Training in a VE can be used to improve real, on-field performance especially when designers take advantage of simulation to provide training methods (e.g., adaptive training) that do not simply recreate the real training situation′′(Gray, 2017).

Petri et al. (2019) find that subtracting reaction times from the first reaction of the responding athlete is an appropriate method to analyze changes in perception and anticipation due to training in VR. These new findings can be used in karate training to improve motor learning in beginners to enhance performance.

3.3. Summary and future research

In this review, we evaluated research measuring the effectiveness of using virtual reality to improve motor or psychomotor skills. Whether participants was students (Barbosa, 2020; Rutkowski et al., 2021; Sunyue ye et al., 2018; Tharani et al., 2020; Vernadakis et al., 2015) or athletes (Amprasi et al., 2021; Gray, 2017; Petri et al., 2019) this studies demonstrated that a VR training programme can improve motor and psychomotor skills. The only study from this review who doesn`t showed motor or psychomotor skills improvement was Drew et al. (2020), maybe because of the short duration.

Notably, studies like Petri, et al. (2019) using real international successful karate kumite athletes, all of them with the black belt degree (1st - 4th Dan) to build an avatar which was used in the intervention program.

The short number of studies included in this review suggests that is a great need of research who investigates the capability of VR technology to improve motor or psychomotor skills.

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Current Aspects of Physiotherapy in the Treatment of Plantar Pain

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Abstract

Prolonged mechanical demands during daily activities or during physical exercices frequently generate significant pain at the plantar level, with a negative impact on the individual's quality of life.

In this study 37 patients with plantar pain were included, who were diagnosed by musculoskeletal imaging with plantar fasciitis.

The treatment performed consisted in the use of physiotherapy procedures such as shock-wave and Super Inductive System.

The therapeutic protocol was also adapted according to the associated plantar pathologies.

Following the physiotherapy treatment, a significant decrease in pain and inflammation at the level of plantar fascia was found, also a reduced number of intense pain episodes.

The research conducted demonstrates that physiotherapy procedures such as schock-wave and super inductive system have an increased efficiency in the treatment of plantar pain.

Keywords: *shock wave, inflammation, recovery, super inductive system, plantar fasciitis.*

1. Introduction

The plantar aponeurosis is made up of connective tissue and is located from calcaneus to the toes, forming together with the calcaneonavicular

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ligament and the long plantar ligament, the passive tension structure of the plantar arch.

The most common cause of plantar pain is represented by plantar fasciitis, which consists in the presence of inflammatory process located at the level of the plantar fascia.

The specific symptomatology consists in pain which is present at the level of the heel or towards the medial area of the plantar arch, especially in the morning when taking the first steps after a night's rest, or after a period of inactivity (Guttec et al., 2019).

Plantar fasciitis is more common in individuals aged 45-60 years, other studies showing that the prevalence is higher among runners (Lopes et al., 2012).

This condition has multifactorial origin being reaction to repeated mechanical overload mechanisms that produce micro-lesions over time, which can represent risk factors for musculotendinous retractions of the calf, overloading of the opposite limb, sedentary lifestyle, deformities of the foot (Van Leeuwen et al., 2016).

A high percentage of patients with plantar pain experience shortening of the calf muscles, which leads to a decrease in the amplitude of the dorsiflexion of the leg, which will lead to an increase in tension in the plantar fascia (Bolgla et al., 2004).

Frequently, plantar pain is associated with the presence of calcaneal spurs that lead to inflammation of the plantar aponeurosis through the pressure exerted by the osteophyte on the soft tissues (Ahmad et al., 2016; Kirkpatrick et al., 2017; Nishimura et al., 2017) .

The anamnesis together with palpation of the plantar fascia and mobilization in dorsiflexion of the fingers lead to the development of the clinical diagnosis, which will be completed by paraclinical investigations such as radiography (Schneider et al., 2018) and soft tissues ultrasound or magnetic resonance imaging (Ehrmann et al., 2014).

Conservative treatment in the acute stage consists in the administration of non-steroidal anti-inflammatory drugs (Donley et al., 2007), and weight loss in the case of overweight people can help reduce pain (Lee et al., 2009).

In order to relieve pain, electrotherapy procedures such as low-intensity currents, ultrasound (Ulusoy et al., 2017) and high-intensity laser are also used, which can lead to superior results when associated with stretching of the calf muscles and plantar aponeurosis (Katzap et al., 2018).

Studies highlight the fact that extracorporeal shock wave treatment has a significant role in relieving plantar pain (Gutteck et al., 2019) and can lead to increased rehabilitation performance by combining it with physiotheraputic means.

Extracorporeal shock wave therapy is used to promote neovascularization that helps to heal the degenerated tissue of the plantar fascia, the literature underlining the fact that this form of therapy represents a viable option in case of chronic plantar pain, being a non-invasive way of therapy that can enhance the healing process (Goff & Crawford., 2011).

Side effects of shock wave therapy are reversible and manifest in the form of ecchymosis, local edema or temporary hypoesthesia (Rompe et al., 2007).

In severe cases, when conservative treatment is no longer helpful, surgery may be a solution. Partial or total fasciotomy reduces the tension of the plantar aponeurosis at the level of its insertion, this procedure can lead to the improvement of painful symptoms (Othman et al., 2010).

2. Material and method

The study was conducted on a group of 37 subjects with unilateral plantar pain that was not caused by local trauma.

The inclusion criteria were: the presence of pain at the level of the plantar fascia, imaging confirmation of plantar fasciitis by musculoskeletal ultrasound.

The exclusion criteria were: the presence of foot trauma, plantar static disorders (platfus), peripheral vascular diseases and peripheral neuropathies.

The present paper started from the hypothesis that the use of extracorporeal shock wave therapy in association with the use of high intensity magnetic waves can lead to a significant improvement of the painful syndrome and inflammation located at the level of the plantar aponeurosis.

The therapeutic intervention consisted in applying extracorporeal shock waves to the plantar fascia using shock wave therapy. The parameters used took into account both the intensity of the pain and the degree of inflammation revealed by the musculoskeletal ultrasound, as well as the presence and location of the calcaneal exostosis.

A number of 3000 shocks were applied per session, at a frequency of 10 Hz and an intensity between 1.5 and 3 bars. In the first 2 sessions, the intensity of the shock started from 1.5 bar for the first 500 shocks, increasing progressively up to 2.5 bar, every 500 shocks, after which the application intensity decreased to 2 bar for the last 500 shocks. Depending on the evolution of the pain, the intensity for the next 2 sessions was set on the same principle from 2 bar to the maximum intensity of 3 bar, maintaining the same dosage from 500 to 500 shocks.

In the case of patients who have performed 6 treatment sessions, the intensity of the shock remains constant at 2.5 bar throughout the duration of the session.

The application technique and the approach to the inflamed tissue was carried out from the outside of the painful perimeter progressively towards the epicenter of the pain, with the oblique positioning of the applicator in the periphery of the painful area and perpendicular to the painful point.

The treatment sessions were completed by the application of high-intensity magnetic waves with the BTL-6000 Super Inductive System device. They were performed immediately after the shock wave therapy, having an equal number of sessions. The applications were made by positioning the magnetic induction device at the level of the plantar fascia, without direct contact with it.

A preset program generated by the device was used for the diagnosis of plantar fasciitis with modular parameters on 7 sections between 5 Hz and 50 Hz, their intensity and frequency not changing manually during the treatment session. The application duration was for 10 minutes.

The methodology of applying the procedures consisted of performing the shock as the first therapeutic intervention followed by high-intensity electromagnetic waves, taking into account the analgesic effect obtained by BTL-6000 Super Inductive System device.

3. Results and discussions

In order to highlight the results obtained as a result of the research, the statistical analysis was carried out with IBM SPSS Statistics 20 program, in order to highlight the level of significance.

The evolution of loading pain, from the initial evaluation to final evaluation, after 4 sessions of therapy, is represented in table no.1.

Table 1. Pain level evaluation after 4 treatment sessions

		Mean	Std. Deviation	Std. Error Mean	p
Pair 1	Weight bearing pain Initial evaluation	6,33	1,113	,287	0,000*
	Morning gait pain Initial evaluation	7,93	,594	,153	
Pair 2	Weight bearing pain Final evaluation	,73	,961	,248	0,334
	Morning gait pain Final evaluation	,47	,516	,133	

Regarding the results obtained by the subjects in the assessment of initial loading pain and the final assessment of loading pain, there are statistically significant differences between the two tests, after 4 applications of extracorporeal shock wave and super inductive system treatment.

This evolution is related to an initial average pain of 6.33 on the visual analog scale which represents a moderate pain that may suggest chronic plantar fascia damage, for which the final score of 0.73 indicates significant pain relief and the need for a small number of therapy sessions.

In the case of morning pain at gait initiation, it is also observed that there is a positive, statistically significant evolution between the initial and the final assessment when starting to walk with a final value of the pain level of 0.74 on the visual analogue scale.

For the patients who benefited from 4 treatment sessions, it is noted that at the final evaluation, there are no statistically significant differences between the 2 types of pain (during weight bearing and in the morning when the patients initiate the gait). This aspect highlights the fact that the number of sessions required for significant pain relief in the 2 cases is effective, reducing the pain to a minimum regardless of the type of stress on the plantar aponeurosis.

Other studies highlight the positive effects of shock-wave therapy also in the case of chronic pain caused by inflammation of the plantar fascia (Sun et al., 2017).

Table 2. Pain level evaluation after 6 treatment sessions

		Mean	Std. Deviation	Std. Error Mean	p
Pair 1	Weight bearing pain Initial evaluation	7,95	,950	,203	0,002*
	Morning gait pain Initial evaluation	8,82	,395	,084	
Pair 2	Weight bearing pain Final evaluation	1,59	1,098	,234	0,000*
	Morning gait pain Final evaluation	,73	,767	,164	

Patients who received 6 treatment sessions had a higher mean initial pain for loading pain (7.95 on the VAS scale) but also for morning pain when starting to walk (with a mean VAS scale of 8.82) . This increased pain may suggest more intense damage, with a greater degree of inflammation at the level of the plantar fascia, inflammation also determined and maintained by the presence of calcaneal exostoses at the level of insertion of the plantar aponeurosis.

A statistically significant positive evolution is observed both for the evolution of loading pain and especially for the morning pain when the patients initiate the gait.

According to clinical studies, shock wave therapy is a non-invasive method, with long-lasting analgesic and anti-inflammatory effects (Aquil et al., 2013).

Figure 1 shows the evolution of pain from the initial assessment to the final assessment, depending on the number of shock wave and super inductive system sessions used.

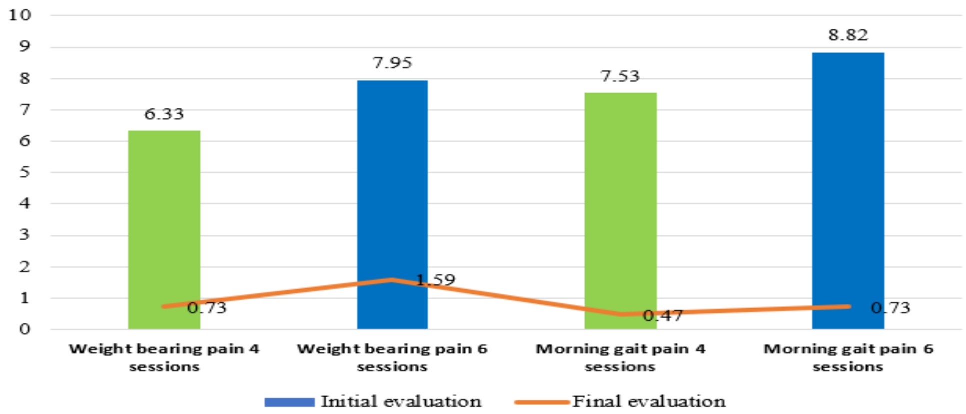

Figure 1. Evolution of pain according to the number of therapy sessions

According to the figure above, a positive evolution can be observed in the 37 subjects regardless of the number of sessions that were applied (4 or 6), progress that depended specifically on the cause of the pain. Thus it is observed that patients who presented a higher initial pain score also had associated calcaneal exostoses and needed a greater number of sessions to obtain benefits similar to those of subjects who benefited from only 4 shock wave sessions and high intensity magnetic induction.

Low-intensity magnetic wave therapy has low effectiveness in the treatment of pain syndrome (Cao et al., 2012) compared to high-intensity electromagnetic field therapy.

The differences between the two groups of subjects are not statistically significant for the two types of pain (weight bearing pain and morning gait pain), an aspect that highlights the fact that the effectiveness of the applied treatment is related to the triggering factor of the pain and the correlated sessions number.

4. Conclusions

Extracorporeal shock wave therapy is an effective mean of decreasing and ameliorating pain and inflammation in the plantar fascia, which has been studied and applied in current medical recovery programs due to its analgesic effects.

An important role in combating inflammation, pain and increasing tissue regeneration potential is played by high-intensity electromagnetic wave therapy applied to the area of the affected tissue.

For increased efficiency in the relief of plantar pain syndrome, it is recommended to combine therapy with extracorporeal shock waves and successive high-intensity magnetic induction, in a variable number of sessions related to the clinical-functional complexity of the patient.

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The Relation Between Swimming Performance and Muscles Strength

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Abstract

Aim: The aim of this study is to examine the relation between strength/power development level and 50 m freestyle and backstroke swim times. **Methods:** A total of 10 swimmers (mean age 11.60 ± 1.43 years), girls (n=4) and boys (n=6), participated in this study. All of them have been practicing swimming for 3-4 years, one hour twice a week. The study uses 50 m swim times achieved in a competition (freestyle/ backstroke) and strength measurement test results - standing long jump (SLJ), bent-arm hang (BAH), plank (P), superman (S), right hand grip (RHG), and left hand grip (LHG). **Results:** A statistical analysis of data reveals a negative statistical correlation (r = -0.808, df = 8, p = 0.005) between the 50 m backstroke swim time and the (SLJ) test results. The data show there is a negative statistical correlation (r = - 0.692, df = 8, p = 0.026) between the 50 m freestyle swim time and the (BAH) test results. Significant negative correlations are found between the 50 m freestyle swim time and the hand grip test results (r = - 0. 724, df = 8, p = 0.018); (r = - 0.743, df = 8, p = 0.014). Significant negative correlations are between the 50 m backstroke swim time and the hand grip test results as well (r = - 0.713, df = 8, p = 0.021); (r = - 0.714, df = 8, p = 0.020). **Conclusions:** The interpretation of these results reveals that the level of strength/power development influences swimming performance. For the most part in this study, significant negative correlations are found between the 50m freestyle/backstroke swim time and the (SLJ, BAH, RHG and LHG) strength test results.

Keywords: *freestyle, backstroke, muscle strength, correlation*.

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1. Introduction

Numerous studies have highlighted the relationship between the level of strength development and swimmers' performance (Zampagni, Casino, Benelli, Visani, Marcacci, & De Vito, 2008); Girold, Calmels, Maurin, Milhau, & Chatard, 2006; Aspenes, Per-Ludvik Kjendlie, Hoff, & Helgerud, 2009; Gola, Urbanik, Iwańska, & Madej, 2014, Toskić, 2018). This relationship is statistically stronger for short distances, and decreases as distances increase (Gola, Urbanik, Iwańska, & Madej, 2014). Dry-land training can influence the ability of muscles to generate propulsive forces in water, especially for short distances (Lubkowska, Wiażewicz, & Eider, 2017). Some studies confirm the influence of dry-land training, particularly maximal no weight strength training (Garrido, Marinho, Reis, van den Tillaar, Costa, Silva, & Marques, 2010), on swimmers. A swimmer's strength/power also manifests itself over longer distances, when the swimmer must perform turns at the end of the pool. The duration of these turns influences the final performance. Push force into the wall and short contact with the wall depend on swimmers' strength, which is why coaches recommend using strength/power development training (Hermosilla, Sanders, González-Mohíno, Yustres, & González-Rave, 2021).

The main aim of this study is to examine the relationship between strength/power development level and 50 m freestyle and backstroke swim times. The results achieved in a competition held for young swimmers on the 4th of June 2022 were used as reference times.

2. Materials and Methods

2.1. Study group

A total of 10 swimmers (mean age 11.60 ± 1.43 years), girls (n=4) and boys (n=6), participated in this study. All of them have been practicing swimming for 3-4 years, one hour twice a week, except during summer school holidays when they go on break for about 6 weeks.

2.2. Measurements

The participants took part in a competition where their 50m freestyle and backstroke times were recorded.

Two weeks after the competition, 10 swimmers participated, with parental consent, in a series of tests to determine their level of strength/power development. The strength/power tests we conducted were: standing long jump (SLJ), bent-arm hang (BAH), plank (P), superman (S), right hand grip (RHG), and left hand grip (LHG).

In the (SLJ) test, we measured the distance between the take-off line and the landing area.

In the (BAH) test, we measured the time the swimmers could stay in hanging position with supinated grip, flexed upper limbs and chin above the bar. The (P) test consisted in measuring the time the swimmers could hold their position (face down, resting on forearms). The (S) test consisted in lying in a facedown position, extending both arms and legs, and holding this position as long as possible. The (RHG/LHG) test consisted in holding a dynamometer and recording the scores.

3. Results and discussions

Table 1 shows the 50m freestyle & backstroke swimming times and the strength test results of the young swimmers.

Table 3. Descriptive statistics with the results on 50m freestyle/ backstroke and the results for strength and power tests

	Time on 50m freestyle	Time on 50m backstroke	Standing long jump	Bent-arm hang	Plank	Right hand grip strength	Left hand grip strength
Mean	49.6090	47.4570	164.8000	22.5120	114.1730	25.3000	24.8000
Std. Deviation	9.55549	7.03925	25.31052	19.40609	67.84274	6.84836	7.29992
Minimum	37.52	39.00	128.00	2.06	34.94	15.00	16.00
Maximum	66.00	61.00	216.00	67.00	223.06	39.00	37.00

A statistical analysis of our data reveals that there is a negative statistical correlation ($r = -0.808$, $df = 8$, $p = 0.005$) between the 50 m backstroke swim time and the (SLJ) test results (Table 2).

Table 4. Pearson correlation, time on 50m backstroke and standing long jump

		Time on 50m backstroke	Standing long jump
Time on 50m backstroke	Pearson Correlation	1	-.808**
	Sig. (2-tailed)		.005
	N	10	10
Standing long jump	Pearson Correlation	-.808**	1
	Sig. (2-tailed)	.005	
	N	10	10

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

Our data show a statistically significant negative correlation ($r = -0.692$, $df = 8$, $p = 0.026$) between the 50 m freestyle time and the (BAH) test results (Table 3).

Table 5. Pearson correlation, time on 50 m freestyle and bent-arm hang

		Time on 50m freestyle	Bent-arm hang
Time on 50m freestyle	Pearson Correlation	1	-.692*
	Sig. (2-tailed)		.026
	N	10	10
Bent-arm hang	Pearson Correlation	-.692*	1
	Sig. (2-tailed)	.026	
	N	10	10

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

Data analysis reveals a significant negative correlation ($r = -0.724$, $df = 8$, $p = 0.018$) between the 50 m freestyle time and (RHG) test results (Table 4).

Table 6. Pearson correlation, time on 50m freestyle and right hand grip strength

		Time on 50m freestyle	Right hand grip strength
Time on 50m freestyle	Pearson Correlation	1	-.724*
	Sig. (2-tailed)		.018
	N	10	10
Right hand grip strength	Pearson Correlation	-.724*	1
	Sig. (2-tailed)	.018	
	N	10	10

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

A significant negative correlation ($r = -0.743$, $df = 8$, $p = 0.014$) is found between the 50 m freestyle time and the (LHG) test results (Table 5).

Table 7. Pearson correlation, time on 50m freestyle and left hand grip strength

		Time on 50m freestyle	Left hand grip strength
Time on 50m freestyle	Pearson Correlation	1	-.743*
	Sig. (2-tailed)		.014
	N	10	10
Left hand grip strength	Pearson Correlation	-.743*	1
	Sig. (2-tailed)	.014	
	N	10	10

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

There is a significant negative correlation (r = - 0.713, df = 8, p = 0.021) between the 50 m backstroke time and the (RHG) test results (Table 6).

Table 8. Pearson correlation, time on 50m backstroke and right hand grip strength

		Time on 50m backstroke	Right hand grip strength
Time on 50m backstroke	Pearson Correlation	1	-.713*
	Sig. (2-tailed)		.021
	N	10	10
Right hand grip strength	Pearson Correlation	-.713*	1
	Sig. (2-tailed)	.021	
	N	10	10

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

A statistical analysis of our data reveals a significant negative correlation (r = - 0.714, df = 8, p = 0.020) between the 50 m backstroke time and the (LHG) test results (Table 7).

Table 9. Pearson correlation, time on 50m backstroke and left hand grip strength

		Time on 50m backstroke	Left hand grip strength
Time on 50m backstroke	Pearson Correlation	1	-.714*
	Sig. (2-tailed)		.020
	N	10	10
Left hand grip strength	Pearson Correlation	-.714*	1
	Sig. (2-tailed)	.020	
	N	10	10

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

In this study, we have found negative correlations between 50 m swimming times and limb muscle strength.

Although we have not found a significant correlation between the 50 m freestyle time and (SLJ), the chart line stretches from the upper left corner to the lower right corner, which indicates a negative correlation ($r = -0.478$, $df = 2$, $p = 0.163$). The correlation between 50 m freestyle swim times and plank test scores is negative (though not significant) ($r = -0.478$, $df = 8$, $p = 0.163$).

In one of the studies, the participants who had the highest speed in swimming 25m and 50m freestyle were those with higher scores in the tests conducted to determine strength in elbow flexors, shoulder flexors and shoulder extensors (Gola, Urbanik, Iwańska, & Madej, 2014).

In another study, the participants who showed higher levels of strength in lower limb extensors and abdominal muscles performed better over short distances (Toskić, D, 2018).

The conclusion of another study is that dry-land training, which includes bench presses and medicine ball throws, in addition to in-water resistance training (using water parachute and hand paddles) facilitate increase in strength levels and implicitly higher performance in speed events (Amara, Barbosa, Negra, Hammami, Khalifa, & Sabri, 2021).

4. Conclusions

The interpretation of the results reveals that the level of strength/power development influences swimming performance. This shows how important it is for swimmers to be involved in strength development training that is also carried out on dry land.

For the most part in this study, significant negative correlations have been found between 50 m freestyle/backstroke swim times and (SLJ, BAH, RHG and LHG) strength test results.

No significant negative correlations have been found between 50 m swim times and plank and superman test results.

A continuation of such a study, with more participants and by including an experimental group to participate in dry-land strength development training, is needed.

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Nonverbal Communication in Performance Sports

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Abstract
Communicational process in professional sports includes several types of communication: verbal, nonverbal, intrapersonal, interpersonal and the group. Nonverbal communication is a type of communication that is frequently used in a professional sport team: technical sessions, trainings or official matches. The role of nonverbal communication is to help the understanding of verbalized notions expressed with the help of verbal communication and sometimes, to replace totally verbal communication. Can be noted in the advantages chapter the following ideas: short time of communication, the possibility of providing a greater amount of information's in a shorter time and a much better understanding of the message from the receiver in the case of existence of disturbing factors (the music from the stadium or the crowd). According to prof. Cristian Radu, we can receive messages through nonverbal communication by studying elements such as: paraverbal communication (the timbre and intensity of a coach/player's voice or the pauses or speech defects of an athlete), clothes (can underline aspects like the importance of the event or it can show us how much a coach/player cares about his image, mimicry and facial expressions can show us the intensity of the moment (technical instructions of coaches during the match).

Keywords: *communication, nonverbal, paraverbal, sports.*

1. Introduction

The communicational process in sports is an important component of sports activities and is indispensable in this type of physical activity. One of

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the axioms of the Palo Alto School tells us that "it is impossible to not communicate". (Radu, 2019) With communication a player, a trainer, or a manager could offer important information to the receptor, helping for reaching the goals proposed. The importance of nonverbal communication is underlined by the ideas of Albert Mehrabian, who created the rule "7-38-55", which means that in personal communication, 55% are represented by body language, 38% by voice and tone, and 7% are represented by spoken words. (Amsel, 2019) Concerning this classification, we can see how important is for a sportsman to build his communication process. Septimiu Chelcea, Ivan Loredana, and Adina Chelcea formulated some axioms of nonverbal communication. In their acceptance: "In direct interpersonal relations it is impossible to not communicate nonverbal" and "Nonverbal communication represents an element in the human communication system and it should be analyzed as it is, not independent from the verbal communication" (Chelcea&Ivan, 2008). That underlines the fact that verbal and nonverbal communication are complementary and each one has its role in the process of communication.

Before proceeding to an analysis of the advantages and disadvantages of nonverbal communication, we propose an enumeration of the elements of communication. According to Denis Mcquail, the elements of communication are: "a communicator or transmitter of a message, a message, a language or a code, a channel of transmission and a receiver capable of decoding the messages" (Mcquail, 1999). Concerning these elements, we must note that the appearance of problems within them can alter the communication process. For example, if the language is not similar to one sender and receiver, we can expect a faulty understanding of the message. At the same time, disturbing factors must also be taken into account.

2. Advantages of nonverbal communication in sports

People in sports could use nonverbal communication in various situations when verbal communication is not very efficient. To give strength to these affirmations, we will see several situations when nonverbal communication is more efficient than other ways of communication.

The first situation is when the stadium crowd is too loud and the trainer of a team wants to give explanations about some situations in the game. Eventually, he will use verbal communication, especially by whistling to the players, but the important ideas will be transmitted by nonverbal communication (placements in some moments of the game, sign of eventual substitutions). The same situation is when the player wants to transmit something important to the bench (claims an injury or wants to be substituted). In the following example, we will see how the former Denmark football manager between 2000-2015 Morten Olsen, tries to calm the tempo of his team during the World Cup 2006 Qualifiers game against Greece.

Figure 1. (Image 1 – Morten Olsen, ex-Denmark head coach, offering indications during the game Denmark - Greece) (Gettyimages, 2017)

We can observe the position of the body, which is slightly bent forward, and the hand is held down, firmly, with the fingers outstretched. The face also suggests firmness in the decision. The gaze is fixed on the players. Another element inspired is calmness. This movement does not suggest aggression but inspires safety. A trainer needs to inspire safety and trust in his decisions.

The second situation is at half-time. According to professor Gomboș Leon, at half-time, the players are very exhausted at this period at the game, so it will be much easier to understand simple messages and ideas. (Gomboș, 2012) This thing might be done with nonverbal communication, instead of using too many words and with the risk of losing the concentration of the players.

Looking at these examples, we could see some advantages of using nonverbal communication. First is the capacity of transmitting information in various conditions which could lead to good advantage for the team or the player, especially when the crowd is too loud. Second is the possibility of the expression of more ideas in a short time, which helps the coach to deliver instructions in a much better way and not lose his players. Compared to decoding words, nonverbal language is decoded 4.5 times faster. (Zamfir, 2017)

3. Disadvantages of nonverbal communication in sports

There are some situations when nonverbal communication creates problems or represents a trap in understanding the transmitted message. The most common situations of this kind are when the receiver and the sender do not know each other well enough. Although some signs are already a convention in society, some signs can represent game instructions that are known only by the players of that team, representing a code language.

For example, a new player will not understand from the beginning the signs sent by the coach or his colleagues. These misunderstandings can lead to improper execution of game tasks or misunderstanding between players. Therefore, nonverbal communication is good to be used when both parties use a common language.

Another situation is when nonverbal communication is used wrongly and it can produce image damage for the user. It’s usually the adapters that can make people uncomfortable. Here we refer to gestures such as scratching or smelling. A very good example, also reported by the media is Joachim Low, former head coach of the German national football team. He was caught many times by the cameras in certain embarrassing positions. We will detail more in the article, in the paragraph dedicated to adapters.

4. Ways of manifestation of nonverbal communication

Professor Cristian Radu made a classification of the ways of manifestation of nonverbal communication. In the next lines, we will observe several with their application in sports.

4.1. Silence

The first one is silence. There are several types of silence, each one with his interpretation. Among the human characteristics betrayed by silence, we can list arrogance, the feeling of guilt, boredom, or concentration (Radu, 2019). In sports, we can identify a phenomenon called "Silenzio Stampa". The term is from the Italian language and it means "press silence". It is an initiative of sports teams to not provide press statements or pieces of information in general. This is a type of protest used by the sports team when, for example, the press is too aggressive in the reports about the team or when serious untruths are published.

4.2. Objects

For the image of the person, small elements such as jewelry (watches, rings, and others) and bigger elements like cars or houses could construct the image of the person. (Radu, 2019).

In 2017, the French sports daily L'Equipe published a top with the coaches from Ligue 1 and their watches. From this top, we can distinguish several types of coaches. The first category is the coaches who don't spend a lot on a watch, such as Frederic Hantz or Stephane Moulin, who chose simple watches, at 13 euros. The second category is formed by the coaches who spend moderately for a watch like Phillipe Hischberger (a 150 euro watch). The third category is formed by the coaches who like to spend a lot of money on their watches such as Bruno Genesio or Christophe Galthier (several thousands of euros). (L'Equipe, 2017)

Comeback to our purpose, a study from 2015 suggests that people who can wear watches can be more conscientious. In the same study, we can find that people who wear watches "arrived significantly earlier to appointments in comparison to controls". (…) In sports, these two qualities, conscientiousness and punctuality are strong values, at same time for players and coaches

The objective of L'Equipe article analysis is to underline the fact that these nonverbal aspects are more and more important and they are observed by the public. In addition to the characteristics presented in the previous paragraph, we can add the fact that the style of the watch can help us discover the style of that sportsman.

4.3. Gestures

Gestures are a component of nonverbal communication. According to professor Cristian Radu, who uses the Paul Ekman and Wallace Friesen classification, we could see a lot of gestures that are present in a sportsman activity. (Radu, 2019)

First, they are the emblems. "Emblems are a gesture that substitute (conventionally or not) words and, in certain situations, can constitute one language itself (for example, the language of deaf-mutes". The same authors suggest some examples of gesture: "the index finger placed on the lips to impose silence, shaking the head vertically as a sign of confirmation, the sign of victory".

The idea of the index finger placed on the lips to impose silence is frequently used in sports. Some examples are representative. Football manager Jose Mourinho is a good example of this aspect. His image constructed by the media is an image of a confident person, a professional in football but at the same time, he is considered an arrogant person, and some of his public appearances show sincerity, and direct and tell things as they are. This sign was used sometimes by Mourinho when his team was victorious and he tried with this to teach a lesson to the contestants. It is a gesture that imposes something and for this reason, could be interpreted very easily in many directions.

Figure 2. (Image 2 – Jose Mourinho with a message for the fans and media after a game) (Dailymail, 2016)

Shaking the head vertically as a sign of confirmation is very often used in sports. It is a short way to confirm and it is used especially during training or matches. Using words or too many words in this situation may lead to the disclosure of some secrets during the game. For example, when a player shows with his finger the direction of his shoot before taking a penalty shot. It is much easier for the trainer to do this short gesture of confirmation.

The next categories are the illustrators. These are "gestures that accompany the verbal language and complete, reinforce or nuance the information conveyed by it". Some of them are frequently used by sportsmen.

Kinetographs "reproduces a corporal motion through which we intend to reinforce what we want to say.". (Radu, 2019) These gestures are often used especially when the players try to explain some things to the trainer or their colleagues. They are present both in the training sessions and in the matches. A good example is the coaches' press conferences. Put in front of the pressure of the results, of the fans, and the questions of the press, the coaches are put in difficult situations, and many times they want to underline what they want to say, so using nonverbal communication could be a good instrument for him. The use of nonverbal communication can convey confidence to the world because sometimes times, the coaches are considered weak and lacking in authority. For sure, the nonverbal communication role is not to supply the results of the team or to distract the attention from the activity of the manager, but it can be a good way to face the pressure.

Deictic movements are another type of illustrator that we can see frequently in sports. Their role is to "indicate directly certain people, places or objects" (Radu, 2019). These movements are used in the training ground, in technical meetings, or even in the games. Their role is to simplify communication and increase the speed of actions.

In the following example, Thorir Hergeirsson, coach of the Norwegian handball women's team, tries to explain a position in the game to Nora Mork, one of the Norwegian players. We can tell by the look of the player that the coach is trying to show her a certain place on the field. It is a simpler method than going to that point on the field.

Figure 3. (Image 3 – Thorir Hergeirsson offering indications to Nora Mork) (Gettyimages, 2017)

Spatial movements have the role of "indicating the relationships of closeness or distance existing between individuals or objects that represent the subject of communication" (Radu, 2019). In sports, they are often used especially when the coaches try to offer explanations about an opponent. For example, a coach explains to the player how close he must mark his opponent. Simultaneously, these movements could be used also by referees when they explain to the players how close the ball was to entering the goal or to describe some actions that lead to sanctions for a player.

Rhythmic movements are used to "highlight the pace of an action" (Radu, 2019). The most common situation when this type of movement is used is when a player or a coach tries to describe or suggest the tempo of an action. To realize this aspect, a person who executes this movement must offer attention to some aspects such as the position of arms and hands, posture, and facial expression. These elements could describe the dimension of demand: a suggestion or an order.

After illustrators, the third category is represented by adjustment gestures. Their role is to "guide and maintain the communication" (Radu, 2019). Also, they "suggest the attitude of the communicators, and that leads to adjustments in their discourse" (Radu, 2019). These gestures are present in sports and we could see it when a player talks with his coach or when the referee spoke.

Affective gestures are, more often, "involuntary gestures that often betray emotions" (Radu, 2019). Thinking of sports, which involves pressure, tension, and emotions it is easy to understand how they are used. The applause of encouragement from the tunnel to the field, and the coach congratulating the player who just scored, are some examples of how these gestures are used in sports. In the final of the 2016 European Championship, Cristiano Ronaldo punched a colleague in the leg as a sign of the tension accumulated throughout the match. The moment was considered rather funny, Ronaldo apologizing to Adrien Silva. This gesture is translated as a manifestation of the emotions that a sportsman can have during a match, a mix of emotions that at a given moment can be externalized.

The fifth category is represented by the adaptors. They "didn't have a lower communicative function" (Radu, 2019) but, as the author says, "it is important to control them for reasons of politeness" (Radu, 2019). These adaptors could be: "scratching, wiping sweat" (Radu, 2019). In sports are some examples of trainers who did not pay attention to such aspects and as a result, they were apostrophized in the press and by the public. Despite their smaller role, these gestures could also betray some emotions. For example, biting your nails during a game could betray increased tension, fear, or nervousness. In 2016, at European Football Championship, former German national team head coach, Joachim Low was caught on camera making certain gestures that are more about intimacy. (scratching and smelling himself). Both the press and the public took notice and they took advantage of the situation, commenting on the actions of the German coach. What we can take from this situation is image damage to Joachim Low.

5. Conclusions

In conclusion, nonverbal communication represents a very active component in the communication process bearing in mind that this can help communication by shortening the transmission time and by delivering the messages despite the disturbing factors but also it can mean a trap if the communication elements are not in an optimal relationship, leading to the erroneous understanding of the content of the message. At the same time, if used carelessly, nonverbal communication can damage the image of the person who uses it.

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The Restructuring of the Physical Education Class and the Impact of Modern Technology on the Optimization of the Motor Capacity of Students from Rural Areas

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Abstract
Introduction. The evolution of technology forces us to keep up with the modern and the innovative. That can be used for a practical purpose, namely, to practice physical exercises, thus fulfilling the desire to access modern technology among students. The use of modern equipment in order to carry out some motor actions and improve physical development represents a good way of using technology, not only the one for which he opts, thus attracting the student of the 21st century to combine the use of technology with the practice of physical exercises, both during the physical education class, as well as in free time. The purpose of the research was to identify the impact of physical exercises, taught through modern technology, on the motor capacity of students from rural areas.
Method. The research consisted in the introduction, in each physical education class, of some work programs based on interactive technologies depending on the theme of the classes. These were used as aids in the fundamental part of the class and the exercises were projected on a screen. The research subjects (n=37, age 10±1.5) participated twice a week, for 20 weeks, and have been tested before and after applying the work schedules. The tests were focused on reaction and execution speed, segmental flexibility, static balance, and abdominal strength. The statistical analysis of the data was carried out with the SPSS program, v.24. The research results highlighted significant differences between the two tests ($p<0.05$), and the work programs were validated from a statistical point of view.

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Conclusions. The development of the programs was carried out to mitigate this tendency by engaging the students and not only in an active lifestyle, which means systematic moderate physical effort, in secondary school students, from rural areas, applied exercises have a positive effect on their motor capacity.

Keywords: *motor capacities, physical education, technology, rural.*

1. Introduction

The introduction of modern technology in education had a strong impact, even if its manifestations were somewhat different. In the study "Exploring physical education teachers' perceptions and attitudes towards digital technology in outdoor education", in the Swedish educational system, outdoor physical education is of great importance. This study is about what physical education teachers think about modern technology in outdoor physical education. Their perceptions about modern technology in outdoor physical education depend on: what the students need, the gadgets used and what the teachers want to address in the respective class.

These rules are reported as a relationship between the practice of outdoor exercises and the curriculum changes that intervene in the Swedish educational system. (Karlsson et al., 2022). As the Internet is increasingly used and almost indispensable, just like physical education, students are starting to get familiar with it, using it to improve sports results. Also, the results obtained are surprisingly good.

The introduction of modern technology in physical education has many benefits, having a positive role in the evolution of students in physical education class and beyond. (An, 2018). The introduction of modern technology has an extremely important role in the educational system, supporting the evaluation process, increasing sports performances, increasing student motivation, and supporting the physical education teacher, if there is an imbalance in the use of technology and the evaluation of students in physical education class. (Edginton et al., 2016).

Unfortunately, physical activity is not a priority in schools, the priority being the subjects that require an incorrect posture, caused by the multitude of curricular activities, but also extracurricular ones, children being forced to have incorrect postures, both at the table, at school, and also at home, during homework. (Heikinaro-Johansson et al., 2014).

2. Method

2.1. Experimental design

The research assumed the introduction in each physical education class of some work programs based on interactive technologies depending on the theme of the classes, these being used as aids in the fundamental part of the class, depending on the themes and objectives. The subjects of the research were 37 students from the rural area who participated twice a week at the physical education class based on interactive technology. They were tested before and after applying the working program (after 20 weeks) with special tests from the Eurofit assessment program (to evaluate some of the motor capacity skills like balance, speed execution, flexibility, strength, and agility). The subjects voluntarily participated in this research and the informed consent of the guardians was signed.

The statistical analysis of the data was carried out through the SPSS program, version 26, the calculated parameters being the arithmetic mean, the standard deviation, the minimum value, the maximum value. To test the null hypothesis, we used the Wilcoxon test for dependent samples, observing whether there are significant differences between the pre- and posttest means.

Table 2. Wilcoxon Signed Ranks

Ranks				
		N	*Mean Rank*	*Sum of Ranks*
Weight	Negative Ranks	0[a]	.00	.00
	Positive Ranks	0[b]	.00	.00
	Ties	37[c]		
	Total	37		
Height	Negative Ranks	0[d]	.00	.00
	Positive Ranks	0[e]	.00	.00
	Ties	37[f]		
	Total	37		
Flamingo balance test	Negative Ranks	8[g]	4.50	36.00

Ranks				
		N	*Mean Rank*	*Sum of Ranks*
	Positive Ranks	0[h]	.00	.00
	Ties	29[i]		
	Total	37		
Touch the tiles	Negative Ranks	36[j]	19.26	693.50
	Positive Ranks	1[k]	9.50	9.50
	Ties	0[l]		
	Total	37		
Flexibility test	Negative Ranks	2[m]	9.00	18.00
	Positive Ranks	29[n]	16.48	478.00
	Ties	6[o]		
	Total	37		
Standing long jump	Negative Ranks	2[p]	10.25	20.50
	Positive Ranks	33[q]	18.47	609.50
	Ties	2[r]		
	Total	37		
Lifting the trunk from the supine position	Negative Ranks	1[s]	8.50	8.50
	Positive Ranks	34[t]	18.28	621.50
	Ties	2[u]		
	Total	37		
Hanging test	Negative Ranks	3[v]	12.17	36.50
	Positive Ranks	34[w]	19.60	666.50
	Ties	0[x]		
	Total	37		
Race 10x5 m	Negative Ranks	32[y]	20.00	640.00
	Positive Ranks	5[z]	12.60	63.00
	Ties	0[aa]		
	Total	37		

Table 2. Descriptive statisctic of the results

	Pretest (n=24)	**Posttest (n=24)**	**P**	**Z**
Age	10 (±0.5)	10.81(±0.5)	1.00	0.000
Weight	54.22 (±7.53)	54.21 (±7.54)	1.00	0.000
Height	1.65 (±0.03)	1.65 (±0.03)	1.00	0.000
Flamingo test	0.43 (±0.76)	0.13 (±0.34)	0.009	-2.598
Touch the tiles test	113.73 (±14.90)	106 (±12.11)	0.000	-5.165
Flexibility test	17.68 (±4,74)	18.91 (±4.57)	0.000	-4.618
Long Jump	151.27 (±28.35)	154.81 (±27.83)	0.000	-4.853
Abs	19.54 (±4.65)	21.43 (±4.49)	0.000	-5.089
Hanging Test	83.14 (±124.64)	96.00 (±131.99)	0.000	-4.757
Race 10x5m	232.97 (±20.10)	222.81 (±24.15)	0.000	-4.354

2.2. Part of the working program

The training programs offered to students are part of various applications downloaded on the mobile phone such as:

“365 games”, where students can enjoy a multitude of games designed for motor skills and qualities, such as:

- games for balance
- games in pairs (football in pairs: in this version of the football game, the players are teamed in pairs, hold hands and play together. It is optimal for each team to be made up of three or four pairs depending on the size of the field play. The rules are the official rules of the football game and may change depending on the situation. The team that scores the most goals wins.
- running games
- games for jumping (sack race: players are put in bags with their feet and hold the edge with their hands, from the beginning of the race to the end. The one who crosses the finish line first wins.
- games for throwing and catching (the ball to the captain: the players are divided into two columns, and in front of each column, a student holding a ball will be seated facing the players. He will throw the ball to each of his players. After the ball it was caught by the first player in the column, he will throw it back to the captain, then squat down as quickly as possible to facilitate throwing the ball as quickly as possible to the next player in the column until the ball reaches the last player When the ball has reached the last student in the column, he will quickly come forward, becoming the captain. The team with the most captains wins.
- games for farming,
- push games
- team games (the players are divided in pairs, a few steps apart, in as many teams as possible. One player from each team will hold a ball and the other a cone. The one holding the ball will have to throw it so that it enters the colleague's cone. When the ball entered the cone, they will move a few meters apart. The team that moved the farthest wins.

– individual games
– games in different work formations
– funny games (hot potato: it is a funny game for children. The players must form a circle and throw the ball from one to the other slowly. At the "hot potato" signal, the players will very quickly throw the ball from one to the other, so that there is very little contact with it. Whoever drops the ball receives the penalty of 5 squats.

3. Results

The descriptive and inferential statistics of the data can be found in Table 1. Thus, at the initial testing, an average body mass value of 54.22 (±7.53kg) is observed, with the values oscillating between 39 and 70 kg. After applying the work program, the average value is 54.21 (±7.54Kg), the values being between 40 and 70 kg. A Wilcoxon signed-rank test showed that a 20-week working program did not show a statistically significant change in weight (Z=0.000; p=1.00). The height registers an average value of 1.65 ((±0.3m) and at the final testing this parameter does not register significant changes (Z=0.000, p=1.00).

Unipodal balance testing recorded an average imbalance value of 0.43 (±0.76) at initial testing, with values ranging between 0 and 3 imbalances. After applying the work schedule, the average value is 0.13 (±0.34), the values being between 0 and 1 imbalance. A Wilcoxon signed-rank test showed that a 20-week working program elicited a statistically significant change in balance (Z=-2.598; p=0.00).

Testing the touches of the tiles, recorded in the initial testing a mean value of 113.73 (±14.90touches), the values oscillating between 81 and 140 touches. After applying the working program, the mean value was 106.75 (±12.11), the values being between 80 and 132 touches. The Wilcoxon signed-rank test showed that the applied working program got a statistically significant change in "touch the tiles" test (Z=-5.16; p=0.00).

On the flexibility test (sit and reach test), at the initial testing was recorded a mean value of 17.68 (±4.74 cm), the values oscillating between 6 and 27 cm. The Wilcoxon signed-rank test showed that the applied working program got a statistically significant change in Flexibility (Z=-4.61; p=0.00).

Testing the standing long jump a value of 151.27 (±28.35cm) was recorded during the initial testing. After applying the working program, the mean value was 154.81 (±27.83cm), with the minimum and maximum value between 90 and 202 cm. The Wilcoxon signed-rank test showed that a 20-week working program got a statistically significant change in strength on lower limbs (Z=-4.85; p=0.00).

The trunk lifting test from the lying-dorsal position recorded an average value of the trunk lifting of 19.54 (±4.65) at the initial test. After applying the working program, the average value was 21.43 (±4.49), the values being between 10 and 30 trunk lifts. A Wilcoxon signed-rank test showed that a 20-week working program got a statistically significant change in abdominal strength (Z=-5.08; p=0.00).

The Kept Hanging test recorded a mean value of 83.14 (±124.60) at initial testing. After applying the working program, the average value is 96.00 (±131.99s), the average values being between 5 and 550. The Wilcoxon signed-rank test showed that 20 weeks working program got a statistically significant change in arms strength (Z=- 4.75; p=0.00).

On the 10x5 m shuttle race an average value of 232.97 (±20.10) was recorded in the initial test. After applying the working program, the mean value was 222.81 (±24.15), with the min and maximum between 185 and 315. The Wilcoxon signed-rank test showed that 20-weeks working program got a statistically significant change in students' agility (Z=- 4.35; p=0.00).

4. Disscution

Physical exercises contribute to a harmonious physical development, but also to a more efficient access to knowledge, which also contributes to the educational success of students. (Heikinaro-Johansson et al., 2014).

The degree of physical activity in schools is related to the practice of physical education. For years, schools have been trying to highlight the motor level of students through sports competitions. Similar results were also found in the study designed by Dobre et al. (2015), using in the PE lessons the movement games.

As a rule, physical activity is recommended as a benchmark in different sports, but also in school physical activity, in this environment, even children who are usually sedentary, perform physical activities at higher intensities. (McKenzie et al., 2009). Lately, we can see that the reduced physical activity of the population has caused major changes in the quality of life. Since society requires us to have a certain lifestyle, it is necessary to repeatedly carry out physical training and sports activities.

Society obliges us to capitalize on both our personality and mental health by practicing physical exercises. The basic benchmark of humanity is represented by physical health and mental health. (Cristea, 2010). There must be a close relationship between physical exercises performed regularly and mental health, sports offering a multitude of benefits necessary for human health that prevent various diseases and increase the quality of life. (Williams at al., 2012).

Currently, the introduction of modern technology in the educational system increases the academic level, improves the psychological level, the positive effects being numerous. (Mura et al., 2015).

Such systems that can be implemented in schools and have great appreciation in other countries are the HOPsport and Brain Breaks systems, used to keep students active, both physically and mentally during breaks, improving language, creativity and increasing physical performance. (Chin et al., 2013).

In order to be able to implement these systems, you only need the Internet, where students and teachers can access various videos. It can be said, however, that more studies are needed to combat sedentarism and to increase the level of physical activity among young people and students in many countries. (Kueh et al., 2018).

Technology is part of the modern life of students. Sedentarism is associated with the use of technological devices, such as the computer on different games or video clips and less in doing homework. This unhealthy behaviour leads to a sedentary lifestyle if it is not used for purposes that can improve physical and mental performance. Many studies have shown that technology can also be used for useful purposes, growing together with the physical activity and academic performance of young students, promoting a healthy lifestyle and a healthy lifestyle. (Bilgrami et al., 2017).

Interactive video games based on physical exercises arouse the students' interest in the class and in the involvement in the physical act. (Hall et al., 2015). In schools, the implementation of technology can appear as a motivation for practicing physical exercises. Modern technology in schools has a multitude of benefits, positively influences pedagogical strategies, can serve to help the physical education teacher's efforts, and can facilitate the assessment of young students, the positive effects being countless if there is a balance in its use. (Edginton et al., 2016)

Physical activity has a huge impact on children's growth and development. Despite the increasing number of studies emphasizing the positive effects of physical activity in children (Donnelly et al., 2016), this is not consistently practiced by students.

The research results showed that the applied work programs, based on interactive technology, had a positive impact on the development of some components of the motor capacity (balance, flexibility, strength, and speed).

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Swimming as a Means of Recovery From Injuries and Maintaining/Improving General Physical Condition in Soccer Players

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Abstract
Introduction: The rigors of practicing a performance sport require participation in both intense training and competitions. Thus, the increased physical demands leave their mark on the athletes regardless of how well they are prepared. In these conditions, restoring the body after exercise is essential for obtaining the desired results and for avoiding injuries or overtraining. *Objectives*: The tasks of this study are oriented in the following directions: the opinion of football players on the effectiveness of using swimming as a means of recovery of the body after exertion, as a means of recovery of the body after injuries and as a means of improving the general physical condition. *Materials and methods*: To achieve the research objectives, a quantitative study was carried out in which the opinion of football players on swimming, as a means of recovery after effort, was followed. The questionnaire, made with the help of the Google Forms application, composed of 10 questions, was distributed to football players registered with football teams that regularly participate in championship games, in different leagues in Romania. *Conclusions:* Following the analysis of the answers obtained, we find that, although the respondents are aware that swimming and water activity bring many benefits as means used by football players in recovery after effort, in recovery after injuries, respectively for maintaining/improving the general physical condition, this type of recovery is not used sufficiently by the respondents, the main reasons mentioned by the respondents being the lack of adequate infrastructure and the costs being too high.

Keywords: *swimming, footbal, players, opinion.*

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1. Intoduction

The fact that swimming is an activity that can be practiced at any age gives its forms a universal attribute. Sedentarism is one of the predominant characteristics of modern lifestyles. Physical activity successfully combats the harmful effects of a sedentary lifestyle, swimming being one of the most popular physical activities, which also provides multiple beneficial effects. It is also well known that practicing different physical activities has not only physical benefits but also social benefits, which facilitate the interaction between people with similar hobbies. (Waller et al. 2014) (Stoychevski 2021)

Swimming can be a safe option for people suffering from various conditions such as arthritis, various injuries, various types of disabilities, other types of problems that limit the use of high-impact exercise. (Boltz et al. 2021) (Van Beijsterveldt et al. 2013)

In terms of swimming strokes, swimming can be practiced using both the competitional stroke techniques (effective) and the folk stroke techniques (less effective). (Parvis et al. 2016)

According to an article published on the International Water Sport Federation's website, specialists recommend casual swimming for 150 minutes a week or 75 minutes vigorously, as it is an excellent way to activate the whole body and stimulate the cardiovascular system, having minimal impact on muscles and joints. According to the article, swimming is one of the most popular physical activities in the United States because of its main benefits: improves cardiovascular performance without stressing the body; tones the entire muscular system; improves overall fitness by increasing strength and endurance. (Waller et al. 2014)

Aquatic therapy consists of a variety of water-based exercise programs. This type of therapy is beneficial for a wide variety of ailments and medical conditions. One of the main benefits of water activity is weight relief due to the buoyancy given by submerging the body into the water. This upward force reduces the weight felt by the body, as the stress forces acting on the body's support apparatus are reduced. (Bălan and Mitrea 2017) (Tate et al. 2020)

Water density is a very good source of resistance that can easily be incorporated into an aquatic therapy exercise program. Water resistance allows muscles toning without the use of weights, allowing various muscle groups to work with reduced joint stress, a result which cannot be achieved outside the water. (Shi et al. 2018) (Sokołowski, Strzała, and Radecki-Pawlik 2022)

Water temperature can also play a very important role in the results of aquatic therapy. An appropriate water temperature produces vasodilation, increasing blood flow to the affected areas, which helps patients with muscle disorders recover faster. (Shell et al. 2020) (Zarzeczny, Kuberski, and Suliga 2022)

2. Hypothesis

By conducting this study, we aim to find out the opinion of football players regarding the use of swimming as a means of recovery after specific effort.

The starting hypothesis is that the majority of the respondents consider swimming to be effective as a means of body recovery after effort, as a means of body recovery after injury and as a means of maintaining/improving general fitness.

3. Materials and methods

In order to achieve the research objectives, a quantitative study was carried out in which the opinion of football players on swimming as a means of recovery after exercise was followed. The questionnaire, made with the help of Google Forms application, was composed of 10 questions and was distributed to football players affiliated to football teams participating regularly in championship games in different leagues in Romania. Several research methods were used to conduct the present study:

Bibliographic study - was used to search, find, sort and verify relevant information about the research topic. The main bibliographical sources used within the study were: websites with general information about swimming, information related to the use of swimming in recovery after exercise, recovery after injury and improvement of general fitness.

Graphical representation method - this method was used to make the information presented easier to understand, as the written information was illustrated into charts. Due to the variety of charts, this tool has great versatility of use. In the present study the graphical representation method was used less in the introductory part, but it was used in the special part of the paper, for the illustration of the data about the respondents and the data obtained.

Statistical-mathematical method - method used to accurately describe the studied phenomena, by which information is concentrated, it is easier to synthesize, the results obtained are clearly interpreted, and conclusions about the studied phenomenon can be formulated. In this study, the statistical-mathematical method was used to interpret the responses obtained, using statistical indicators such as mean, median, standard deviation, minimum and maximum.

Questionnaire survey method - is the most widely used method concerning data collection, the instrument used being the questionnaire. For the present study a questionnaire was designed, made with the help of Google Forms application, consisting of 10 questions oriented to the following types of data:

- Data about the respondent (gender, age category, level of the league in which the team where he/she is enrolled plays);
- Respondents' opinion on the effectiveness of swimming as a means of recovery after effort, as a means of recovery after injuries and as a means of improving general fitness;
- Information on the use of swimming as a means of recovery after exercise, as a means of recovery after injury and as a means of improving general fitness;
- Information on the reasons why swimming is not used as a means of recovery from effort, as a means of recovery from injury and as a means of improving general fitness.

The ten questions that make up the questionnaire have been arranged in a logical sequence, their typology being varied: closed questions with a choice of one or more answers, opinion questions and open questions.

The Excel tool from the Microsoft Office Professional Plus 2016 suite was used to generate the charts and perform the statistical calculations.

4. Results

Given that the number of respondents was 136, the margin of error of the results obtained is +/-8.4% at a confidence level of 0,05.

The gender of the respondents is shown in the chart below: 106 respondents (77.9%) are male and 30 respondents (22.1%) are female.

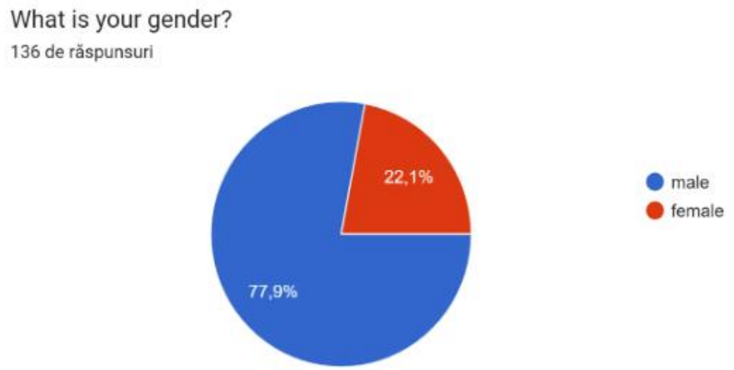

Chart 1. Gender of the respondents

The age categories of the respondents are shown in the following chart:

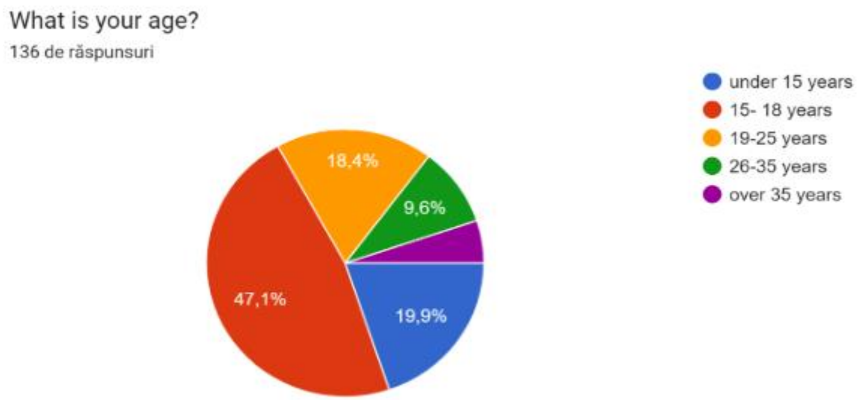

Chart 2. Age category of the respondents

Most of the respondents, 64 (47.1%), belong to the 15-18 age category. The under 15 age category is represented by 27 respondents (19.9%). The 19 - 25 age category is represented by 25 respondents (18.4%). The 26 - 35 age category is represented by 13 respondents (9.6%) and the least represented category is the over 35 years old, with 7 respondents (5.1%).

Concerning the level of the league in which the respondents play/have played, the responses received are shown in the chart below:

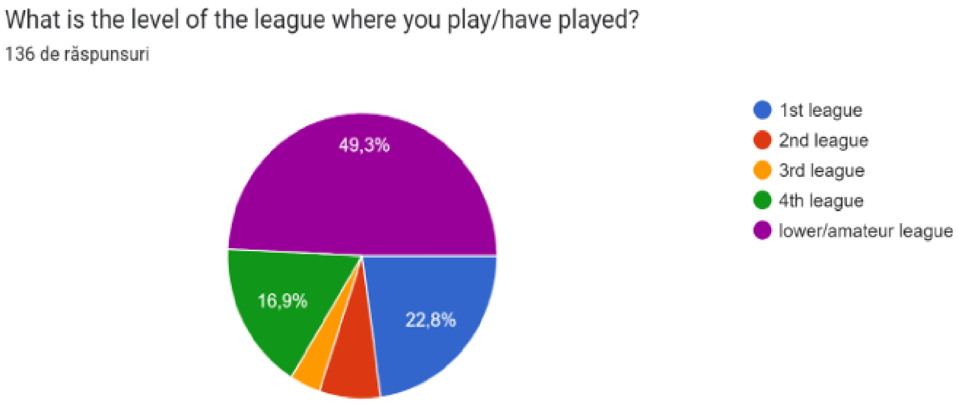

Chart 3. Level of the league where the respondents play/have played

Most of the respondents, 67 (49.3%) play or have played in the lower/amateur leagues. 31 of the respondents (22.8%) play or have played in the 1st league. The 4th league is represented by 23 respondents (16.9%). The 2nd league has 10 respondents (7.4%) and the 3rd league has the lowest number of respondents, 5 respondents (3.7%).

The answers received to the question on the respondents' opinion on the effectiveness of swimming as a means of recovery after exercise are shown in the following chart:

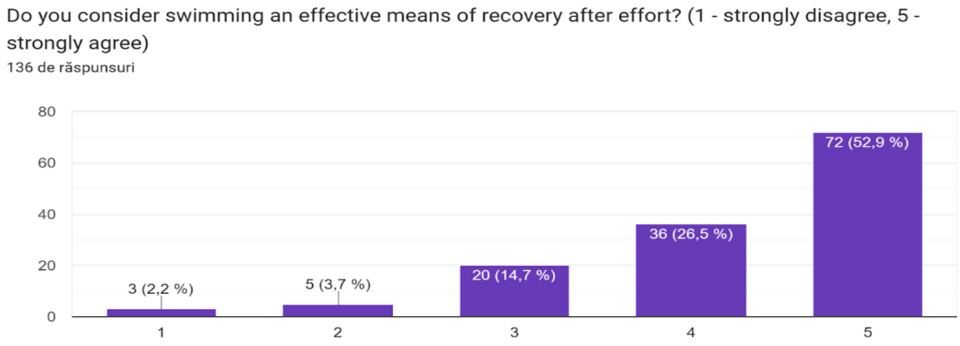

Chart 4. The effectiveness of swimming as a means of recovery after effort

The majority of respondents, 72 (52.9%) strongly agree (5 points awarded) that swimming is an effective means of recovery after effort; 36 respondents (26.5%) opted for a good agreement (4 points awarded); 20 respondents (14.7%) opted for a medium agreement (3 points awarded); 5 respondents (3.7%) opted for poor agreement; 3 respondents (2.2%) disagree with the question.

The answers received to the question on respondents' opinion on the effectiveness of swimming as a means of recovery after injuries are shown in the following chart:

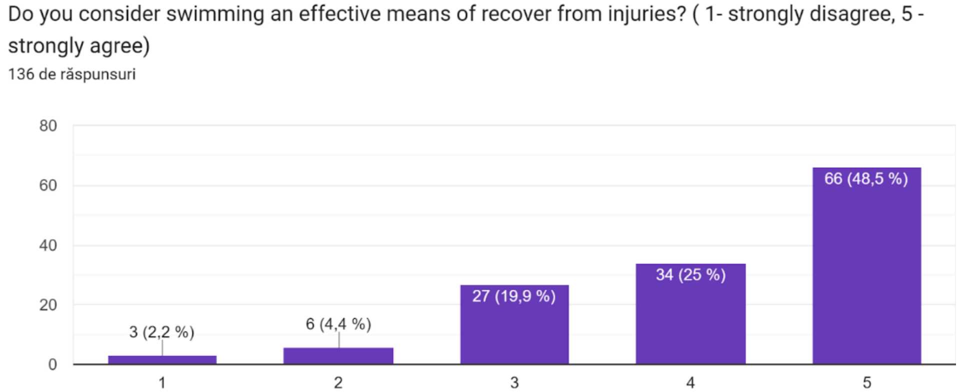

Chart 5. The effectiveness of swimming as a means of recovery after injuries

Most of the respondents, 66 (48.2%), strongly agree (5 points awarded) that swimming is an effective means of recovery after effort; 34 respondents (25%) opted for a good agreement (4 points awarded); 27 respondents (19.9%) opted for a medium agreement (3 points awarded); 6 respondents (4.4%) opted for poor agreement; 3 respondents (2.2%) disagree with the question.

The answers received to the question on the respondents' opinion on the effectiveness of swimming as a means of maintaining/improving general fitness are shown in the following chart:

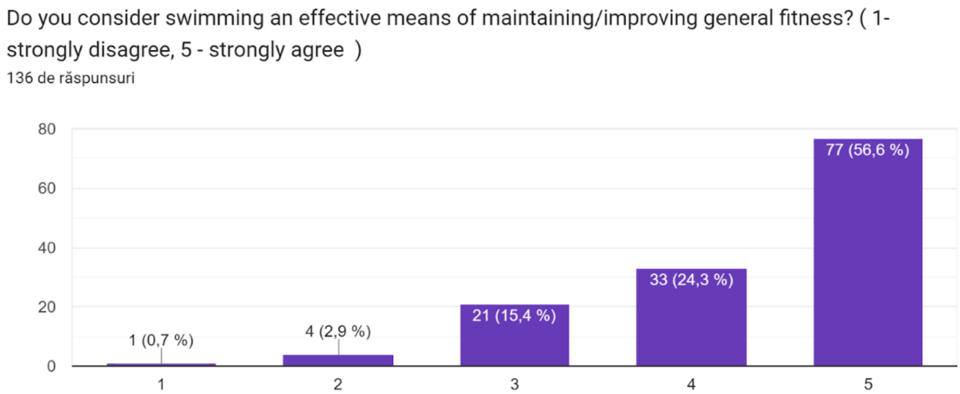

Chart 6. The effectiveness of swimming as a means of maintaining/improving general fitness

The majority of respondents, 77 (56.6%), strongly agree (5 points awarded) that swimming is an effective means of recovery after effort; 33 respondents (24.3%) opted for a good agreement (4 points awarded); 21 respondents (15.4%) opted for a medium agreement; 4 respondents (2.9%) opted for poor agreement; one respondent (0.7%) disagrees with the question.

The answers received to the question on the frequency of using swimming as a means of recovery after effort are shown in the chart:

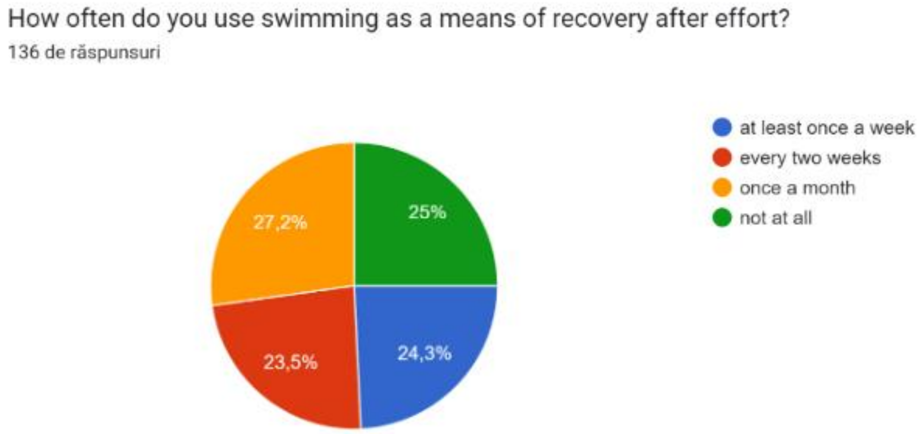

Chart 7. Frequency of using swimming as a means of recovery after effort

The answers received are relatively balanced, 33 of the respondents (24.3%) use swimming as a means of recovery after effort at least once a week; 32 of the respondents (23.5%) use it every two weeks; 37 of the respondents (27.2%) use it once a month; 34 of the respondents (25%) do not use swimming at all.

The answers received to the question on the frequency of using swimming as a means of recovery after injury are shown in the chart below:

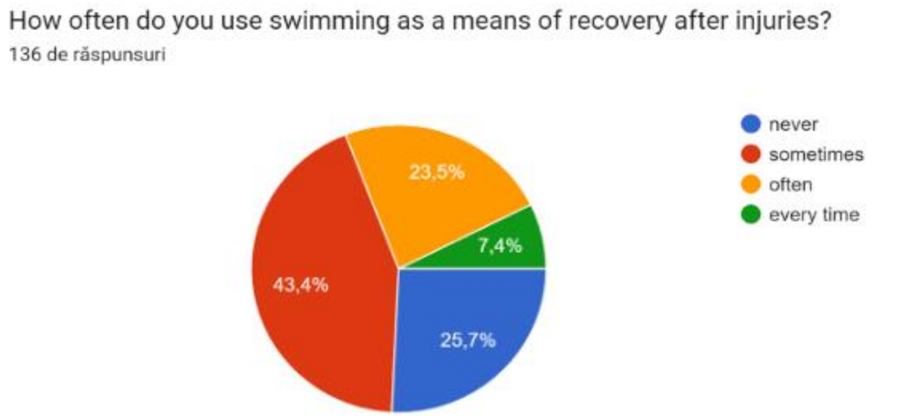

Chart 8. Frequency of using swimming as a means of recovery after effort

Most of the respondents, 59 (24.3%) sometimes use swimming as a means of recovery after injuries; 35 of the respondents (25.7%) never use it; 32 of the respondents (23.5%) often use it; 10 of the respondents (7.4%) always use swimming as a means of recovering from injuries.

The answers received to the question on the frequency of using swimming as a means of maintaining/improving general fitness are shown in the chart below:

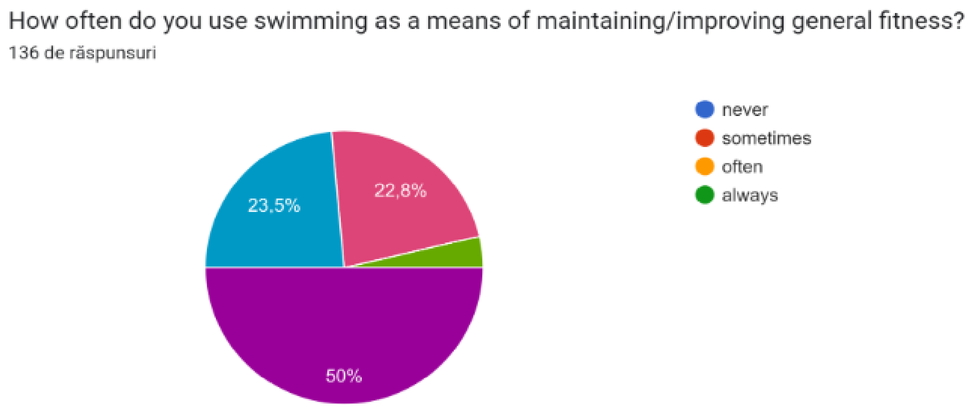

Chart 9. Frequency of using swimming as a means of maintaining/improving general fitness

Half of the respondents, 68 (50%), sometimes use swimming as a means of maintaining/improving general fitness; 32 of the respondents (23.5%) never use swimming as a means of maintaining/improving general fitness; 31 of the respondents (22.8%) often use swimming; 5 of the respondents (3.7%) always use swimming as a means of maintaining/ improving general fitness.

The answers received to the question about the reasons why swimming is not used/ insufficiently used as a means of recovery after exercise/recovery after injuries/maintenance/improvement of general fitness are presented in the chart below. As this was a question for which more than one answer could be selected, the respondents have selected 184 answers.

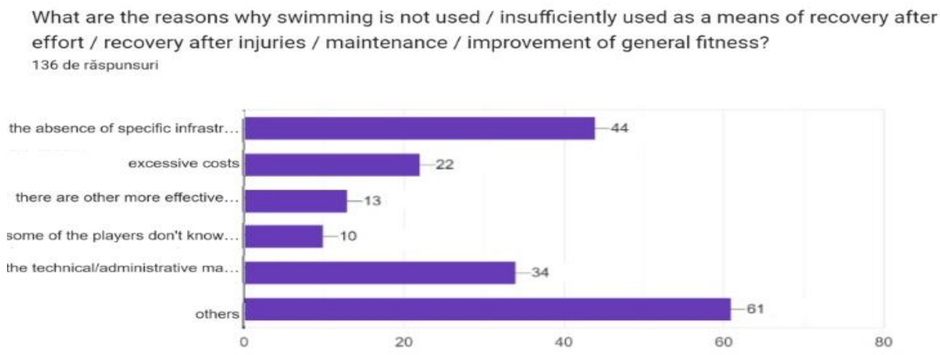

Chart 10. Reasons why swimming is not sufficiently used as a means of recovery after exercise, recovery from injury or maintenance/improvement of general fitness

The absence of specific infrastructure turns out to be the main reason why swimming is not sufficiently used as a means of recovery after effort, recovery after injuries or maintenance/improvement of general fitness by 44 of the respondents (23.9% of the total responses); 34 of the respondents (18.4% of the total responses) claimed that the technical and administrative management does not consider swimming necessary; 22 of the respondents (11.9% of the total responses) claimed that the costs are too high; 13 of the respondents (7% of the total responses) claimed that there are other more efficient means; 10 of the respondents (5.4% of the total responses) claimed that some of the football players do not know how to swim; 61 respondents (33.3% of the total responses) have indicated other reasons such as: risk of injury, risk of illness or lack of enjoyment when swimming.

5. Discussions

A study published in 2009 in the Journal of Strength and Conditioning Research compares recovery strategies used in young football players. The authors concluded that recovery sessions after effort should be considered as an integral part of training, taking into account several criteria such as: nature of the sport, body composition, recovery time, etc. The study shows the benefits of using aquatic activities as a means of recovery and pleads the implementation of combined recovery means.(Inugasa and Ilding 2009)

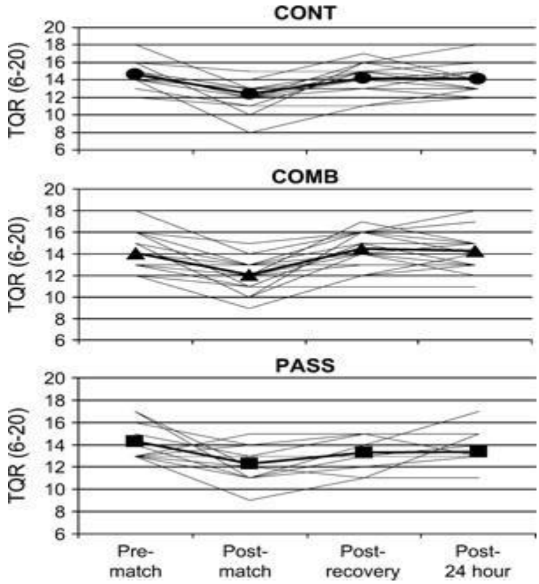

Figure 1. Total Quality of Recovery (TQR) values using different recovery strategies (Inugasa and Ilding 2009)

Another study published in 2014 in the Journal of Strength and Conditioning Research shows that recovering knee injury patients show reduced joint pain, improved balance and mobility after participating in a 6-week underwater treadmill recovery program that incorporated balance exercises and HIIT-type exercises. The authors also point out that no subjects experienced adverse reactions, suggesting that this type of recovery is well tolerated by patients.(Ressel et al. 2014)

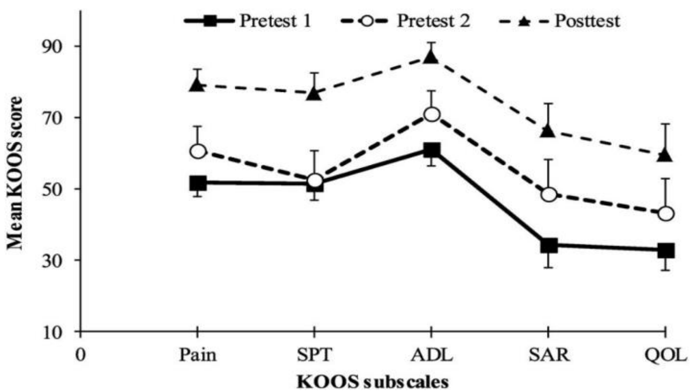

Figure 2. Knee Injury and Osteoarthritis Outcome Score (KOOS) subscale scores for baseline and endpoint testing (Ressel et al. 2014)

An article published on the website https://yoursoccerhome.com/, examines the advantages and disadvantages of swimming for football players. The advantages include: improved cardiovascular capacity, improved lung capacity, improved body stability, stabilized body mass index, improved flexibility, reduced recovery time after effort and reduced recovery time after injury. The article also points out the disadvantages of swimming: swimming is an aerobic exercise, whereas in football the action is fast and anaerobic. There is a risk of dehydration, swimming is not intense and is time consuming.

6. Conclusions

After conducting the study, we find that the majority of respondents consider swimming and water activity to be an effective means of body recovery after effort and injury. Regarding the effectiveness of swimming and water activity in maintaining/improving general fitness, the majority of respondents are in average agreement with this statement.

Although the majority of respondents are aware of the value of swimming and water activity for football players, only 51.4% of respondents use this means for body recovery after effort at least once a month.

Swimming and water activities were used by the majority of respondents as a means of recovery after injuries.

We also find that 48.6% of respondents do not use swimming and water activities at all as a means of maintaining/improving general fitness.

Thus, we find that swimming and water activities, although bringing many benefits as a means used by football players in recovery after effort, in recovery after injuries, in maintaining/improving general fitness, it is not used enough by the respondents. The main reasons why this means is not sufficiently used by the respondents are the lack of adequate infrastructure and excessive costs.

As a result of this survey, we suggest to coaches and physical trainers of football teams to include swimming and water activity in the training routine of the athletes. We suggest that swimming and water activity sessions be used as follows:

- Body recovery after effort: cold water immersion sessions, water immersion sessions with alternating cold/warm temperatures, warm water immersion sessions, slowly swimming, etc.;
- Recovery from injury: the use of swimming and water activities as prescribed by the doctor/physiotherapist;
- Maintaining/improving general fitness: the use of swimming sessions for active rest days.

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Development of Fine Skills Through Occupational Therapy in Preschool Children with Special Educational Needs

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Abstract
Children develop on their timelines – just because a child exhibits delayed fine motor skills doesn't mean there is automatically a problem. However, there are times when early intervention is necessary. Children use fine motor skills to make small ("fine") movements with their fingers, toes, and other parts of their body, like their hands, tongue, and lips. Fine motor delay occurs when a child has difficulty with the movement of their small muscle groups. Based on the literature review findings, fine motor skills are an important skill to develop during the preschool years.
The Occupational Therapy session is adapted to each child's needs, probably the most important factor in the development of fine motor skills in children with special educational needs.
This study was carried out in an interpretative and descriptive paradigm which involves preschool children with Special Educational Needs (SEN). Materials and method. The research is based on a case study of five children with special educational needs who carry out therapies in the Sun-Rise kindergarten in Chisinau. The subjects who were included in the study benefited from occupational therapy services during the 2021-2022 school year once a week.

Keywords: *occupationa therapy, special educational needs, preschool, motor skills, fine skills, children, kindergarten.*

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1. Introduction

Assessment of motor development in preschool children has become increasingly important with the recent acknowledgment that motor impairment/deficit is linked with cognitive, language, social, and emotional difficulties. As there is a lack of evidence regarding motor development and early intervention in children with special education needs (SEN), the purpose of this study was to assess the motor development of preschool children with SEN within the educational context to allow their teachers to design appropriate physical education activities to improve students' motor proficiency.

Differences in the difficulties encountered during the subtests by children in different SEN groups were found, suggesting that evidence of certain motor weaknesses is more likely for children with specific SEN. An unsatisfactory level in overall performance in gross, fine, and total motor quotients confirmed the delayed motor development of students with SEN. The paper concludes with recommendations for an appropriate evaluative measure and early intervention programs for children with specific motor impairments (Riga, Misirle & Komessaariou, 2020).

Fine motor performance skills are essential for children's successful educational participation. Kindergarten curriculums are increasingly academic with less emphasis on play-based learning. Increased expectations for kindergarten readiness do not align with developmental milestones. Occupational therapists are uniquely positioned to support children and teachers in preparing for kindergarten. These three moths collaborative intervention utilized fine motor and sensory activity centers, integrated within the classroom, to promote kindergarten readiness for 5 preschool children. Pre- and post-testing indicated clinically significant gains in readiness skills. Results of this pilot study support the effectiveness of integrating occupational therapy within the preschool classroom to improve kindergarten readiness skills (Martino & Lape, 2020).

Fine motor skills are an integral part of everyday activities. Children with neurological disorders, such as cerebral palsy and autism spectrum disorder, have problems with fine motor skills, social interaction, and communication. Such children need to repeat a skill to acquire it. Therapy is needed so that children can develop important life skills and be involved in academic activities. However, children need to undergo long sessions of therapy, which will be tedious for them.

Occupational therapists realize the importance of fine motor skills, including reaching, grasping, carrying, voluntary release, in-hand manipulation, and bilateral hand use. A variety of child factors influence the development of fine motor skills such as movement skills, visual skills, sensory integration, visual perception, cognition, and social and cultural factors. When children mature with normal development, they have effective visual-hand coordination skills, and later develop eye-hand coordination with visual perception skills. For these reasons, children have delayed fine motor development when barriers reach academic achievement goals. Children with special educational needs are at risk of delayed fine motor development (Suchitporn L., Supawadee P. & Kewalin P., 2016).

As mentioned above, early detection and evaluation of fine motor problems in children with special educational needs are needed. After evaluating a child's performance, therapists develop and design an intervention program individually by systematic activity analysis and a synthesis process for each child, so that the program can be related to a child's skills, limitations, and culture (Chen, Ringenbach, & Albert, 2013). Most intervention programs for improving fine motor skills include exercises or activities by using hands. Research for adults with special educational needs included assisted and voluntary exercise with music that could improve fine manual dexterity (Chen, Ringenbach, & Albert, 2013). However, more consideration should be given to the developmental milestone of children with ASD (Frank & Esbensen, 2015). For these reasons, this study was interested in designing an intervention program and researching the effectiveness of the fine motor activities program to promote fine motor skills, including bilateral hand coordination, hand prehension, manual dexterity, in-hand manipulation, and hand muscle strength in a study case. Fine motor performance skills are essential for children's successful educational participation. Kindergarten curricula are increasingly academic with less emphasis on play-based learning. Increased expectations for kindergarten readiness do not align with developmental milestones. Occupational therapists are uniquely positioned to support children and educators in preparing for school. Those three months' collaborative intervention utilized fine motor and sensory activity centers, integrated within the classroom, to promote school fine motor skills for five preschool children with special educational needs. Results of this pilot study support the effectiveness of integrating occupational therapy within the preschool classroom to improve fine motor skills.

1.1. Evaluation of people with special needs

The evaluation of people with special needs is based on complex knowledge of the medical, psychological, and social plan, covering the entire issue encountered by educational attainments, especially in the ordinary living environment. It should be emphasized that, in the vast majority of cases, the evaluation is a continuous process, not an instant X-RAY of the subject's condition, requiring a prolonged collaboration, the differential between the members of the evaluation team and the person with special requirements. Also, evaluation as an indispensable process in the structure of services offered to people with disabilities is based on a series of important elements, frequently invoked in current specialized literature a certain philosophy of evaluation, coherent and unitary constructions of content evaluations, modern and flexible legislation in the field of social services. Last but not the least, the evaluation is based on a series of criteria that can be classified as follows:

- Specific criteria to each field (medical, physiological, educational, and social);

- Specific criteria for classification in a degree of deficiently/disabilities;
- Specific criteria for school and professional orientation (Savițchi & Agapii, 2021).

1.2. The purpose of the research

The purpose is to develop fine skills for preschool children with special education needs through occupational therapy.

In realization of the research, we started from the following **hypothesis** it is assumed that through occupational therapy we will develop fine skills in preschool children with special educational needs.

In order to concretely guide the research activity, we established and formulated the following research **objective:**

- The study of the theory and practice of the process of developing fine skills in preschool children with special educational needs.
- Elaboration and implementation of the occupational therapy program for children with special educational requirements for the development of fine skills.
- Experimentation and argumentation of the occupational therapy program for the development of fine skills in preschool children with special educational needs Experimentation and argumentation of the occupational therapy program for the development of fine skills in preschool children with special educational needs.

2. Material and methods

The research took place at the “ Sun Rise” kindergarten, for three months. Preschool children with special educational needs (n = 5) received occupational therapy a minimum of one individual 30-minute session, and one group 30-minute session per week for one year of study. Two assessment tests were administered twice to each child, at the beginning and end of the school year. Fine motor skills are essential for children's successful participation in education. Kindergarten curricula are increasingly academic, with less emphasis on play-based learning. Raised expectations for kindergarten readiness do not align with developmental milestones. Occupational therapists are uniquely positioned to support children and educators in school readiness. This three-month collaborative intervention used classroom-integrated fine motor and sensory activity centers to promote scholastic fine motor skills for five preschool children with special educational needs. Pre- and post-testing indicated clinically significant gains in preparation skills. The results of this pilot study support the effectiveness of integrating occupational therapy into the preschool classroom to improve fine motor skills.

2.1. Selection criteria

The inclusion criteria to form part of the group of children with ASD were:

- to have a clinical diagnosis of ASD;
- to be aged between 5 and 6 years old;
- to have had an informed consent form signed by a parent or legal guardian.

On the other hand, the exclusion criteria were the presence of comorbid disorders added to ASD.

SPSS software was used to enter and analyze the obtained data.

3. Results

Fine motor skills refer to the movements of the flexor muscles in the fingers, hands, and forearms. These skills develop over time as children try to discover the world around them. As children improve their fine motor skills, they will become able to make controlled and steady movements, as well as learn to do more things with their hands independently, such as:Holding a pencil

- Tying the strings
- They feed themselves
- Cutting along straight and curved lines
- Opening lunch boxes
- Drawing circles
- Making sculptures with materials such as Playfoam etc.

3.1. Suggested modeling themes that can be achieved through various rendering procedures

This checklist was designed to serve as a functional assessment of developmental skills by age group. It does not constitute an evaluation, nor does it reflect strictly standardized research.

The occupational therapy program was carried out by all patients, who proved to be even interested in the association in the rehabilitation assistance of this particular modality of therapy. The reasons for dividing the two activities were many, one being that fine motor skills are involved in teaching activities and will help prepare children with special educational needs for school. Moreover, training different types of fine motor skills has been shown to influence other aspects related to motor performance, namely didactic activity. The generic early curriculum is thought to promote positive motor developments. For example, found that a longer period at kindergarten was associated with better grapho-motor skills (fine hand coordination, as well as ability to copy different figures as a whole and their parts) in both boys and girls (Pitchford et al., 2016).

The graphs represent the distribution of the values of the didactic activities evaluation questionnaire before (evaluation I) the occupational therapy program and after therapy (evaluation II).

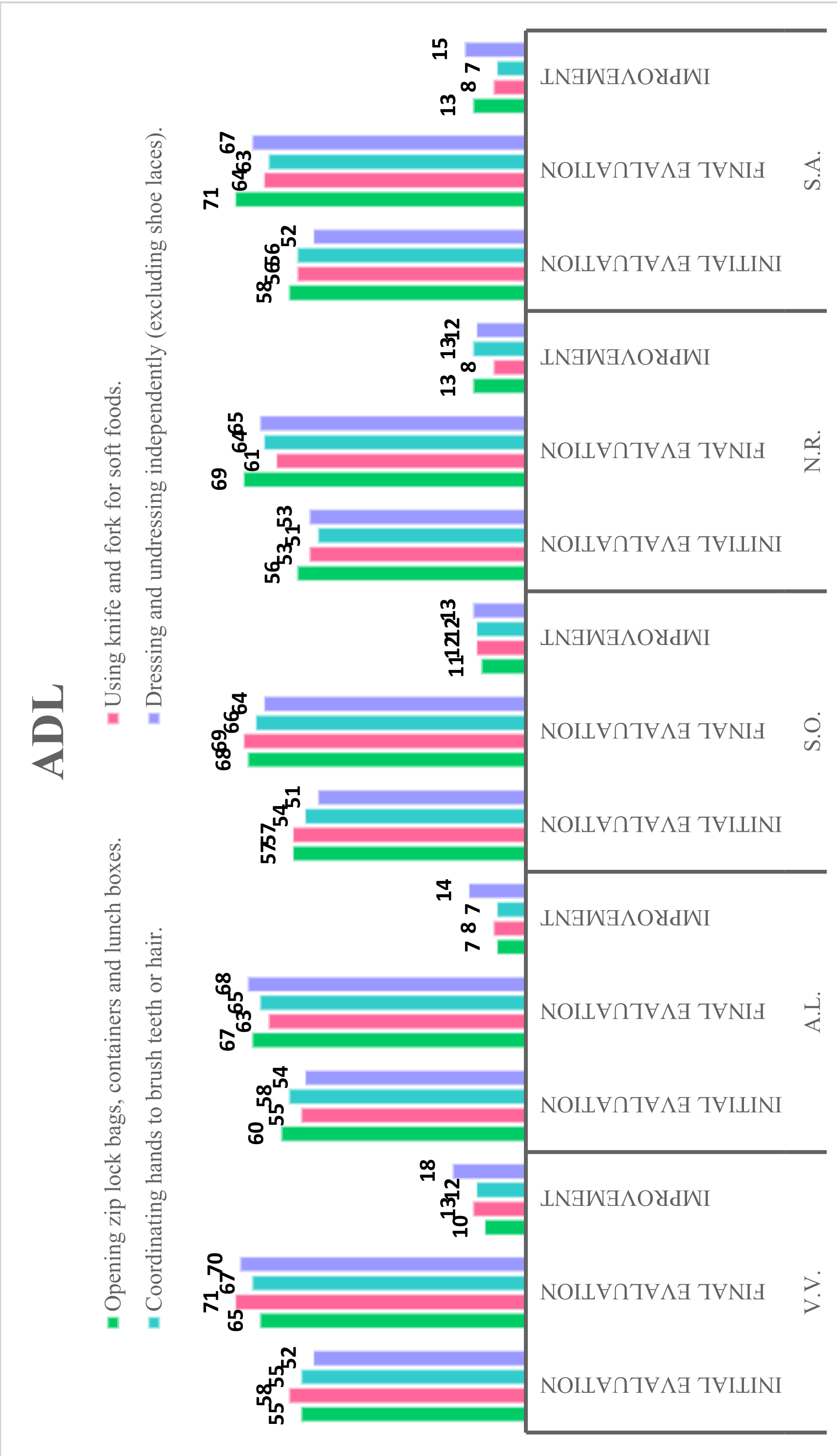

Figure 1. Comparative data of ADLs

The tradigital pincer improved after applying for the occupational therapy program, finally obtaining an average score of 58 points compared to the initial score of 50 points at the patient V.V. (Figure 2). The lowest score of the patient V.V. was obtained at drawing a basic picture only 4 points improvement. The lowest score was on the criteria Coordinating hands to brush teeth or hair average of 7 points (patient A.L. and S.A.) proved to be a difficult task (Figure 1).

At the patient A.L. the tradigital pincer at first evaluation 56 points ant the final of the therapy final score was 67 points, an improvement 11 points (Figure 2). The highest improvement was obtained in designing own Lego models at 17 points, the lowest at 9 points at three didactic activities. At the ADLs, activities patient A.L. the best score was on Dressing and undressing independently (excluding shoe laces) improvement by 14 points. For the patient S.O. the highest score of improvement was from the didactic activities at the criterion Self-generating letters independently, the lowest score of improvement was 8 points at the criterion tradigital pincer (Figure 2).

Not all children with special educational needs, however, are equally likely to recover ADL independence. In our study, all children with special educational needs recovered their ADL function. The highest score for ADL activities after applying the occupational program have got patient V.V. at the criteria Dressing and undressing independently (excluding shoe laces) 18 points (Figure 1). Our findings are consistent with the objective that the likelihood of ADL improvement increases substantially with the development of fine motor skills.

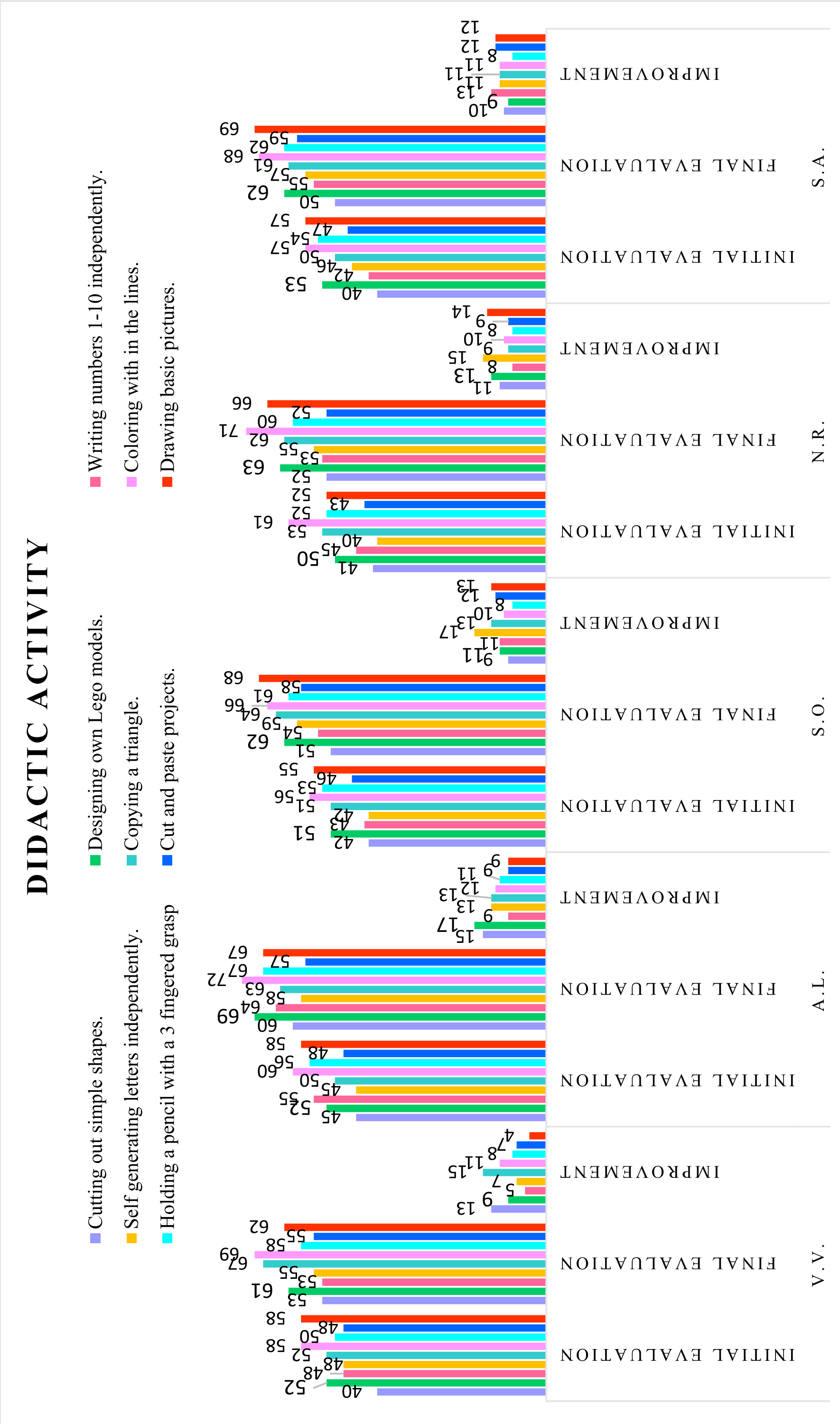

Figure 2. Comparative data of didactic activity

The ability to brush teeth for the A.L. results in 10 points, whereas for the V.V. 12 points. For dressing and undressing independently for the A.L. at first evaluation 54 at the final 64 points improvement 10 points (Figure 1), patient V.V. at the start of therapy 52 points and the final 71 points (Figure 1), improvement 19 points. However, the case study of this research used the program for three months, which may not be enough time for obvious changes to appear. Thus, increasing the intervention time would be a factor in improving the skills of the case study subject. Additionally, a child with special education needs have an intellectual disability, and limitations in learning and performing cognitive functions. Indeed, he/she might need more time to learn, integrate, recall, and receive feedback (Suchitporn, Supawadee & Kewalin P, 2016).

Fine motor skills deserve further consideration, especially at early school age. In this study, both gross and fine motor skills significantly improved with the occupational therapy program. This trend was expected as competency in fundamental movement skills has been shown to follow an increasing developmental trajectory, with both gross and fine motor skills improving with the application of the occupational therapy program.

4. Conclusion

The objective of this study was to develop a fine motor activities program and examine its efficiency in promoting fine motor skills in a study of children with special education needs. This study found that the fine motor activities program promoted fine motor skills, including bilateral hand coordination, hand prehension, manual dexterity, in-hand manipulation, and hand muscle strength activity sets, which were designed and developed by activity analysis and a synthesis process based on various related approaches, such as Neurodevelopmental, Biomechanical, and Motor Skill Acquisition and Psychosocial ones. Because fine motor skills consist of movement and visual skills, sensory integration, visual perception, and cognition, as well as social and cultural factors, using a single approach in designing and developing an intervention program, did not encourage fine motor skills. After designing and developing a program of activities, the case study was implemented within three months. Finally, the subject showed a clear improvement in fine motor skills, especially in assessing hand manipulation. However, due to limited cognitive functions, he needed more time to improve and sustain his fine motor skills by using the therapists' adaptation and modification of the program. Additionally, to continue his development, integration of fine motor activities into his daily activities, especially those of self-care and play, might be planned by his parents with therapists because interventions using functional life skills have been shown to increase the efficacy of an intervention program and the child's motivation to participate.

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Improve Skiing Race Competencies / Actual Aspects of preparation

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Abstract
"Junior slalom skiing is about to be a big disaster because the juniors only focus on attacking the pennant and deflecting it. In general, I believe in a logical, basic approach to ski racing, and I integrate the speed of a competitor because of the interaction between two essential components: the verticality of the slope and the approach to the turns. The competitor who gets the tightest line throughout the course will have the fastest speed, therefore, all technical elements of ski racing, including flag attack technique, should be oriented towards the race trajectory" (H. Nagler, ex-coach of Ingeman Stenmark, TV show)
Technological progress (recorded in the superior quality of ski materials and equipment) has imposed significant changes recorded both in the competition technique and in the regulations for the conduct of ski competitions. (Canadian Ski Instructors Alliance, 2006))
The appearance of pennants/articulated/tilting gates induced important changes in the technique and trajectory of the competition. Due to the reduced impact force, skiers are less concerned with the consequences of contact with the pole, the main objective being to achieve a tighter race line. The technique of approaching articulated pennants has undergone numerous changes and is a current priority of technical and tactical training. The formation of the correct "attack" skill of the pennant is an essential aspect of preparing children for the competition, at this level the profile of the future high-performance competitor is formed. (Hirano, 2002)
The present work aims to synthesize some current theoretical-methodological concepts related to the issue of optimizing the technical-tactical compartment at the level of 10-13-year-old children. The study also aims at validating the manner of effective optimization of the flag attack by inserting means and methods focused on the use of operational structures based on the use of roller skates and roller skis during the extra-season.
Keywords: *performance, alpine skiing, 12-13 years performers.*

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1. Specific aspects of alpine skiing

A. Motricity specific aspects: sliding sport - acquired unnatural mechanisms, the group of high-speed skill sports, maximum intensity efforts in a short time, extreme stress on the nervous system, the psychological factor - special role, skiing is a sport of adaptation to environmental variables.

B. Technical-tactical specifics: complexity, skiing is the prototype of the improvisation sport, composition technique means precision, effectiveness, preparation priorities represented by acceleration (skidding elimination, turning radius reduction).

C. On a technical-material level: the quality of the material and its preparation directly influence the performance, the presence of the risk factor imprints a particular behavior (Pelin, 2007)

The characterization of motor positions and gestures requires the automatic integration of the skis into the body scheme of the subject (constitution of the system, of the skier-ski ensemble), a fact that requires giving increased importance to the specific material.

Basic technique of alpine skiing represents a set of motor skills with a deeply specific character, which allows movement on snow-covered terrain, for different purposes: formative, utilitarian, recreational.

Racing technique derives from the basic one, it focuses on obtaining an increased speed, demanding the physical and mental possibilities of the skier to the limit. (Matijevec, 2003)

Skiers' technique is the primary limiting factor and stems from the skier's ability to effectively steer their skis and body down the glide direction relative to the current pattern. (Wormwood, 2007)

1.1. Aspects of competition technique

The skiing technique is based on complex motor skills (cyclic and acyclic), different from the skills formed in other sports activities, requiring a high coordination in conditions of dynamic balance and a strength in resistance mode of the whole body, especially of the limbs lower. Toth Z.

(2009) has the opinion that additions can be made to the technique of alpine skiing by optimizing aspects of a mechanical, biomechanical, dynamic, psychophysiological, anatomic-physiological, neurophysiological, kinematic nature...

Competitive alpine skiing has five distinct events: slalom, giant slalom, super-giant slalom, downhill and alpine combined (slalom and downhill).

1.2. Slalom race

The principle of slalom is to ski, as fast as possible, through an imposed route, 55-75 men's gates, 40-60 women's, two legs, both the distance and their placement being established by FIS rules. According to the regulations, a slalom gate consists of two pennants, consecutive gates alternately blue, red. (width of 4 - 6 meters; distance between successive gates 6-13 meters (rule valid for all categories). Exceptions are competitions for categories U16–U14: between 7-11 meters. Combinations of gates, doubles and vertical wires must be positioned in straight line. The "banana" combination must be 12 - 18 m (for the U16 and U14 categories 15 meters) from the bypassing flag to the next bypassing flag. (FIS/ICR/2018)

1.3. Changes induced by the appearance of the sliding pennant.

The appearance of pennants/hinged/tilting gates brought important changes to the competition routes. Because of the reduced impact force, skiers were less concerned about the aftermath of pole contact. A pennant boxing style was later implemented (with numerous variations optimized by the grand champions) to achieve a tighter race line. Although the new design of the modern pennant significantly dissipates the shock of contact, additional protective, tibial, palmar, facial protective equipment is required. Correct interaction of the competitor with the directional gate has an important role in maintaining speed, obtaining the optimal race trajectory, preventing injuries implicitly the associated psychological factors. Depending on the type of lift, the mass of the skier and the method of approach, a substantial amount of kinetic energy (momentum) can be lost, which influences the achievement of a superior lap time. (Schwartz, Trost, & Wervey, 2004)

1.4. Problems of the initiation process of boxing articulated pennants

a. Moment of impact with the pennant - exaggerated twisting of the body towards the pennant, incorrect alignment, the skier is focused on hitting the gate not on correct sliding.

b. Lack of lean/side projection skills / poor fore/aft balance: minimal ski lean, inability to initiate turn over gate, weight dominance on outer side of turn arc, narrow glide base (reduced ski opening) to allow angulation Maxim

c. Fear: intimidated by contact with the flag, which induces a static, passive skiing manner (waiting for the gate)

1.5. Methodical indications

Pronounced edge bevel /adequate glide base/ski independence

- obtained by free skiing with an emphasis on independent work of the skis / separation
- flexed inside the foot (90% pressure on the outer ski)
- the legs must work together (windshield wiper principle)

Open routes / high vertical to train the early attack reflex

Contact with the pennant at calf level, ankles / knees / skis facing the new gate, upper body remains vertical

Effective stick positioningKeeping the head inside the turning arc (Ștefănescu 2019)

Slalom technique has changed dramatically in the last five years. The new short skis with large sidecuts allowed competitors to ski faster and cut trails more cleanly as they became more technical).

The horizontal gap of the gates has increased considerably, making the slalom more complex, this requires from the competitor a great lateral balance and lateral inclination (angulation). At the same time, modern equipment allows the simultaneous/independent use of the legs during all phases of the turn (both during the trigger and during the transition phase). The vertical and anteroposterior sway has greatly decreased in intensity. the pennant attack technique approached that used in GS. Understanding this technique and the correct approach to teaching it still plays an important (if not the most important) role in the training of slalom skiers. (Hirano, 2002))

Related to the technique of approaching the pennants, the questions arise which technique is faster, the transverse block (attacking the pennant with the outer arm) or the internal block (attack/contact with the inner arm.? …when the listed options are effective ? …at what age should children be introduced to the boxing technique? …What are the consequences of its premature introduction?

Cross-block is not always the best tactic for young competitors. The last competitive decade has confirmed that at the level of children's competitions the main concern must be sliding, approaching an optimal race trajectory and not boxing the pennant. (Hirano, 2002)

2. The purpose, hypothesis and tasks of the research

The purpose of the paper is to determine the extent to which the technical profile of children involved in performance alpine skiing can be developed (we are referring here to the optimization of the ability to approach the tipping pennant), by integrating the application circuits and the thematic game both in the off-season training (on land) as well as in snow training. The theoretical support, from the theoretical substantiation part, supports this approach in terms of information. At the same time, it aims to argue the need to diversify the means used in the sports training lesson, in order to increase its attractiveness, respectively its efficiency.

Summarizing, I want to demonstrate the fact that the optimization of the attack at the sliding pennant can be achieved under conditions of efficiency by using unconventional means and methods, including during the training period on land. These means refer to the large-scale integration during the training period on land of some operational structures based on the use of roller skates, roller skis.

2.1. Specific assumptions

– if new, interactive, innovative actuation systems (based on inline rollers, balance boards, applicative routes, games and relays) are introduced systematically and continuously in the training lesson, technical parameters specific to the pennant attack will improve;

– if it is practiced within the circuits (in a timed manner and permanently modified in terms of complexity), the quality of the strength is implicitly improved;
– if the exercises chosen for each component workshop of the circuit are diverse and attractive, students are more involved in movement activities;
– if the exercises selected for each workshop of the circuit are of interest to the students, they will approach an active and proactive behavior;
– if the circuits are organized against time, or in the form of a competition, the students' involvement in the activity will increase considerably, stimulating emulation;
– if practicing within the circuit involves working in teams, groups or pairs, collaborative relationships can be developed, helping to show the spirit of fair play.

2.2. Research objectives

a. Carrying out a conclusive experimental study, aimed at validating the working hypotheses;

b. The development and application of the operational training programs within the physical education lessons by including the non-conventional work methodology as methods dedicated to the optimization of the pennant attack at the mentioned work level;

c. The processing and interpretation of the results obtained through the experimental argumentation of the effectiveness of the application of specific training programs;

d. Validation of working hypotheses by applying research elements;

e. Dissemination of research results.

3. Organizing the research

In order to organize the intervention within the research program, we created specific circuits on in-line rollers (if we refer to the preparation on land), respectively on skis (on snow), in view of the aforementioned objective of increasing the performance capacity through optimization of the flag attack (considered to be effective in this approach). The content of the circuits respects the methodological provisions specific to age, gender and training level.

The testing includes two tests, one on dry land and one on snow, complying with the requirements of the F.I.S. regulation for the categories of children.. The slope on which the tests took place is located in Toplița, The following circuits were applied:

a. Circuit 1. / with inline rollers, on dry land

Skating in a straight line on horizontal ground over a distance of 10 meters, from the starting line to the starting line of the circuit, starting from the start, at the sound signal / whistle. (sticks help to start)

Completing a route consisting of 15 milestones positioned in a 5 m wide lane, spaced approximately 4 m apart (the milestones are similar to the official ones and positioned so that they tip over)

Skating in a straight line on horizontal ground for a distance of 10m to the finish line

Timing

b. Circuit 2./ with skis, on snow

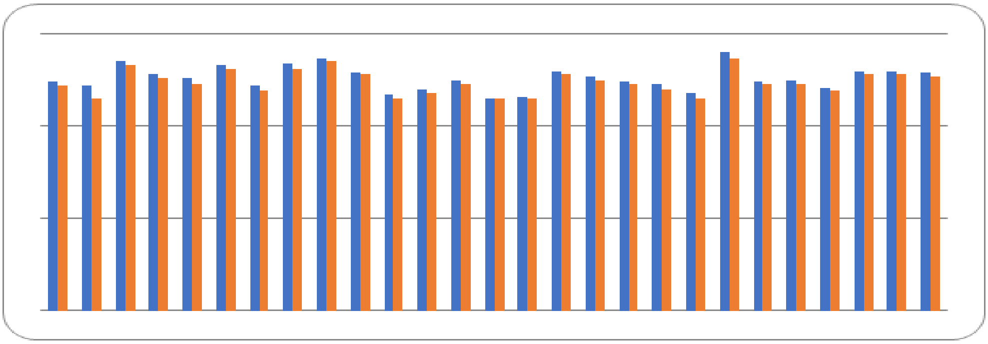
Start at the sound signal (with the triggering of the timing bar), traveling a pre-marked route of 20 rhythmically distributed gates (at a distance of 5m)

Timing: each athlete covered the proposed circuit twice, recording the best time.

During this initial testing period, we also performed anthropometric measurements - weight, height, span and length of the upper and lower limbs.

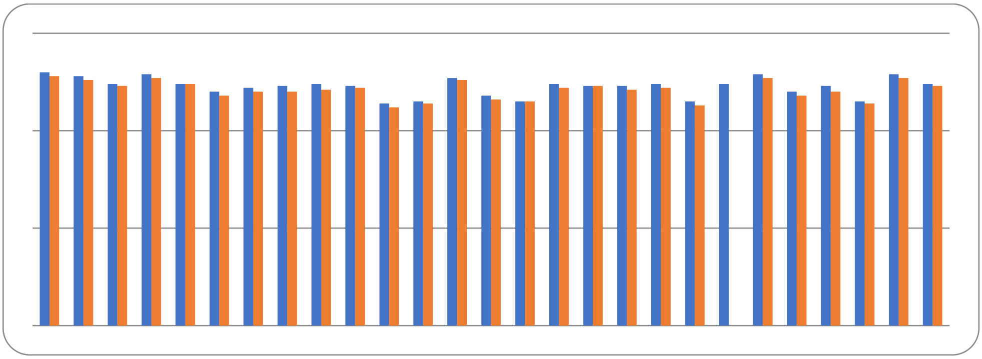
4. Results and interpretation

The results obtained from the two tests are presented graphically, using the comparison method.



Graph 1. Representation, comparative, final test - circuit 1

experimental
control



Graph 2. Representation, final test - circuit 2

5. Research limits

Although the experimental approach of the entire research took place according to the pre-established program, a series of limiting factors could be observed that qualitatively influenced the recorded results. These factors observed during the lessons, are:

A. Emotional, motivational factors:

– the lack of involvement of some children in the proposed activities;
– emotional, stressful states before the two tests;
– lack of motivation to carry out motor tasks;
– shyness;
– the fear of making a mistake, of not registering a poor result.

B. Factors regarding the students' state of health:
- colds, seasonal flu;
- muscle soreness.

C. Organizational and pedagogical factors:
- the organization of the initial and final tests required too much time, each student performing the circuits twice, at different times.

6. Conclusions

6.1. Conclusions regarding the general theme

The content of the training lesson must include updated contents according to practice trends, especially in children who are willing to try challenges, who are looking for the new, activities out of the classic patterns. The introduction of unconventional motor structures, associated with games, circuits...etc in the sports training lessons aimed at developing the technical parameters of 10-13 year old skiers, represents a qualitative plus, noting a special motor density. The mentioned age category presents the morphological and physiological peculiarities necessary to support these efforts, a fact that justifies their involvement in the running of the experiment. From discussions with them, we concluded that they prefer the organization of circuits because they bring more variety and place the training content outside the routine.

From the discussions with the experimental team, we found the general interest in optimizing the technical profile, respectively the attack to the pennant (an element that is essential in the current competition in alpine skiing).

6.2. Conclusions related to the research

The results recorded after the application of the two circuit variants confirm the hypothesis, even if the differences obtained between the two tests are not spectacular. However, we must consider a number of external variables as a limiting factor in conducting research

- the situation imposed by the health crisis that left its mark on sports training;

- modification of the competition calendar;
- changing the school year;
- restrictions related to access to training bases, ski slopes...etc.;
- reluctance registered among parents in relation to children's participation in training and competition.

It was found that:

- the level of technical ability (related to the efficiency of approaching the pennants) on land and snow was low during the initial tests, the students performing the proposed imposed motor structures with difficulty;
- the children were more concerned with completing the circuit than performing the specific movements correctly;
- most of the children from both experimental groups showed interest in the proposed tasks and got involved accordingly, realizing their participation in the pedagogical experiment;
- the students in the control group showed apathy tendencies in the activities with specific strength development exercises, considering them cumbersome and untraining;
- the students from the experimental group practiced these exercises in some circuits, most of the time against a timer or a competition with a maximum number of repetitions, being much more motivated;

Synthesizing and analyzing the obtained results, the following conclusions can be issued: the integration of in-line rollers and ski-rollers in training on land essentially optimizes the improvement of the pennant attack technique.

- crossblock and clearblock technigue can be learned, perfected by using roller skis during training.

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Digital Health and Physical Therapy

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Abstract

In recent years, digital health has become more incorporated in daily live in general, and in clinical practice in medicine.
Mobile health (mHealth) technologies are modernizing medicine by affording greater patient engagement, monitoring, outreach, and health-care delivery.
The cardiopulmonary fields have led the integration of mHealth into clinical practice and research. mHealth technologies in these areas include smartphone applications, wearable devices, and handheld devices, among others, and provide real-time monitoring of numerous important physiological measurements and other key parameters. Cardiac rehabilitation and secondary prevention are modalities that could greatly benefit from digital health integration, as current compliance and cardiac rehabilitation participation rates are low and optimisation is urgently required. This viewpoint offers a perspective on current use of digital health technologies in cardiac rehabilitation, heart failure and secondary prevention.
Telehealth refers to health care interactions that leverage telecommunication devices to provide medical care outside the traditional face-to-face, in-person medical encounter. Technology advances and research have expanded use of telehealth in health care delivery
Physical medicine and rehabilitation providers may use telehealth to deliver care to populations with neurologic and musculoskeletal conditions, commonly treated in both acute care and outpatient settings.
Telehealth physical therapy has the potential to transform many critical areas of care in musculoskeletal practice.

Keywords: *digital health; mobile health; telehealth; physical therapy; rehabilitation.*

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1. Introduction

Rapidly accelerating technological development in recent years has brought many new opportunities in the field of healthcare services.

The global challenge caused by the COVID-19 pandemic drives the world to innovative solutions. Just as in other industries, a demand appeared for digital, free from personal contact consultation in healthcare, alongside the classic doctor-patient relationship. This trend is expected to determine the future of healthcare in the long term (Vitéz-Durgula, 2022).

2. Digital health

Digital health is transforming medicine at a breathtaking pace: wearable biosensors, mobile health applications, and electronic health records have revolutionized data collection and processing, allowing low-cost, quick delivery of data from patients directly to healthcare providers, administrators, and analysts. Modern technologies have the potential to dramatically transform health care for the better. It may be tempting to rush in and invest or develop new products in the medtech space, but you can't just walk into digital health technology and expect it to work on the front lines of clinical care. The mistake many entrepreneurs make is thinking that their tools and experience will apply to healthcare as well, which is rarely the case (Spiegel, 2017).

Digital health refers to the use of information and communications technologies in medicine and other health professions to manage illnesses and health risks and to promote wellness. Digital health has a broad scope and includes the use of wearable devices, mobile health, telehealth, health information technology, and telemedicine (Ronquillo, 2022).

According to Australian Institute of Health and Welfare (2022) digital health has a broad scope, and includes:

- ✓ mobile health and applications (such as SMS reminders via mobile messaging, wellness apps, Medicare Online and COVID check-in apps);

- ✓ electronic prescribing;
- ✓ electronic health records (including My Health Record);
- ✓ telehealth and telemedicine;
- ✓ wearable devices (such as fitness trackers and monitors);
- ✓ robotics and artificial intelligence.

In recent years, digital health has become more incorporated in daily live in general, and in clinical practice in medicine. According to Falter et al. (2020) while electronic health records, smartphone health applications and smartwatches are already becoming part of routine practice, evolutions in the field of telemedicine, robotics and artificial intelligence indicate that our current methods are just the tip of the iceberg.

Digital health is becoming more integrated in daily medical practice. In cardiology, patient care is already moving from the hospital to the patients' homes, with large trials showing positive results in the field of telemonitoring via cardiac implantable electronic devices (CIEDs), monitoring of pulmonary artery pressure via implantable devices, telemonitoring via home-based non-invasive sensors, and screening for atrial fibrillation via smartphone and smartwatch technology. Cardiac rehabilitation and secondary prevention are modalities that could greatly benefit from digital health integration, as current compliance and cardiac rehabilitation participation rates are low and optimisation is urgently required. This viewpoint offers a perspective on current use of digital health technologies in cardiac rehabilitation, heart failure and secondary prevention (Falter, 2020).

3. Mobile Health

Mobile Health (mHealth) is defined by the World Health Organization as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices" (Kay, 2011). This definition has more recently expanded to include mobile applications ("apps"), social media, and location tracking technology to obtain data relevant to surveillance, diagnosis, and management of chronic diseases (Bostrom, 2020).

Use of mHealth-compatible devices has increased in recent years, and age and socioeconomic gaps of ownership are narrowing (MacKinnon, 2020).

Wearable mHealth technologies include smartwatches, handheld devices, and skin patches, among others. Approximately 25% of US adults use wearables at least once a month, driven by smartwatch popularity with young adults. About 45% of smartwatch owners use their smartwatch as an activity tracker, second only to messaging notifications (Liu, 2017). According to Steinhubl (2015) cited by MacKinnon (2020) reported physiological parameters measurable by wrist-worn watches include pulse, BP, heart rhythm, cardiac output, body temperature, respiratory rate, oxygen saturation, blood glucose, physical activity, sleep patterns, and stress level.

There are estimated to be more than 250 000 mHealth applications currently available to consumers, and many applications have been designed for surveillance and management of cardiovascular disease (CVD) (Bostrom, 2020).

Mobile health (mHealth) technologies are modernizing medicine by affording greater patient engagement, monitoring, outreach, and health-care delivery. The cardiopulmonary fields have led the integration of mHealth into clinical practice and research. mHealth technologies in these areas include smartphone applications, wearable devices, and handheld devices, among others, and provide real-time monitoring of numerous important physiological measurements and other key parameters(MacKinnon, 2020).

mHealth technologies have demonstrated superior accuracy of measuring physical activity compared with self-reporting, the latter of which routinely results in overestimation of activity. Beyond their monitoring capacities, mobile apps and wearables with personalized feedback have shown success in increasing daily steps and weekly minutes of moderate to vigorous physical activity. The mActive trial demonstrated an increase in daily steps with an activity tracking and personalized text messaging intervention, whereas no change in daily steps was observed in activity tracking alone(MacKinnon, 2020).

CVD, perhaps more than other disease domains, lends itself to synchronization with mHealth technologies, as many metrics relevant to disease management (heart rate, blood pressure, weight, rhythm analysis) are dynamic and quantifiable. To date, mHealth has been used to facilitate recovery after acute myocardial infarction (AMI), monitor arrhythmias, and to track ambulatory blood pressures. Applications have also been created to encourage medication adherence, facilitate social support, and augment the positive effects of cardiac rehabilitation (CR) (Bostrom, 2020).

Some apps include social networks with peer comparison and connections to social media. Apps with social feedback were beneficial in mothers and older adults whereas no effect was observed in young adult men. Mothers also reported significant reductions in depression scores, presumed to be the result of increased physical activity. mHealth interventions potentially may improve multiple cardiovascular risk factors (CVRFs), as illustrated by the mActive-Smoke study finding an inverse relationship between smoking urge scoring and steps taken 30 to 120 min prior to the urge reporting (MacKinnon, 2020).

mHealth has enabled numerous avenues for remote management of CVD. Older adults, with the highest burden of disease, may stand to benefit the most. mHealth-CR represents a particularly attractive area given traditional barriers to facility-based CR. Small studies have demonstrated potential benefits to mHealth-CR, but older adults have been under-represented, and further research will help to elucidate engagement and outcomes among older adults who are prescribed this intervention. Despite potential barriers to mHealth adoption in older populations, there is also evidence that older patients may be willing to adopt these technologies (Bostrom, 2019).

A significant utility of mHealth is the delivery of accessible cardiac and pulmonary rehabilitation and secondary prevention programs (CR/SPPs) to people otherwise not reached by traditional CR/SPPs. The inability to drive is one of the strongest predictors of nonparticipation in CR/SPPs, suggesting a potential role for remote interventions. When compared with traditional CR/SPPs, home-centered mHealth CR/SPPs demonstrated increased participation and completion rates. Improved health outcomes of functional capacity, weight loss, and mental health were also observed. Cardiac and pulmonary rehabilitation and secondary prevention programs (CR/SPPs) can modify cardiovascular risk factors and improve exercise capacity. Furthermore, participation in CR/SPPs reduces all-cause mortality after percutaneous coronary interventions by 45% to 47% (MacKinnon, 2020).

According to MacKinnon et al. (2020) mHealth interventions have shown utility in the prevention, monitoring, and management of atrial fibrillation, heart failure, and myocardial infarction. With the growing prevalence of cardiopulmonary disease, mHealth technologies may become a more essential element of care within and outside of traditional health-care settings.

According to Bostrom et al (2020) some studies have shown that mHealth interventions may be cost effective in the setting of heart failure (HF) and cardiovascular rehabilitation(CR).

mHealth may prove to be a means of increasing patient engagement, and its community outreach facilitates more equitable and sustainable care. However, access to mHealth, unless supplemented financially, may limit its overall utility in the most vulnerable populations (MacKinnon, 2020).

According to McCool et al (2022) we are undoubtedly in the wake of one of the most vociferous shifts in health care but one where the benefits are likely to reach primarily the middle and higher socioeconomic groups unless we deliberately focus our efforts on low- and middle-income countries (LMICs).

4. Telehealth

Increasingly we are seeing media reports and company announcements about the use of digital platforms and technologies to provide physical therapy. The advancement of care delivery models that embrace technology has great potential to increase consumer access to care, promote consistent evidence-based treatment, and reduce unnecessary, costly, or riskier treatment (Roger, 2022).

Telehealth refers to health care interactions that leverage telecommunication devices to provide medical care outside the traditional face-to-face, in-person medical encounter. Technology advances and research have expanded use of telehealth in health care delivery (Tenforde, 2017).

The World Health Organization defines telehealth as the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries; for research and evaluation; and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities. The American Physical Therapy Association (APTA) defines telehealth as the use of secure electronic communications to provide and deliver a host of health-related information and health care services, including but not limited to physical therapy–related information and services for patients and clients(Lee, 2018).

Internationally, physical therapists utilize telerehabilitation as the common term for telehealth applications. For example, the Australian Physiotherapy Association's position statement2 describes the provision of rehabilitation across the spectrum of acute, subacute, and community settings at a distance, using telecommunication technology to deliver real-time audio and video conferencing between providers and patients as synchronous telehealth. Other telehealth applications include secure electronic transmission of clinical information and medical data, described as asynchronous or store-and-forward telehealth. Telehealth physical therapy has the potential to transform many critical areas of care in musculoskeletal practice (Lee, 2018).

Physical medicine and rehabilitation providers may use telehealth to deliver care to populations with neurologic and musculoskeletal conditions, commonly treated in both acute care and outpatient settings. Patients with impaired mobility and those living in locations with reduced access to care may particularly benefit. Video-teleconferencing has been shown to be effective for management of burn patients during acute rehabilitation, including reduced health care use expenses and less disruptions to care. Telehealth can facilitate developing interprofessional care plans. Patients with neurologic conditions including stroke, spinal cord injury, traumatic brain injury, and amyotrophic lateral sclerosis may use telehealth to monitor symptoms and response to treatment. Telehealth also may facilitate occupational and physical therapy programs as well as improve weight management and skin care in patients with chronic conditions. Other applications include imaging review in sports medicine, symptom management and counseling in concussion, traumatic brain injury, and pain management programs. Limitations of telehealth include barriers in establishing relationship between medical provider and patient, ability to perform limited physical examination, and differences in payment models and liability coverage (Tenforde, 2017).

Russell and colleagues (2011) reported high patient satisfaction with a 6-week telerehabilitation intervention compared to usual care in outpatients after total knee arthroplasty in Australia.

Many telehealth applications currently available to physical therapist, for example: Goniometer Pro, Physitrack, et al.

Digital therapeutic company DarioHealth is launching a digital physical therapy and musculoskeletal (MSK) care platform dubbed Dario Move. Dario Move includes a biofeedback sensor, real-time feedback and support from physical therapists and coaches, and personalized exercise programs designed by therapists. The new product comes after Dario acquired MSK health company Upright Technologies. The deal was originally announced in January 2021 (Olsen, 2021).

According to Konstantin Mehl: "Kaia Health is providing a proven MSK and COPD solution combining computer vision and human care to achieve better outcomes," said Kaia Health CEO, President, and Founder. Its virtual physical therapy provides chronic disease management technology to enable real-time exercise feedback that has been third-party validated for its accuracy (Mageit, 2021).

Omada's latest MSK tech empowers physical therapists to conduct remote appointments. Chronic care management company Omada Health is rolling out a new tool that uses computer vision technology to help physical therapists virtually measure a patient's movement and range of motion. The new technology will be integrated into Omada's musculoskeletal (MSK) services and will be able to provide therapists and patients with a set of longitudinal data (Lovett, 2021).

SWORD Health provides employer-based virtual physical therapy with a focus on musculoskeletal disorders.The platform matches patients with a licensed physical therapist who creates personalized programs for each member. During sessions, patients wear motion sensors that wirelessly send information to the physical therapist, who can provide real-time feedback on the patient's performance. After each session, the sensors share patient data with the physical therapist so they can analyze the metrics and make adjustments as needed (Hackett, 2021).

The effectiveness and feasibility of telerehabilitation was also seen in patients with various neurological disorders, with results showing significant improvements in patients affected by amyotrophic lateral sclerosis, multiple sclerosis, Rett syndrome, acquired brain injury and other neurological disabilities. Remote rehabilitation indeed made it possible to reach patients unable to travel and to overcome the need for recurrent outpatiens visits. Lastly, telerehabilitation also appeared to be a feasible, effective and generally wellaccepted intervention in patients with a variety of other conditions, including orthopedic complaints, vestibular dysfunction, fibromyalgia, spinal disorders, stroke, oedema, as well as pulmonary, oncological, overweight and obese patients. Where appropriate, the implementation of telerehabilitation in clinical practice could therefore be considered an alternative or complementary option to traditional in-person care (Brigo, 2022).

5. Conclusion

Aided by digital technology, a future could be realised in which we are able to offer high-quality, affordable, personalised healthcare in a patient-centred way (Falter, 2020).

Telerehabilitation is now a mainstay in health care delivery, with recent trends pointed to continued expansion in the future. Physical therapy (PT) being provided via telehealth, also known as virtual PT, has been demonstrated to provide functional improvements and satisfaction for the consumer and provider, and is applicable in various physical therapy treatment diagnostic areas. Research and technology enhancements will continue to offer new and innovative means to provide physical therapy (Havran, 2021).

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The Importance of Feedback in Improving Freestyle Swimming Performance in Children

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Abstract
Increasing the sports longevity of children and juniors is considered to be the "supreme goal" in the first stage of their training, with the aim of increasing the efficiency of the activity, which is desired by all specialists.
Following the studies carried out by the specialists in the field, it was found that in order to achieve remarkable results in higher age categories, respectively, youth and seniors, the selection for swimming must be lowered to the age of preschoolers, a fact hat ensures an optimal training period.
Considering the complexity and accelerated pace of the learning process among children, we approached this theme with the aim of capitalizing on the visual, auditory, kinesthetic feedback in learning by monitoring the technical executions of each subject to research following the application of an own strategy of learning and strengthening the freestyle stroke (crawl) in swimming.
Feedback is the way of verbal and/or non-verbal communication of a person or a group regarding the behavior and the way it can affect us. At the same time, it plays an important role in identifying behaviors that can be followed and carried out, taking into account two necessary aspects: on the one hand, the positive effects produced, and on the other hand, the modification and change of those behaviors depending on the negative impact which he exercises.
By consolidating the technical executions, as well as by performing some exercises on medium and long distances, performed with medium intensity, but also short sprints (15-25m) with the aim of correcting the technique under conditions of sustained effort, progress has been recorded to -4.61 sec. between initial and final testing.

Keywords: *swimming, feedback, children, freestyle technique, progress.*

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1. Introduction

Compared to the description of other areas, the sphere of knowledge and child development is constantly expanding. If over time a great emphasis was placed on the discovery of certain knowledge in areas such as physiology, biochemistry, anatomy, medicine, human behavior sciences, nowadays scientists have turned their attention to the discovery of the child and his role in society. One of the reasons why the issue of childhood and child development did not concern the sphere of interest of specialists is the lack of information.

Nowadays, if we talk about swimming, we refer to a sport with a fascinating evolution. A sport that, in order to be successful, in addition to talent, requires strong doses of perseverance, will, motivation and determination. Swimming has always occupied a special place among the sports branches, due to the spectacle it offers, due to the competition that is constantly growing, where new records are being recorded, more and more frequently, in national and international competitions.

Following the studies carried out by the specialists in the field, it was found that in order to achieve remarkable results in higher age categories, respectively, youth and seniors, the selection for swimming must be lowered to the age of preschoolers, a fact that ensures an optimal training period.

As Alexe (1993) states, for the achievement of the above-mentioned tasks, between the training of children, juniors and seniors, the need for a close connection, continuity and organic interdependence appears more and more obvious. The selection of a preschooler, followed by the growth and development of a junior champion, and finally, the transformation into a true European, world-class swimmer, constitutes a remarkable work of creation, an entire instructive-educational process, which is based on respecting the particularities of age and gender, of the morphological, functional and psychological particularities of the organism which is growing.

Feedback is a way of evaluating the response of others following our actions and words. When we enter in a new environment, interacting with new people, we rely on the feedback that is created between us and others to find out what works and what doesn't. Regarding the transmission of information, by recording the feedback of each child, we understand the answers that he transmits following the instruction provided.

The freestyle stroke, or crawl movement, occupies an important place during swimming training. It is also the fastest stroke in swimming events, thus generating the most research.

2. Topic addressed

As the studies about the child have gained momentum, there is an evolution in the manner of its growth and development, an improved attitude of society regarding the birth of children and raising them, as well as the importance of their place both in the family and in society.

From the study of the specialized literature, regarding the development of the child, it emerges, almost unanimously, the idea according to which the main starting point of everything that the child learns in the first years of life and, then, one of the important reference points for "learning to become a durable and transferable one, it starts from the child's body and emotions" (Gravel S., Tremblay J., 2004).

Learning by discovering his own body, the daily bodily experiences that the child goes through lead to mastering his own body and to its desirable and constructive use, in the most diverse situations. Gradually, he will move on to the discovery of the environment around him: physical, in the first instance, then, affective and, finally, social. (Piaget J., Inhelder B. 2005) This evolutionary process will constitute the foundation of his psychic development (affective and intellectual).

Nowadays, if we talk about swimming, we refer to a sport with a fascinating evolution. A sport in which, in order to be successful, in addition to talent, strong doses of perseverance, will, motivation and determination are needed. Swimming has always occupied a special place among the sports branches, due to the spectacle it offers, due to the competition that is constantly growing, where new records are being recorded, more and more frequently, in national and international competitions.

In swimming, as sport, for example, largely under the influence of the Australian and American experience from the 1950s, the idea crystallized according to which training in this sports branch should be started at the age of 6-8 (Platonov, 2015, p. 230).

It is known that a child is not a miniature adult, therefore, it needs to be treated differently in the training process (Hahn E., 1996). Thus, it is necessary for the coach-teacher to acquire in-depth knowledge about each stage of the child's development and growth, with the rules specific to the particularities of age. In children, the need for movement is, in fact, a necessity for physical, mental and motor development, and this is manifested by their desire to swim, jump, slide, throw themselves, either spontaneously or organized.

Swimming tones the muscles and improves the functions of the nervous system, decreases the feeling of heaviness of the body, regulates breathing movements and heartbeats, relaxes and combats muscle contractions (Tanaka H., 2009), which means that there is no pain in the execution of the movements, to be done easily, accelerates energy metabolism and activates venous circulation in the limbs.

Although there are numerous studies that mention the optimal age to start swimming, due to the requirements and the accelerated pace of completing the initial stage, which is constantly changing, coaches want to achieve notable performances from these young ages, a fact that demonstrates that many among the reactions, the responses of the child, who is in full growth and development process, are not taken into account. Thus, we proposed recording the results following the initial and final testing of the subjects, performing their comparative analysis and tracking whether or not there is progress from a statistical point of view.

In order to become a successful swimmer, it is recommended to work gradually, step by step. According to the statement of Bompa (2003), working carefully in all echelons of training over a period of 7-9 years of systematic training, well programmed starting from the childhood years, from 6-7 years, related to the observance of biological requirements, psycho-pedagogical, the possibility is created that at the above-mentioned ages, against the background of a solid multilateral physical training, superior health indices and a degree of technical mastery, to reach world performances, some incredibly achieved a few years ago.

Regarding the transmission of information, by recording the feedback of each child, we understand the answer that he transmits following the instruction provided. We will follow and record the subjects' feedback following the information received, in the role of receivers.

Feedback is the domain of verbal and/or non-verbal communication of a person or a group in terms of behavior and how it cannot affect (Tulgan B., 1999). Studies show that it contains a perceptual component (what I observe in the other's behavior) and an emotional component (the feelings and experiences caused by the observed behavior). At the same time, it plays an important role in detecting behaviors that can be followed and carried out, taking into account two necessary aspects: on the one hand, positive effects produced, and on the other hand, the modification and change of those behaviors depending on the negative impact which he exercises.

A careful reflection on this topic is brought by Zeus and Skiffington (2000). They define feedback as "what we do when we give our opinion or when we evaluate someone's behavior or performance. It is any communication that provides information to another person about our perception of them and how their behavior affects us.".

Giannousi, Mountaki, and Kioumourtzoglou (2017) investigated the effects of different types of feedback on the performance and learning of the freestyle technique at the novice level. They concluded that the combination of visual and auditory feedback (audio-feedback), and more specifically the self-modeling, observational method, can be the most effective way to learn new skills and also, to improve overall performance.

As stated by Barbosa et al. (2010), the biophysical determinants of swimming performance represent one of the most attractive topics in swimming science.

According to McLeod (2010), even a strong, well-designed house will eventually collapse if the foundation is weak. In other words, a solid technical foundation created from the first years of activity in the pool, from childhood, ensures the support of future performance among cadets, juniors and seniors. Increasing the sporting longevity of children and juniors is considered to be the ultimate objective in the first stage of their training, with the aim of increasing the efficiency of the activity, deliberately pursued by all specialists.

The crawl, or free movement, occupies an important place during swimming training. It is also the fastest procedure in swimming events, thus generating the most research.

When the hand enters the water, it is followed by its joint and the elbow, the arm being extended in the initial position of the propulsive phase (Figure 1). The upward rotation of the shoulder blade allows the swimmer to adopt an elongated position in the water. From this phase, the first part of the propulsive phase begins with the arm entering the water.

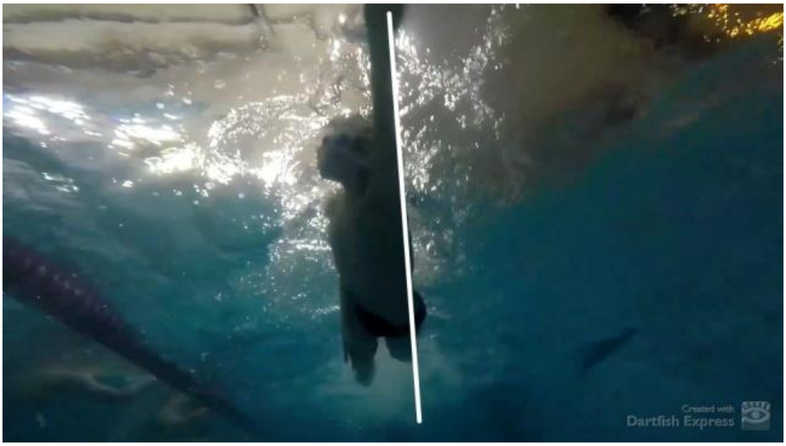

Figure 1. The body position on the water

The most important, even fundamental, component in swimming, valid for all procedures, is the body position on the water (streamline). This has the role of considerably reducing the frictional force through an efficient sliding at the water level, being determined by two components:

a) head position – the head represents the segment that determines the position of the whole body. The gaze is directed forward, down. If the position of the head is too high on the water, it would mean changing the position of the feet far below the water level, which would lead to a forward movement with a high degree of difficulty (Figure 2).

Figure 2. Incorrect head position

Figure 3. Correct head position

b) hip position – is interconnected with head position because one leads to the other. So by maintaining a correct head position, in alignment with the spine and hips, there will be no slowness or feeling of weight on the water.

The next element is the water capture phase. This includes the entry of the hand and fingers into the water as the first element in the catching phase. Thus, the hand pierces the water with the middle finger, 12-18 cm away from the shoulder, forming an angle of 45°, followed by the extension of the arm into the water, at which point the chest begins to open.

At the elbow, the flexors begin to contract at the beginning of the catch phase, gradually bringing the elbow from full extension to a flexed position of approximately 30°. The most important part is the EVF (Early Vertical Forearm, in translation). This EVF means that, as soon as the fingertips pierce the water, they follow their lead to the bottom of the pool, during which the forearm becomes as vertical as possible, so that the palm (hand) has the role of a shovel. Thus, the third element of the propulsive phase is traction, or pushing, which involves not only the hand, but also the entire forearm. Once traction is initiated, the propulsion phase follows which will pull the body forward, while the body rotation phase occurs.

All these elements constitute the aquatic path of the arms, propulsive, from the overall structure of the action of the arms. In addition to the water path, the structure of the stroke also includes an aerial path, the return, which has the role of preparing a new movement cycle.

The role of the arms is to propel the swimmer's body with a predominantly lateral, vertical movement, the propulsion being thus dominated by the bearing force and not by the resistant one. (Vasile L., Balan V., 2021).

When a water path and an air path are made with each arm, it means that one arm cycle has been completed. Thus, in freestyle the arms work alternately cyclically, in the idea that when one arm rows, the other returns through the air.

Footwork, also called kicks or beats, facilitates propulsion through the water by maintaining body balance and lateral alignment, allowing the athlete to rise above the water.

Just like the movements of the arms, the kick movements can be divided into the propulsive (descending) phase, with the role of lifting, and the passive (ascending) phase, with the role of overcoming the inertia of the downward blow, by changing the direction of movement upwards, with minimal costs energy; they are also called "downbeat", respectively "upbeat".

In the specialized literature, the coordination of six kicks per arm cycle can be found, but recent studies show that this type of coordination is only "a myth that should have been dispelled with the first underwater footage". In this sense, the researchers believe that the actual movement is composed of four strokes per arm cycle, the main role of the legs being to ensure the balance of the body and not propulsion.

Hattie and Timperley (2007) noted that feedback is one of the most powerful influences on learning and acquisition, but this impact can be either positive or negative. Its importance is frequently mentioned in articles on learning and teaching, but surprisingly, there are few recent studies that have systematically investigated its meaning. Through their study, the authors showed that although feedback is among the major influences, the type of feedback and how it is delivered can be extremely effective in the training process.

Our work aims to detect these behaviors - responses of the subjects subjected to research following the stimuli applied in the process of learning and assimilation of technical executions in the free process. The research is based on the circular exchange of information (visual, auditory, sensory, kinesthetic) between at least two parties: the coach - the subjects.

In other words, we can think of feedback as a way of evaluating the response of others following our actions and words. When we enter in a new environment, interacting with new people, we rely on the feedback that is created between us and others to find out what works and what doesn't. Regarding the transmission of information, by recording the feedback of each child, we understand the answers that he transmits following the instruction provided.

According to Mooney et al. (2016), methods based on video footage are the most frequently used, highlighting a percentage of 70% among coaches who use this method in their training plans, the attention being focused on the qualitative part and not on the quantitative one. Barriers to the widespread use of quantitative biomechanical analysis in elite swimming settings were explored. Constraints include time, cost and resource availability, while other circumstances such as sources of swimming performance information, analysis and control of service delivery are discussed, with particular emphasis on video-based methods and emerging sensor-based technologies.

2.1. Study Design and Subjects

Considering the complexity and accelerated pace of the learning process among children, we approached this theme with the aim of capitalizing on the visual, auditory, kinesthetic feedback in learning by monitoring the technical executions of each subject subject to research following the application of an own strategy of learning and consolidating the technical procedures for swimming.

2.2. Research subjects

We brought together the members of the *"perspective group"* made up of 30 children who show skills for practicing swimming. *(the group was formed on the basis of the results obtained by participating in a contest/trial based on the establishment of criteria for access/selection in the respective group).*

2.3. Research methods

Scientific documentation, observation, experiment, statistical-mathematical methods.

The present study covered a period of four months of training. Thus, 16 weeks of training were completed, structured in 48 specific training sessions, with a duration of 1 hour 30 minutes each, which adds up to a total of 72 hours of actual training (in the water), carried out in three weekly sessions, on Tuesdays, Thursdays and Fridays, between 15:30 and 17:00.

During this stage, we carried out two checks, initial and final. After completing the initial verification, from January, we introduced the weekly viewing of videos focused on the technical execution of the movements in the free process. More precisely, we allocated 30 minutes to Friday, during which the subjects were subjected to the visualization of their own technical executions compared to the technical executions demonstrated by world-class swimmers. From a structural point of view, each week of the 16 training sessions corresponded to one element from the free technical procedure, in order to analyze the movements, tractions, body segments positions, entry and exit points of the upper limbs in and out of the water, leg movements . Thus, in addition to the 72 hours of specific training, in the water, we recorded a total of 8 hours allocated to visual images.

An integral part of the training of small athletes, table no. 1 describes a microcycle of their training process.

Table 1. Microcycle of their training process

Day	Exercices	Duration	Pause	Description	Observation
Tuesday	➢ Warm-up: 250m invers IM	5′		100m freestyle/75m breaststroke/50m backstroke/25m butterfly	
	➢ Technique : 20 x 25m Freestyle	20′	Pl. = 1′	#2: freestyle kick with arms stretched forward, hands resting on the water, without support, head in the water; #2: free kick with arms outstretched by the body, twisting the body with the shoulder above the water (6 kicks on each side); #2: 6 right-side free kick, 6 left-side free kick, 3 strong free strokes; #2: free kick holding the board under the water with right arm extended above water (out of water), lateral breathing after each 6 kick moves;	The exercise is performed with fins. Pay attention to the body position on the surface of the water during all exercises.

Day	Exercices	Duration	Pause	Description	Observation
				#2: the same exercise, the left arm keeps the board under the water, the right arm is held above it; #2: the left arm is fixed stretched on the water forward, only the right one works (emphasis on the trajectory of the arm underwater); #2: the same exercise, the right arm sits, the left arm works; #2: scoring the water in three areas: near the leg, in the armpit area (bending the elbow, raising the shoulder above the water) and above de head (at the point where the palm enters in the water for the catching phase); #2: freestyle with head above the water; #1: free with scraped fingers; #1: free with closed fist.	
	➢ Basic set: 10 x 50m Backstroke	15′	Pl. = 1′30	Descending #1 to #5	Aim to rotate the torso to allow each shoulder to rise above the water.
	➢ 16 x 25m	10-11′	P. = 15-20″	#25m underwater butterfly kick #25m breaststroke pull with butterfly kick	With fins.
	➢ Cool down: 150m swimming	3-4′		25m freestyle/25m backstroke	
Thursday	➢ Warm-up: 4 x 50m Backstroke	6′	Pl. = 1′30″	#1: 25m - 2x right arm + 2x left arm/25m backstroke #2: 25m slide one arm extended by the body, the other extended by the head, 6 kicks, switch.	
	200m backstroke kick	5′		#25m arms by the body, torso twist keeping the shoulder above the waterfor 6 kicks, switch / #25m arms overhead (streamline position)	
	2 x 25m Backstroke	2′	Pl. = 1′	Maximum speed.	Speed of execution, the movement of the arms and legs, as well as the recorded time track.

Day	Exercices	Duration	Pause	Description	Observation
Friday	➢ Basic set: 4 x (2 x 50m butterfly kick + 4 x 25m butterfly)	20′	Pl.50m = 1′ Pl.25m = 40′′	With fins. The butterfly kick are performed at a fast pace, emphasis on the force of the water stroke.	
	➢ 5 x 20′′ freestyle kick	2′40′′	P. = 20′′	It is performed in a vertical position with the palms above the water.	Body kept in a straight line.
	➢ Cool down: 500m înot	8′		#100m: 75m double backstroke/ 25m breaststroke pull with free kick #100m: 75m back/25m free	
	Viewing - analyzing the technical videos in the freestyle stroke	30′		• Head position; • breathing; • Propulsive phase); • Passive phase; • Body sliding.	
	➢ Warm-up: 10 x 50m	15′	Pl. = 1′30′′	#1: 50m free #2: 50m back	
	➢ Basic set: 8 x 25m freestyle pull	6′	Pl. = 45′′	#1: free with head above the water; #2: free with breathing at 3 strokes; #3: 12,5m maximum speed /12,5m moderate;	Torso rotation. Sliding on water. Arm
	8 x 25m freestyle kick	6′	Pl. = 45′′	#4: 12,5 moderate/12,5m maximum speed; #1 - #4: 12,5m maximum speed/ 12,5m moderate; #5 - #8: 12,5m moderate/12,5m maximum speed.	frequency. Maintaining an equal number of strokes throughout the exercise.
	➢ Cool down : 3 x 200m	12′	Pl. = 4′	150m Craul (50m controlled swim/ 50m constructed swim – from slow to fast/50m long strokes) + 50m double backstroke	The first and last 5m of the second 50m do not breathe.

At the end of this stage, we organized a test at the club level to test the subjects following the completed training period. For us, it was the final test in the research we carried out. As it emerged from the statistical results of the present study, we can note the registration of considerable progress in the results throughout the four months of training.

Table 2. Statistical description of the results obtained

	Mean	N	Std. Deviation	Std. Error Mean	Std. Error Mean	Mini-mum	Maxi-mum	Variance
Initial testing	**46.82**	**30**	**1.72**	**0.31**	**0.31**	**44.21**	**49.81**	**2.980**
Final Testing	**42.21**	**30**	**2.12**	**0.38**	**0.38**	**38.73**	**45.53**	**4.521**

This analysis involves a comparison between the initial time, I.T., of testing, and the end of the study (F.T.). Average results show improvements in terms of recorded times of 4.61sec. between the two tests (I.T.=46.82sec and F.T.=42.21sec), which means increasing efficiency and improving technique execution.

Table 3. Statistical correlations of the results in the 50m Freestyle

			Significance	
Pair 1	**N**	**Correlation**	**One-Sided p**	**Two-Sided p**
I.T. – F.T.	30	0.887	<0.001	<0.001

Table 3 indicates the extent to which the two tests are correlated. The differences between the two phases of testing are significant for the test in 50m Freestyle applied event, the coefficient of 0.887 indicating a significant strong correlation (sig.<0.001). The following table highlights the fact that both the one-sided significance level (one sided p) and the two-sided significance level (two sided p) indicate the existence of a significant difference between the two measurements (I.T. and F.T.), the value of the significance indicator being less than 0.001 for all variables.

Table 4. The T Test results in the 50m Free

	Paired Differences							Significance	
			Std. Error	95% Confidence Interval of the Difference					
	Mean	Std. Dev.	Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
I.T. – F.T.	4.60	0.99	0.18	4.23	4.97	25.36	29	<.001	<.001

The size of the effect, or its magnitude, was calculated using the *Cohen's d* value, whose interpretation is as follows: around 0.20 – the effect is low, 0.50 means the effect is medium and above 0.80 symbolizes a strong effect. The method shows the effectiveness of the training program in order to improve analyzed performances in the freestyle and the impact it produced on the children participating in the study.

Table 5. The effect size of training program

				Point	95% Confidence Interval	
			Standardizer[a]	Estimate	Lower	Upper
1	I.T. –	Cohen's d	0.99	4.63	3.38	5.86
	F.T.	Hedges' correction	1.02	4.51	3.3	5.71

The effect on the 50m Free trial is very strong (0.99), exceeding the value of 0.80 and demonstrating that, following the training program focused on improving technical training in relation with the provision of feedback, the children substantially improved their recorded results in the 50m Free event at the end of the four months.

The results in table 5. Demonstrate that our study had an impact on children's progress, the size of the effect being remarkable following the recorded times.

3. Discussion and Conclusion

Following the aspects followed in the specialized literature and presented in this report, it was found that in order to achieve remarkable results in higher age categories, respectively, youth and seniors, the selection for swimming must be lowered to the age of preschoolers, a fact that ensures an optimal period of training.

By consolidating the technical executions, as well as by performing some exercises on medium and long distances, performed with medium intensity, but also short sprints (15-25m) with the aim of correcting the technique under conditions of sustained effort, progress has been recorded to -4.61 sec. between initial and final testing.

Learning technical procedures requires a well-defined set of skills. According to the experts in the field, swimming is a sport in which, in order to succeed, it is necessary to combine the knowledge of several sciences: medicine, anatomy, biology, physics, chemistry.

In order to create a solid foundation, in which communication is at the top of the hierarchy and which, subsequently, generates a solid coach-athlete relationship, feedback must be provided by both parties.

The checks carried out during the January-April preparation stage, the recorded results, represent useful data for training that also allow the athletes to know their progress and to be able to relate to the objectives pursued; this test constitute the essential part of this research.

By means of the training model applied in the January - April period, the following progress was recorded:

- ✓ In the 50m freestyle test there was a progress of 4.61 seconds recorded at the end of the training stage. If initially, the group recorded an average of 46.82 seconds, at the final testing, the average was substantially improved, resulting in 42.21 seconds.

The proposed training plan contributed to the improvement of the children's results, the differences between the initial testing and the final testing being significant.

Because of these results, we can appreciate that following the involvement of feedback in the children's training program and its monitoring, considerable progress can be registered among children and, at the same time, solid foundations of a technical training that can ensure longevity can be established in performance activity.

Our study supports the idea that in order to achieve remarkable results in higher age categories, namely youth and seniors, the selection for swimming should be lowered to the age of preschoolers, which ensures an optimal training period. The complexity of this sport is given by its own characteristics, and its practice starting from the childhood years, from 6-7 years old, through a well-programmed process in relation to the observance of the biological, psycho-pedagogical requirements, creates the possibility that from the above-mentioned ages, against the background of a solid multilateral physical training, superior health indices and a degree of technical mastery, to reach world performances over time.

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Study Regarding the Importance of Patients Assessment with Static and Dynamic Balance Disorders Depending on the Topography of the Lesion

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Abstract

The purpose of this study is represented by the way in which the therapeutic approach of patients with vestibular syndrome can be improved as a result of the identification of some parameters related to the visual, somesthetic, vestibular, global and preferential scores, parameters reffers to static and dynamic balance.

We included in this reasearch a number of 37 subjects (11 male and 26 female), aged between 36 and 75, diagnosed with a form of of vestibular syndrome. They were divided into two groups; the first group consists in 20 subjects with peripheral vestibular syndrome (14 female and 6 male), while the second group was represented by 17 subjects with mixed vestibular syndrome (12 female and 5 male).

In order to realise functionally assessment, we used Synapsys posturograph, through which we collected data on somesthetic, visual, vestibular, preferential and global parameters, both in the anterior-posterior and in the mid-lateral axis and the results were subjected to statistical analysis, using the SPSS 20 program.

The results highlight the fact that the use of the Synapsys posturography equipment for patients with vestibular syndrome proves to be a valuable therapeutic measure, by accurately describing the balance parameters and, above all, by analyzing the patients' ability to use somatosensory, visual and vestibular informations in order to maintain balance in the anterior-posterior and mid-lateral axis.

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1. Introduction

The topicality of the theme results from the fact that body balance is an important component of health and the way of carrying out socio-professional activities and an adequate postural control is necessary to safely manage the way of doing daily activities. Balance deficits have been identified as important factors that increase the risk of falls and injuries in both children and adolescents and especially in the adult population (Kiss, Schedler & Muehlbauer, 2018). Patients diagnosed with vestibular syndrome may present an impairment of static and/or dynamic balance and their therapeutic behavior is extremely complex. Balance disorders due to dizziness or vestibular syndrome are a risk factor for falls and can have a significant impact on quality of life as they are common in the adult population (Murdin & Schidler, 2015).

At the same time, about 30% of people will suffer from rotational or postural vertigo at some point in their lives; the prevalence of this condition increases with age and is approximately two to three times more common in women than in men (Strupp, Dieterich & Brandt, 2013; Neuhauser, 2016). Vestibular syndrome represents a condition with a diverse etiology, which requires a thorough anamnesis and a complex evaluation, so that the collected data can lead to the initiation of a treatment adapted to the patient's needs and with increased efficiency.

In Romania, the studies that focused on patients diagnosed with vestibular syndrome are limited, especially from the point of view of describing a therapeutic intervention plan aimed at functional rehabilitation and allowing the improvement of static and dynamic balance parameters. In a 2014 study conducted in our country were included a number of 245 romanian patients diagnosed with recurrent peripheral vestibular syndrome, treated with betahistine 48 mg/day for 3 months; sustained and statistically significant improvements in multiple observational study indices were found in patients with this condition and the safety and tolerability of the treatment was good in this group, with only one patient reporting adverse reactions (Bajenaru et al., 2014). In another report from Romania regarding the management of unilateral peripheral vestibular disorders, it was demonstrated that early treatment with corticosteroids associated with electrolytes, antiemetic and vasodilator drugs led to recovery of vestibular function without differences between types of peripheral vestibular dysfunction and it was obtained a complete recovery of vestibular and acoustic dysfunction in cases treated with intratympanic injection (Petri, Chirila, Bolboaca & Cosgarea, 2015).

We can state according to these two reference studies carried out in Romania that patients diagnosed with vertigo follow, in particular, a drug treatment, which proves effective in terms of symptom relief, but still the data related to the functional rehabilitation programs to be performed under the guidance of a physiotherapist are limited; we believe that it is essential that this patients must follow such a rehabilitation program, which is focused on achieving the objective of socio-professional reintegration and on improving the vestibular deficit as much as possible.

In this study, we aim to identify effective assessment methods for patients diagnosed with vestibular syndrome who present static and dynamic balance disorders and to differentiate them according to the topography of the lesion. This approach will conduct our research in order to describe a vestibular rehabilitation protocol, which will materialize in a best practice guide for clinicians.

2. Purpose, objectives, hypotheses

The **purpose** of this research is represented by the way in which the therapeutic approach of patients with vestibular syndrome can be improved as a result of the identification of some parameters related to the visual, somesthetic, vestibular, global and preferential scores, parameters aimed at static and dynamic balance.

Among the **objectives** of the study are the identification of innovative technological equipment used in vestibular rehabilitation, the selection of research subjects or the collection, analysis and interpretation the results, including statistical analysis.

Two **hypotheses** were formulated; the first hypothesis referred to the fact that the assessment of patients with vestibular syndrome will allow the identification of distinct elements related to balance parameters, depending on the location of the lesion and the second hypothesis assumed the identification of an association between the results obtained by patients with vestibular syndrome in terms of someesthetic, visual, vestibular, preferential and global scores.

3. Methods

The period of this study was one year, it started in September 2021 and was completed in August 2022. The research site was represented by the Rehabilitation Hospital of Iasi, the Audiology and Vestibulology Compartment.

We included in this study a number of thirty-seven subjects (male=11 and female=26), aged between 36 and 75 years.

The subjects were diagnosed with a form of vestibular syndrome and were divided into two groups: in group 1 were included a number of twenty subjects with peripheral vestibular syndrome (fourteen female and six male) and in group 2 were included seventeen subjects with mixed vestibular syndrome (twelve female and five male).

Subjects' inclusion criteria were their diagnosis, treatment approach to the condition, consent to evaluation with the Synapsys posturographic device and consent to participate in the study.

Exclusion criteria were the existence of any other pathology, which could have been responsible for influencing the results (neurological conditions, ophthalmological conditions or orthopedic conditions).

In order to functionally evaluate the subjects it was used the Synapsys posturograph, through which data were collected on somesthetic, visual, vestibular, preferential and global parameters, both in the antero-posterior and in the mid-lateral axis. The evaluation involved the subjects being positioned on the platform in orthostatic position, with arms held by the body, under six conditions (which were related to the static or unstable platform as well as changes in the visual stimulus), while sensors calibrated to the software recorded data of the oscillations of the center of gravity on the anterior-posterior and mid-lateral axis.

The software of Synapsys allows to obtain numerical scores related to reference values, which are expressed as follows:

- the somesthetic score - obtaining the score for the somesthetic assessment required reporting the results of condition 2 with the results of condition 1, a report that makes it possible to eliminate visual information and not stimulate the vestibular one, as well as the subject's ability to use somatosensory information;
- the visual score- involves the comparison of condition 4 with condition 1 and highlights the subject's ability to use the visual analyzer, as somesthetic information is eliminated due to the unstable platform and the visual analyzer is responsible for maintaining balance, while the vestibular information is non-existent;
- the vestibular score- is quantified following the reporting of condition 5 to condition 1, so the somesthetic information is eliminated by moving from a stable base to an unstable one, and the visual one is eliminated due to the evaluation position with closed eyes;
- the preferential score- involves reporting conditions 3 and 6 to conditions 2 and 5 and refers to the subject's ability to ignore erroneous visual information (specific to conditions 3 and 6) in order to maintain balance;
- the global score - sums up the results from all six assessment conditions and represents a general assessment that allows highlighting the subject's ability to use all the information necessary to maintain balance.

4. Results

The analysis of the results is illustrated by means of the graphic method, with a series of graphic representations that allow conclusively the presentation of the data collected. At the same time, the statistical analysis program SPSS 20.0 was used, for highlight some statistically relevant results.

In order to highlight the role of balance compensation mechanisms in the case of subjects with peripheral and mixed vestibular syndrome, we performed graphic representations, through which we presented the results of subjects compared to the reference values (expressed by Figures 1 and 2), but and the Independent t test, through which we highlighted whether the average values of the two groups show statistically significant differences, expressed in Table 1, thus also testing the first hypothesis.

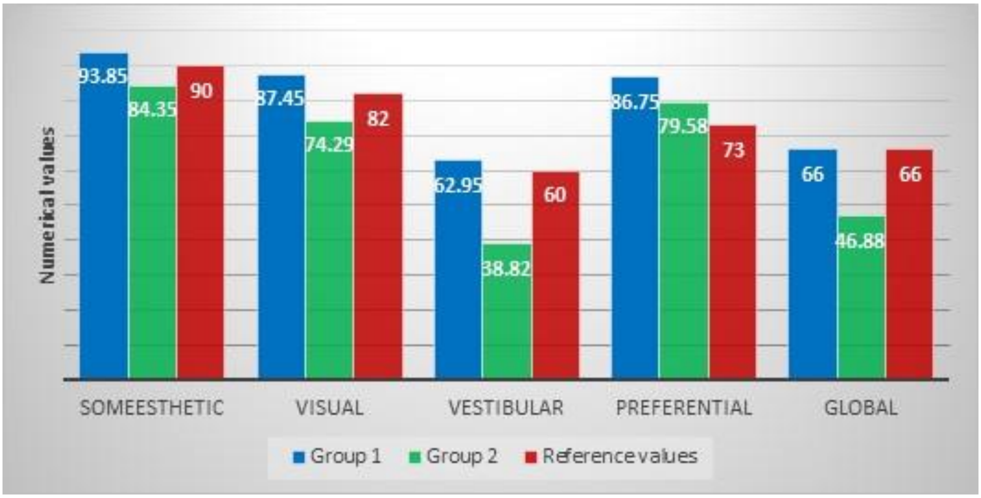

Figure 1. Average results of the two groups in the assessment of balance on the anterior-posterior axis

In Figure 1 we can see the average results of the two groups regarding the assessment of balance in the antero-posterior plane and superior results are found for subjects with peripheral vestibular syndrome, results that are close to the reference values, while subjects with mixed vestibular syndrome shows results below the reference values for most parameters, except for the preferential one.

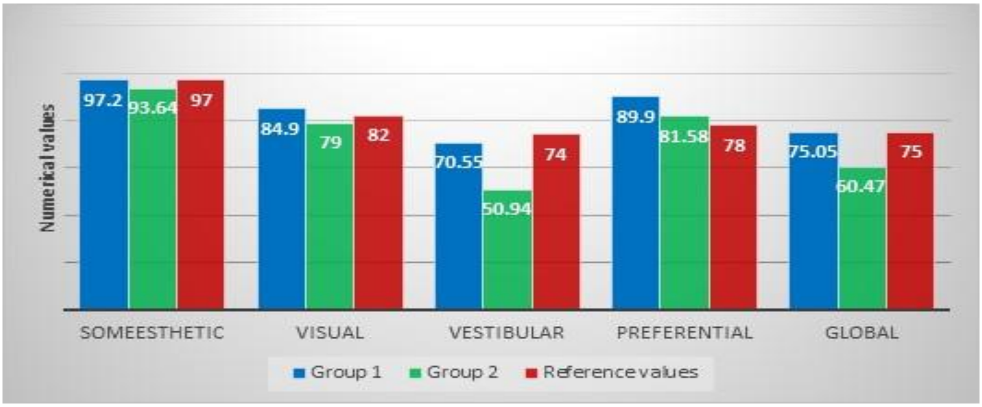

Figure 2. Average results of the two groups in the assessment of balance on the medio-lateral axis

According to Figure 2, we can see the results of the two groups regarding the evaluation of the balance in the mid-lateral plane and superior results are found for subjects with peripheral vestibular syndrome, results that are close to the reference values, with only one situation in which the value is lower than the value of reference (vestibular parameter), while subjects with mixed vestibular syndrome show results below the reference values for most parameters, except for the preferential one.

Table 1. Independent t-test to evaluate the balance between the two groups, according to the location of the lesion

PARAMETERS	AP AXIS	ML AXIS
SOMEESTHETIC	p=.005	p=.014
VISUAL	p=.009	p=.302
VESTIBULAR	p=.003	p=.027
PREFERENTIAL	p=.184	p=.048
GLOBAL	p=.000	p=.002

Legend: AP axis=anterior-posterior axis; ML axis=mid-lateral axis.

The analysis of Table 1 and Figures 1 and 2 shows that the average values of the two groups show statistically significant differences in the case of most balance parameters ($p<0.05$), except for the preferential one ($p=0.184$), which means that we found a superior efficiency of compensation mechanisms of balance in the anterior-posterior axis for subjects with peripheral syndrome; the average values of the groups show statistically significant differences in most balance parameters ($p<0.05$), except for the visual one ($p=0.302$), which means that we found a better efficiency of balance compensation mechanisms in the mid-lateral axis are for subjects with peripheral syndrome; the fact that in the antero-posterior axis the average values do not show statistically significant differences of the preferential parameter ($p=0.184$) would suggest that both subjects (with peripheral and mixed vestibular syndrome) have a good ability to ignore of the erroneous visual stimulus; the fact that in the mid-lateral axis the mean values do not present statistically significant differences in the visual parameter ($p=0.302$) would suggest that both groups have a good ability to use the visual analyzer.

In order to test the second hypothesis, we performed the Pearson correlation, through which we highlighted if exist an interdependence relationship between the balance parameters (somesthetic, visual, vestibular, preferential and global) for each of the two groups, as well as whether it is established a relationship of interdependence between the balance parameters on the two axes (anterior-posterior and mid-lateral).

Table 2. Pearson's correlation for assessment of balance on the anterior-posterior axis

Correlations	Group 1	Group 2
Someesthetic-Visual	p=.01, r=.667	p=.675, r=110
Someesthetic -Vestibular	p=.018, r=.525	p=.001, r=.710
Someesthetic -Preferential	p=.932, r=-.020	p=.975, r=.008
Someesthetic -Global	p=.011, r=.553	p=.010, r=.607
Visual-Vestibular	p=.000, r=.878	p=.583, r=.143
Visual-Preferential	p=.043, r=.457	p=.137, r=.376
Visual-Global	p=.000, r=.915	p=.028, r=.532
Vestibular-Preferential	p=.121, r=359	p=.895, r=.-035
Vestibular-Global	p=.000, r=.924	p=.003, r=.681
Preferential=Global	p=.000, r=.614	p=.168, r=351

Table 2 shows the results of the Pearson correlation for the average values obtained by the two groups the assessment of balance on the anterior-posterior axis and we can describe the following aspects: group 1 recorded statistically significant (positive) correlations in most situations, with the exception of someesthetic-preferential, respectively vestibular-preferential parameters, which may suggest that in the case of subjects with peripheral vestibular syndrome we identify an interdependence relationship between balance parameters in the anterior-posterior axis, and somaesthetic, visual and vestibular information show similar changes after the onset of the condition; group 2 registered statistically significant (positive) correlations in isolated situations, predominating the correlations that are not statistically significant, which may suggest that in the case of subjects with mixed vestibular syndrome, the interdependence ratio between the balance parameters in the anterior-posterior axis is less significant and someesthetic, visual and vestibular information do not necessarily show linear changes after the onset of the condition; the fact that subjects with peripheral vestibular syndrome recorded statistically significant correlations in most situations and subjects with mixed vestibular syndrome predominantly recorded correlations that are not statistically significant could suggest that the efficiency of compensatory mechanisms (in order to maintain balance in the anterior-posterior axis) after the onset of the syndrome is different, depending on the topography of the lesion and it can be suggested that patients with mixed vestibular syndrome present a less efficient compensation process of the vestibular function, which could lead to a greater accentuation of balance disorders and functional deficits in the anterior-posterior axis.

Table 3. Pearson's correlation for the assessment of balance on the mid-lateral axis

Correlations	Group 1	Group 2
Someesthetic-Visual	**p=.001, r=.686**	**p=.643, r=-.121**
Someesthetic -Vestibular	**p=.000, r=.772**	**p=.198, r=.328**
Someesthetic -Preferential	**p=.291, r=.248**	**p=.527, r=-.165**
Someesthetic -Global	**p=.000, r=.781**	**p=.512, r=.171**
Visual-Vestibular	**p=.000, r=.911**	**p=.807, r=.064**
Visual-Preferential	**p=.016, r=.530**	**p=.049, r=.484**
Visual-Global	**p=.000, r=.947**	**p=.102, r=.410**
Vestibular-Preferential	**p=.043, r=.457**	**p=.304, r=-.265**
Vestibular-Global	**p=.000, r=.979**	**p=.000, r=.790**
Preferential=Global	**p=.018, r=.523**	**p=.559, r=.152**

Analyzing Table 3 allows the identification of the results of the Pearson correlation for the average values obtained by the two groups regarding the assessment of balance on the mid-lateral axis, namely: group 1 recorded statistically significant (positive) correlations in most situations, with the exception of the someesthetic –preferentially correlation, which may suggest that in the case of subjects with peripheral vestibular syndrome we identify an interdependence relationship between the balance parameters in the mid-lateral axis and somesthetic, visual and vestibular information show similar changes after the onset of the condition; group 2 recorded correlations that are not statistically significant in most situations, except for the vestibular-global and visual-preferential correlations, which may suggest that in the case of subjects with mixed vestibular syndrome, the interdependence ratio between the balance parameters in the mid-lateral axis is restricted and someesthetic, visual and vestibular information do not necessarily show linear changes after the onset of the condition; the fact that subjects with peripheral vestibular syndrome recorded statistically significant correlations in most situations and subjects with mixed vestibular syndrome predominantly recorded correlations that are not statistically significant could suggest that the efficiency of compensatory mechanisms (in order to maintain balance in the mid-lateral axis) after the onset of the syndrome is different, depending on the topography of the lesion and it can be suggested that patients with mixed vestibular syndrome present a less efficient compensation process of the vestibular function, which could lead to a greater accentuation of balance disorders and functional deficits in the mid-lateral axis.

Table 4 is suggestive for the description of the correlations between the average results obtained by the two groups in terms of the balance parameters in the antero-posterior and mid-lateral axis and thus highlights the following aspects: in the case of group 1 the correlations are statistically significant (positive) for the visual, vestibular and global parameters, while for somesthetic and preferential parameters the correlations are not statistically significant, which would suggest that subjects with peripheral vestibular syndrome show similar changes in visual, vestibular information, but also in the ability to use all the necessary stimuli globally maintaining balance in the two axis; in the case of group 2, the correlations are statistically significant (positive) in the case of all parameters, which may suggest that the reporting of subjects with mixed vestibular syndrome to someesthetic, visual and vestibular information undergoes similar changes in the two axis.

Table 4. Pearson's correlation for balance assessment on the two axes

Corelații	Group 1	Group 2
Someesthetic x axis- Someesthetic y axis	p=.076, r=.405	p=.003, r=.674
Visual x axis- Visual y axis	p=.000, r=.978	p=.000, r=.791
Vestibular x axis- Vestibular y axis	p=.000, r=.945	p=.002, r=.689
Preferential x axis- Preferential y axis	p=.282, r=.253	p=.000, r=.760
Global x axis - Global y axis	p=.000, r=.935	p=.006, r=.636

5. Discussions

The results were collected through the Synapsys device and in this way we recorded data regarding the oscillations of the center of gravity in the anterior-posterior axis, but also in the mid-lateral axis. The same parameter was also targeted in the research of Nair et al. (2017), who used the static platform to record changes in the center of gravity as a statokinesiogram, each test condition being performed for a period of twenty seconds and being scored on the visual score, the vestibular score and the someesthetic score on the antero- posterior and mid-lateral axis. In another research it was used the MediPost mobile posturographic, a newly developed device that has a high sensitivity and specificity in differentiating healthy people from those with vestibular deficit by performing a specific protocol (Rosiak et al., 2022).

According to the results of our preliminary study, it can be stated that subjects diagnosed with a form of peripheral or mixed vestibular syndrome show a different efficiency of compensation mechanisms in order to maintain balance. Taking all this into account, we can direct a future vestibular rehabilitation protocol according to the data collected using the Synapsys platform. The same is supported by the research done by Rosiak et al. (2022), which demonstrated that mobile posturography may be a promising solution to the growing problem of a society suffering from balance disorders. According to these authors, the advantage of posturography, equipped with a multitude of sensors, compared to systems with force plates, is represented by the possibility of following the movements performed and thus identifying including gait disorders.

A basic idea that emerges from the analysis of the preliminary results refers to the fact that subjects with mixed vestibular syndrome show inferior results compared to subjects diagnosed with peripheral vestibular syndrome, which can also be attributed to compensatory mechanisms. This aspect is also supported by Michel, Laurent & Alain (2020), who stated that peripheral vestibular disorders are the most common and can be treated both pharmacologically and by vestibular rehabilitation, but when the treatment is not effective, a mechanism compensatory may develop in the central nervous system and improve the patient's ability to maintain static and dynamic balance. Conversely, in patients with central vestibular syndromes, even if they are less common than peripheral conditions, they should be considered, given their impact on both prognosis and rehabilitation. At the same time, some drugs applied in the treatment of vertigo can have a negative impact on the development of the compensatory phenomenon (Casani, Gufoni & Capobianco, 2021).

There is a lot of research that shows that age is an important factor in the ability of patients diagnosed with a form of vestibular syndrome to maintain their balance. Neuhauser (2016) highlights that each year 5% of the general population experience symptoms of vertigo and the prevalence, frequency and severity of vertigo generally increase with age. At the same time, it is estimated that 25% of the population aged 70 years or older have symptoms of dizziness, most of them remain with these symptoms for more than one year (Vaz et al., 2013) and older people reported more falls due to vertigo than the younger population (Prell, Finn & Axer, 2022). This may also be explained by the fact that older adults with vertigo often suffer from multisensory deficits such as central bilateral vestibulopathy and benign paroxysmal positional vertigo (Lindell et al., 2021).

Lifetime prevalence data for vertigo show a 30% to 50% increase in the elderly (Penger, Strobl & Grill, 2017). Silva et al. (2016) note that some changes due to aging are directly related to the vestibular system, which can cause several otoneurologically related symptoms, such as vertigo and other types of dizziness, hearing loss, tinnitus, changes in body balance, gait disturbances and occasional falls. Similar aspects are also described by Casani (2021), according to which benign vertigo affects approximately 20% of all cases of vestibular syndromes and, even if it can appear at any time of life, it manifests itself more frequently in adults and older patients, with a maximum incidence between the fifth and seventh decades of life.

Regarding the incidence of vertigo according to gender, it was described that, although the number of female patients was higher than that of males, no significant difference in the incidence rate between the two categories was identified (Yin et al., 2009) and the study by Della Torre et al. (2021) highlighted that there were no statistically significant differences in baseline characteristics of subjects with vestibular syndrome by gender. Taking into account all these aspects it is distinguished that the prevalence of vertigo is higher for women (3.2%) than for men (1.6%), but this gender difference disappears in the very old (Silva, 2016; Maarsingh et al. al., 2010); it is also highlighted that 65% of patients are women (Skuladottir et al., 2021; Hulse et al., 2019), and the significant association of female gender with vertigo was mainly explained by the types of orthostatic vertigo and,, rocked" (Filippopulos et al., 2017).

Given the fact that vestibular syndrome, regardless of the etiological factor that led to its installation, produces changes in the ability to maintain balance, we consider it important to study how balance parameters are modified. Such aspects have also been the subject of other studies, through which it has been demonstrated that the sudden alteration of sensory information arising from peripheral vestibular sensory and/or neural elements evokes typical vestibular symptoms characterized by a cascade of functional disturbances that include postural imbalance at rest and during movement, and patients diagnosed with peripheral or mixed vestibular syndrome show an impairment of visual, vestibular and proprioceptive functions (Tighilet et al., 2017).

In this study, we highlighted the importance of somatosensory, visual and vestibular information in order to maintain balance and this aspect is supported by current research, in which it was mentioned that the integration, processing and correct coordination of the stimuli responsible for maintaining balance allow maintaining the projection of the center of body weight inside the support surface, and posturographic assessment proves to be an objective, accurate and complex method of balance assessment (Krawczyk-Suszek, Martowska & Sapula, 2022).

All this information can be valuable due to the possibility of describing a future vestibular rehabilitation protocol, which will be customized according to the topography of the lesion and, above all, depending on how the balance parameters are affected (somesthetic, visual, vestibular). Vestibular rehabilitation is aimed at improving the vestibular compensation process, but its effect on functional recovery is not fully known (Lacour, Tardivet & Thiry, 2021). Some authors state that vestibular rehabilitation is of major importance, both for central and peripheral vestibular disorders (Dunlap, Holmberg & Whitney, 2019) and individual vestibular rehabilitation training decreases the sensation of vertigo, adapts the vestibulo-ocular reflex and, most importantly, it improves stability and can reduce the risk of falling (Carender, Grzesiak & Telian, 2021). However, more than 80% of patients experiencing vertigo in the Netherlands, the United Kingdom and the United States are mainly treated by their general practitioner or primary care physician and are never referred to a specialist (Van Vugt et al., 2019, Stam et al., 2016). Despite the scientific evidence for vestibular rehabilitation, less than 10% of general practitioners in the Netherlands and the UK reported using this therapy (McDonnell & Hillier, 2015; Bhattachayya et al., 2017).

6. Conclusions

The results obtained in this research support the first hypothesis because, following the assessment of subjects with vestibular syndrome by means of the Synapsys posturography equipment, we identified distinct elements of the balance parameters, depending on the location of the lesion, and thus we can state that both subjects with peripheral vestibular syndrome and subjects with mixed vestibular syndrome, show balance changes in the antero-posterior and mid-lateral axis, specifying that these changes are more significant in the case of subjects with mixed vertigo.

Regarding the second hypothesis we can say that it is partially supported by the collected results because we identified reports of interdependence between balance parameters for subjects with peripheral vestibular syndrome, while in the case of subjects with mixed vestibular syndrome they were limited. However, we highlighted similar changes in balance parameters on the two axes, especially for subjects with mixed vestibular syndrome.

The use of the Synapsys posturograph for patients with vestibular syndrome proves to be a valuable therapeutic measure, by accurately describing balance parameters and, above all, by analyzing the patients' ability to use somatosensory, visual and vestibular information in order to maintain balance in the antero-posterior and in the mid-lateral axis.

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The Influence of Psychological Factors on the Performance of Athletics Athletes in the 110 Meter Hurdles Race

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Abstract

Regarding the psychological training of athletes, we can affirm the fact that it is fundamental as it is carried out as part of the educational training of sports training, contributing to the formation of the basic mental qualities in the athlete's personality, qualities necessary to develop, form and finally, to produce that individual with results in sports activity. The athlete cannot be forced, but can be pushed in this direction. For this reason, the formation of a positive attitude towards psychological training has an important contribution. A psychological questionnaire validated at the level of Romania was applied, created in the direction of sports performance, it is structured on three sub-scales that measure cognitive anxiety, somatic anxiety and the level of self-confidence. The questionnaire includes a number of 27 items applied to a number of 7 athletes, finalists of the National Championships in the 110 meter hurdles race. Following the statistical analysis between the scores obtained during the preparation period and the competition period, carried out using the SPSS platform, we identified a significant result ($p<0.05$) for the psychological component cognitive anxiety. Through this interpretation we intend to establish the possible links between anxious states, emotions, discomfort states and agitation states in the training and competition periods.

Keywords: *performance, athletics, 110 meter hurdles, questionnaire, psychological.*

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1. Introduction

Athlete performance relies on both mental and physical strength in terms of athletic ability. This represents that psychological skills are important for optimal athletic performance (Williams, 2000). According to a study by Orlick and Partington, the psychological training of the Canadian national athletes who participated in the 1984 Los Angeles Olympic Games, the psychological component definitely influenced the number of medals won (Orlick, 1988). Sports psychological skills are techniques and strategies for achieving optimal performance by regulating negative psychological factors that overlap with the competitive act, such as anxiety, fear and frustration (Weinberg, 1995). The ability to cope with various emotional or psychological problems in sports is called sports psychological aptitude (Gould, 1988; Vealey, 1988). Hurdling reserves an athletic test in which cyclicity and cadence are the main assets that a guard athlete must possess (Iskra, 2019). The hurdles race takes place over a distance of 110 meters, a distance that must be covered at a pace of 3 steps, attacking the obstacle each time with the same foot (Otsuka, 2010; Iskra, 2000)

The scale used is Competitive State Anxiety Inventory -2 CSAI-2 (Martens,Vealy and Burton,1990). It is a validated questionnaire for Romania and Europe, being specially created in the direction of sports performance that measures anxiety as a current state. This self-assessment scale contains 27 items and was applied to all athletes involved in this research, during the training period and during the competitive period, just to identify if there are differences. The questionnaire is structured on 3 sub-scales:

- cognitive anxiety: this is about the thoughts and ideas that induce and maintain the athlete's anxious states
- somatic anxiety: the manifestations of anxiety on a physiological level
- self-confidence: the confidence that he can face the challenge and achieve his proposed goal

The scores obtained are from min. 9 (low anxiety/confidence) to max.36 (high anxiety/confidence). In order to identify certain states of the athlete, it is necessary that this test be applied before training and then before the competition. Thus, we can make differences and establish what is the athlete's capacity for self-regulation, the optimal way in which they perform (some athletes manage to mobilize best on high anxiety), their type of motivation or the ability to enter the contest state. An athlete who only uses extrinsic motivation is an athlete who will perform at limited capacity without an optimal level of competition.

2. Methods

Hypothesis: We assume that the main psychological components (cognitive, somatic anxiety and self-confidence) can have statistically significant correlations regarding the two preparation and competition periods.

The purpose of this study is to identify some laws between the three psychological components in two different periods of a performance athlete's preparation: training process and competitive duration.

The objective of this study is the testing of 7 finalist performance athletes of the national championships of Romania, both during the training period and during the competitive period through a psychological questionnaire validated at the country level, with a set of 27 questions.

In the following we will observe the differences between the results obtained by the subjects during the training period and those during the competition period. To validate the questionnaire, as well as to identify possible positive correlations between the psychological components within the two periods, we used the Alpha Cronbach test, respectively paired sample T-test, through the SPSS v. 20 platform.

To achieve the scores, we applied a questionnaire with 27 questions with 4 answer options in which the subjects had to choose according to their mental state in the two moments.

3. Results and discussions

In the case of the athlete C. V we see results with a good control of anxiety. If during the training period it has the value of 11 on cognitive anxiety, in the competition it increases to 17 (a small value, but stimulating enough to reach the competition mobilization). He has good body control, somatic anxiety (14) and manages to maintain self-confidence at an optimal level. Confidence in his abilities is high (Table 1).

Table 1. The results of the psychological test
Competitive State Anxiety Inventory – subject C.V

Name of the athlete	subscales	Training	Competition
C. V	Cognitive anxiety	11	17
	Somatic anxiety	14	16
	Confidence	32	33

In table 2, the athlete obtains very close scores between the training state and the competition state. To the same extent, it can be about the situation in which the athlete offers what he considers to be desirable answers, those that he considered to be correct or expected from him (the idea of the coach's expectations that the athlete tries to fulfill them, the desire to cover insecurities or ego). Somatic anxiety has a value of 18 in competition, which shows us that the body feels an average competitive pressure. Self-confidence is at a high level, both in training and in competition.

Table 2. The results of psychological test
Competitive State Anxiety Inventory – subject 2 A. A

Name of the athlete	subscales	Training	Competition
A. A	Cognitive anxiety	12	14
	Somatic anxiety	14	18
	Confidence	33	34

We identify in table 3 important differences between the state of contest and that of competition. The mobilization is in optimal parameters, in the contest the anxiety is medium to high. What influences negatively is the decrease in self-confidence from the value of 31 in training to 24 in competition.

The results of this athlete are significant, in terms of mental mobilization and introduction to the state of competition. For good mobilization, it is also necessary to increase the anxiety between well-being and control in training and the pressure and desire to perform in competition. Thus, it goes from cognitive anxiety 9 (minimum value) in training, to 25 (medium to high value) in competition.

Table 3. The results of psychological test
Competitive State Anxiety Inventory – subject 3 D. V

Name of the athlete	Subscales	Training	Competition
D. V	Cognitive anxiety	9	25
	Somatic anxiety	9	26
	Confidence	31	24

In the case of athlete D. C, we identify insignificant differences between the training state (cognitive anxiety 10) and the competition state (cognitive anxiety 11). The most important reasons are represented by extensive (competitive) experience or the fact that it provided desirable responses, concluding that such results are expected from athletes. Confidence in one's own abilities is a great competitive advantage, and he scores very high on this variable. These values also correspond to a period of positive development (upward trend) which provides good control of anxiety (Table 4).

Table 4. The results of psychological test
Competitive State Anxiety Inventory – subject 4 D. C

Name of the athlete	Subscales	Training	Competition
D. C	Cognitive anxiety	10	11
	Somatic anxiety	13	12
	Confidence	30	29

Athlete F. D has good mental mobilization, cognitive anxiety in training is at a minimum level, which proves that he feels safe and in control of his routine, and this can also be observed at the somatic level (value 10). Confidence in one's own abilities is at a high level (36). This thing changes in competition where cognitive anxiety increases by 4 points causing somatic anxiety to increase by 7 points. The pressure of competition brings a decrease in the score for the variable "self-confidence" around 28 points. From a psychological point of view, this athlete has a normal evolution, from safety and control in the training part to registering an anxiety in average values in a competitive context (Table 5).

Table 5. The results of psychological test
Competitive State Anxiety Inventory – subject 5 F. D

Name of the athlete	Subscales	Training	Competition
F. D	Cognitive anxiety	9	13
	Somatic anxiety	10	17
	Confidence	36	28

Athlete R. R has minimal anxiety in both training and competition. The values for cognitive anxiety are identical in both situations, on the somatic level the variation of 1 point is insignificant. In this context, he shows a self-confidence at high values in training (32 points), which rises in the competition pressure scale to the value of 35 (almost the maximum). We conclude that he is an athlete with high competitive experience or low intrinsic motivation (Table 6).

Table 6. The results of psychological test
Competitive State Anxiety Inventory – subject 6 R. R

Name of the athlete	Subscales	Training	Competition
R. R	Cognitive anxiety	11	11
	Somatic anxiety	17	18
	Confidence	32	35

Athlete S. D has an interesting pattern of development from a psychological point of view. He has an average cognitive anxiety in training (22 points) and a high one in competition (32 points). Somatic anxiety also follows the pattern of cognitive anxiety and increases from medium (24) to medium/high (28).

We find that this athlete registers an average level of self-confidence even in training. We usually find this situation in the athlete with an average competitive experience or in the situation of a falling period. He shows high anxiety in the competition, but even during the training period he is not in the optimal parameters. We also encounter athletes who deliberately induce states of agitation/anxiety in training and competition, on the principle that agitation helps them develop maximum energy and thus achieve a maximum level of performance (Table 7).

Table 7. The results of psychological test Competitive State Anxiety Inventory – subject 7 S. D

Name of the athlete	Subscales	Training	Competition
S. D	Cognitive anxiety	22	32
	Somatic anxiety	24	28
	Confidence	28	20

Most authors state that the degree of correlation must have a value >/= .7, and in the situation where no. items is below ten should have a value >0.5. Most authors follow a basic rule, such as that the Cronbach's alpha value must reach an index of 0.70, for that instrument, test to have an optimal level of coherence (Keith, 2018). In the situation presented previously, the Cronbach alpha index has a significant value (> .70) (Table 8).

Table 8. Cronbach's Alpha Coefficient on the Anxiety Scale

No of subjects	Testing	Alpha Cronbach	Standardized items	No of items
7	*Anxiety Scale*	*.728*	.829	*26*

The yellow color represents the ideal value that each athlete should record while the gray color represents the worst score. The blue and orange colors respectively represent the scores obtained during the preparation and competition periods. The best scores were 26 obtained by D. V respectively 28 obtained by S. D exceeding the threshold of the average value, specifying that the difference between the score obtained in training versus the competition (in the case of subject 3) is a considerable one, which reflects a mobilization optimal psyche for the competition state. The scores obtained by subject two A. A and six R. R. are not so relevant because compared to the training values they are not significant (Figure 1).

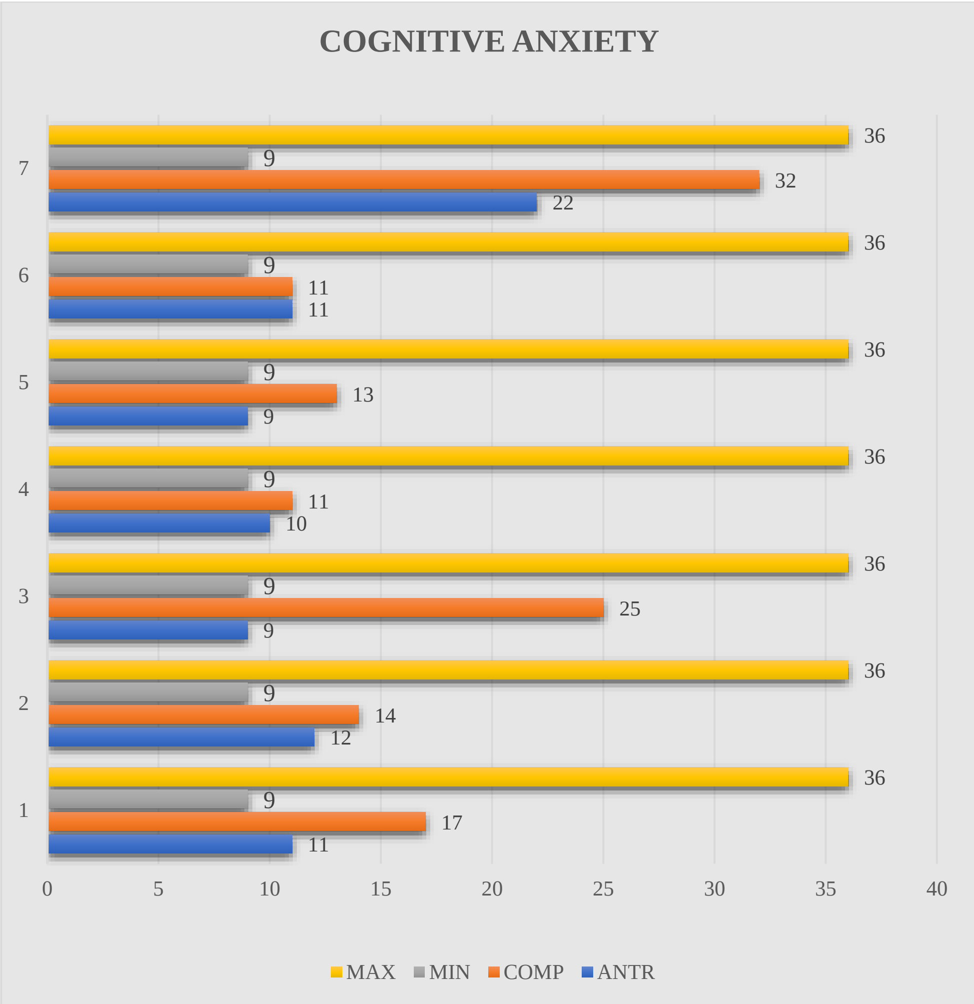

Figure 1. Graphical representation of the results - Cognitive anxiety

In the case of the sub-scale representing self-confidence, we obtained the highest scores of all three applied, both in the training part and in the competition part. In the case of subject seven S. D, lower values were identified (20, respectively 28) contrary to the good results obtained in the other subscales and compared to the other athletes. All the indicators in Figure 2 demonstrate that they have a high level of confidence both during the training period and during the competitions.

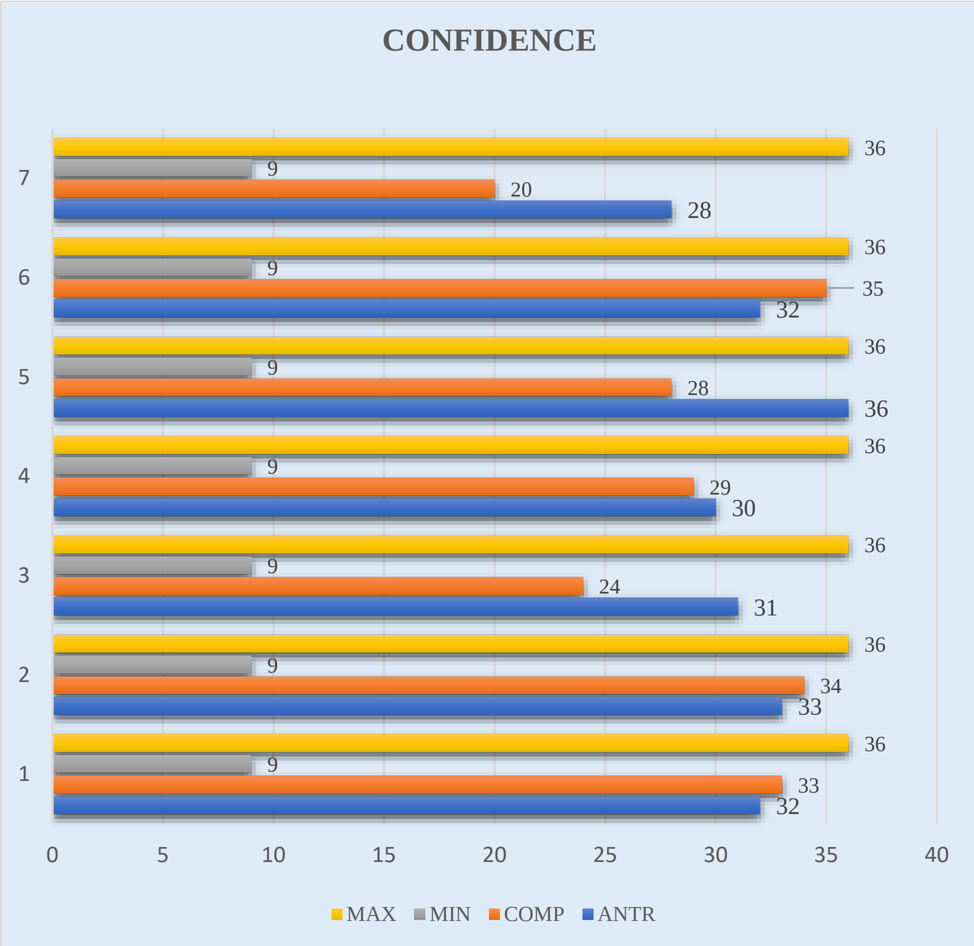

Figure 2. Graphical representation of the results – Self-confidence

As we can see in Figure 3, we obtained a series of percentage values regarding the results obtained following the application of the questionnaire and their interpretation. The sum of all the results obtained in the three subscales: cognitive anxiety, somatic anxiety and self-confidence, both during the preparation period and during the competition period, was obtained. The reference values that represent the ideal of the athlete's psychological profile are framed as a score between 9 (anxiety/low confidence) and 36 (anxiety/high confidence). The highest percentage values obtained within the averages are found next to the self-confidence scale both in training and in competition (23 and 26%, respectively).

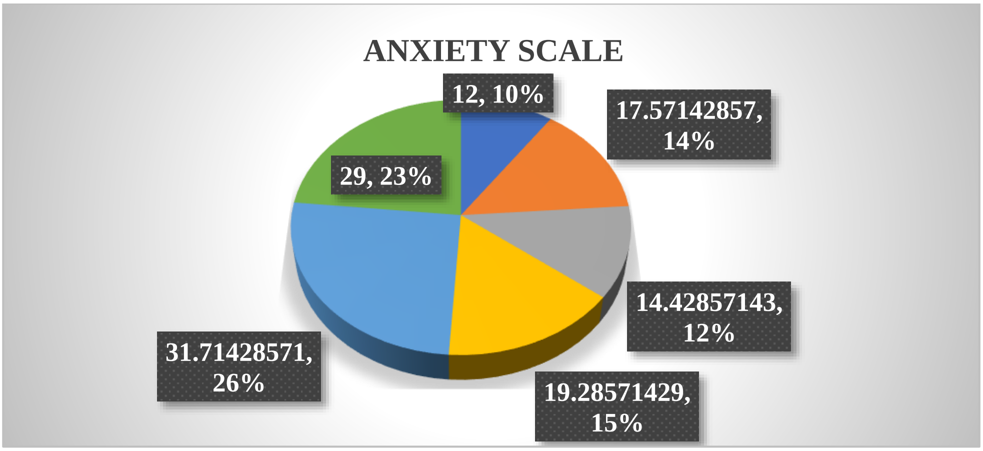

Figure 3. Percentage representation of the results - Anxiety scale

3.1. Statistical analysis of the psychological questionnaire

Following the statistical analysis between the scores obtained during the preparation period and the competition period, carried out using the SPSS platform, in table 9, we identified a significant threshold ($p<0.05$) for the psychological component called cognitive anxiety. Through this interpretation we intend to establish the possible links between anxious states, emotions, discomfort states and agitation states in the training and competition periods.

Table 9. Statistical interpretation of the scores obtained on the psychological questionnaire

No	The psychological component	Mean	Standard deviation	Standard error of the mean	t	p<0.05
1	Cognitive anxiety	-5,5714	5,7113	2,1586	-2,581	***.042***
2	Somatic anxiety	-4,8571	5,9281	2,2406	-2,168	.073
3	Confidence	2,7142	4,7858	1,8089	1,501	.184

p<0.05

Athletes face a psychological barrier during competitions; therefore, not only optimal physical ability and skills, but also the psychological ability to manage fear and anxiety are important in Taekwondo (Eom, 2013). As we can see in what the author Eom mentioned, the psychological components are important in any sports branch, especially when we refer to contact sports or those in direct combat with the opponent.

4. Conclusions

Finally, we can state that a significant relationship between the three psychological components, within the two test periods, can only be established between cognitive anxiety at the level of training and competition. This demonstrates that there are differences between the scores obtained by the subjects included in the research and that there is a possibility that some performances within the competitions are influenced by this identified difference. At the group level, on somatic anxiety and self-confidence, no difference was noticed, which is why we consider that the sports performances obtained by the athletes were not influenced.

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The Effect of 9 Weeks of Various Balance Training Methods on Ski Instructors

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Abstract
In alpine skiing, balance is widely regarded as one of the most important motor skills. However, there are not enough studies in the alpine skiing literature on balance training, balance outcomes, intensity, duration, and frequency of balance training protocols. Although balance ability is a performance factor, there have been few studies on the effect of balance on alpine skiing, and the results have varied. **Objectives**. Given the inconsistency of results reported in studies, this study aims to develop a static and dynamic balance protocol to improve balance values and optimize sports performance in alpine skiing. **Design.** Bifactorial mixed, an intervention study, which comprises nine weeks of five training methods that have been shown to be effective in previous studies. Each method, depending on its specificity, develops different aspects of balance: neuromuscular training, plyometric training, core stability training, proprioceptive training, and balance training with equipment. **Participants.** Twenty-four authorized ski instructors were recruited and divided into an experimental group and a control group. **Measures.** On snow test with CARV device that measures 4 variables: SKI IQ, balance, edging, and pressure and tests on dry-land with ISO FREE, a stabilometric platform with a stable surface measuring seven variables. All variables were retested after the balance training protocol. **Results**. The results show significant improvements in the experimental group in the skier technique represented by the SKI IQ variable ($F_{(1,18)}=34.45$; $p=0.000$; $\eta p2=0.65$). In addition to this, the results show statistically significant improvements in two-legged balance with eyes closed represented by lower values of standard deviation from COP in the anteroposterior ($F=24.952$;$p=0.000$) and mediolateral plane ($F=4.891$;$p=0.038$), as

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well as in right-legged balance in the mediolateral plane(F=7.307;p=0.13). **Conclusion**. Balance training for 9 weeks has a positive effect on balance performance and this complex balance development method can improve certain parameters of the static and dynamic balance of alpine skiers.

Keywords: *balance training, dry-land training, alpine ski training.*

1. Introduction

Alpine skiing is one of the most popular winter sports (Steidl-Müller et al.,2019), with millions of people participating at various levels. It is extremely complex and physically, technically, and tactically demanding (Gilgien et al., 2018; Hydren et al., 2013).

While technical ability appears to have the greatest influence on performance in skiing, the ability to consistently display technical ability within a race and over a long competitive season requires a high physiological capacity (Turnbull et al., 2009; Ferland & Comtois, 2018).

Moreover, alpine skiing is extremely complex because performance requires a combination of multidisciplinary parameters such as strength, coordination, technique, mental preparation, and season planning (Hébert-Losier et al., 2014).

Nevertheless, physical abilities are essential in alpine ski performance and should be trained and tested, as events range from 50 seconds to 2.5 minutes. Several studies have investigated the relationship between performance factors, and it emerges that the skier must be highly trained in the following physical abilities: aerobic and anaerobic capacities, muscular strength, and complex motor skills such as balance, agility, and coordination (Maffiuletti et al., 2006; Patterson et al., 2009; Platzer et al., 2009; Raschner et al., 2013).

Furthermore, alpine skiing necessitates developed motor skills in addition to aerobic and anaerobic capacity and strength. According to some researchers, incorporating specific balance training may be a factor in improving performance (Lesnik et al., 2017.; Slomka et al., 2018; Zech et al., 2010). Thus, the neuromuscular system must be properly trained in order to effectively engage the balance on the downhill slope and prevent falls (Morrissey et al.,1987).

Balance is widely recognized as one of the most important motor skills in alpine skiing (Hydren et al., 2013, Malliou et al., 2004). Alpine skiing is a high-intensity sport that causes lactate buildup, muscular hypoxia, and peripheral neuromotor fatigue, all of which contribute to and affect pro-perceptual depreciation and injury risks (alterate balance ability) (Raschner et al., 2012).

Additionally, Hydren et al. (2013) assert that alpine skiing is characterized by instability with ski-snow interaction, particularly on soft snow and rutty course conditions, and that balance workouts may enhance physical patterning for uncertain conditions by utilizing neurologic adjustments. Therefore, the quality of descent is primarily reflected by a high level of specific motor skills that have a dominant and complex effect on situational efficiency (Male et al., 2013). DeCouto et al. (2020) report that the specific practice of sport can simultaneously develop physiological capacities and necessary technical skills.

According to Nashner (1997), balance is defined as the process of keeping the body's center of gravity vertically over the base of support by relying on rapid and continuous feedback from visual, vestibular, and somatosensory structures and then performing smooth and coordinated neuromuscular actions. This ability is influenced by a variety of factors, including sensory information (from the somatosensory, visual, and vestibular systems), joint range of motion, and force (Palmieri et al., 2002), and is in place to assure the proper execution of multiple sports movements as well as injury prevention (Ricotti, 2011). In addition to this, adequate balance control in the performance of motor skills relies primarily on muscle synergies that minimize center of gravity shifts (Ricotti, 2011). This serves as the foundation for the correct execution of complex technical gestures while also reducing the risk of injury (Ricotti, 2011). Balance capacity is categorized in sports performance as static and dynamic (Ricotti, 2011).

Although balance ability is a performance factor there are few studies investigating the effect of balance on alpine skiing and results vary. Some studies on the effect of interventions on balance ability in alpine skiing show a positive effect after an intervention on the dry land of eight, respectively nine weeks (Cillik & Razusova, 2014; Vitale et al., 2018), while others report no differences between experimental and control groups (Mahieu et al., 2004; Malliou et al., 2006).

Our hypothesis assumes that through a balance development training protocol included in a general plan for the development of the skier's physical abilities as well as through exercises from different methods for the development of balance ability, we will be able to improve sports performance by developing balance performance.

Given the inconsistency of previous research findings and the debate over the effect of balance training on improving and optimizing sports performance in alpine skiing, the research aims to use a balance development protocol to improve balance values and sports performance in alpine skiing.

2. Material & methods

2.1. Experimental approach and participants

The study included 24 subjects randomly divided into a control group (CG) (n=12) and an experimental (EG) (n=12) group. Twenty subjects were tested in the initial and final on-snow tests, and 24 subjects were tested in the dry-land tests. The research subjects are included according to the following characteristics: ski instructors accredited by AMPSR (Association of Professional Ski Instructors in Romania), aged between 25-35 at the time of initial testing, and clinically healthy. Subjects were informed of the purpose of the study and gave written consent to participate in the study. The tests were performed in the same time interval and the manner of testing was similar so that there were no errors in the experiment. In the snow tests, the same route was set for all subjects for the initial and final test, and subjects were tested on the same ski - Atomic Doubledeck GS with the following characteristics: length - 178; average width - 71 mm; weight 2.68 kg. The difference between the experimental and the control group is the application of the independent variable, i.e. the application of training to develop balance. Balance training took place twice a week for nine weeks in September, October, and November as individual training on nonconsecutive days. Each session lasted 45 to 60 minutes and each session started with a standard warm-up. The skiers in both groups were assessed with a CARV device which generates SKI IQ, BALANCE, EDGING, and PRESSURE values, and an ISO FREE (Tecnobody, ITALY) force plate which generates center of pressure (COP) standard deviations in F-B (anterior-posterior) [mm] and M-L (medial-lateral) [mm] direction.

2.2. Procedures

On snow test with CARV device

Following a descent on a giant slalom course set up with 20 gates, with a distance between gates of 20 meters, and an identical level difference, CARV assessed several parameters including balance, edging, pressure, and SKI IQ, which is the weighted average of the other parameters. The best descent out of two was taken into account. The CARV (Motion Metrics Ltd, London, UK) device is an inertial motion unit with 72 pressure sensors, motion sensors, accelerometer, gyroscope, and magnetometer and is composed of an insole and a transmitter which sends data to the app (app version 5.5.1-1676).

Balance assessing with an ISO FREE force platform

The support base of the force plate is a sensing platform with four load cells capable of detecting the subject's ground force distribution in real-time (Iso-Free | TecnoBody, 2018). The ISO FREE force platform is a highly sensitive stabilometric plate certified with MEDICAL APPARATUS (class I) with a ground resolution of 1 mm and an acquisition frequency of 20 Hz (Iso-Free | TecnoBody, 2018).

Balance assessment protocol from standing on two legs with eyes closed (DSEC) in antero-posterior (F-B) [mm], medial-lateral (M-L) [mm]: to begin the assessment, the researcher positioned the athlete's feet on the stability platform using the appropriate alignments for the medial malleolus and the outside border of the heel. The subject position was with hands on hips, feet slightly apart on force plate indicators. The subject was told to stand as still as possible for 30 seconds. The average of the best effort in two 30-second attempts was used for evaluation. The apparatus measures the

COP standard deviation from the ideal upright position in F-B (antero-posterior) and M-L (mediolateral) directions

Balance assessment protocol on the left and right leg respectively with standard deviations of the COP in the F-B [mm] and M-L [mm] direction with eyes open: subject's position was standing on one leg, hands on hips; the other leg slightly flexed resting on the outer malleolus of the supporting leg for 30 seconds. The subject was told to stand as still as possible for 30 seconds The average of the best effort in two 30-second attempts was used for evaluation.

Protocol for the limit of stability (LOS) with COP displacements: As in the study of Juras et al. (2008) subjects were instructed to stand on the force platform barefoot, with their legs in a comfortable position and their arms across their thighs, palms facing their thighs. They kept their heads horizontal and looked ahead. The fixation point was placed on the screen in front of the subjects, 2 meters away from them. Subjects completed 2 consecutive maximal voluntary leaning trials (limits of stability test - LOS test) in the 8 directions (suggested by the platform software), with about 2 minutes of rest in between the trials. For all force plate test indices, a greater inclination from the ideal vertical position over the support base generates a higher numerical value, indicating greater instability. In other words, lower values of the center of pressure path (COP) and body sway indicate a better degree of balance (Staniszewski et al., 2016).

2.3. Balance training protocol

Alpine skiing being a complex sport, we have chosen to use 5 types of training that are effective in other studies as a method of balanced development. Each method has its own specificity and develops certain sides of the balance. The balance training protocol for EG was developed from findings from other research. We chose neuromuscular training as a method of balance development because it has been shown in other studies (Hewett et al., 1999; Mandelbaum et al., 2005; Zazulak et al., 2007) to improve postural stability. Also, we chose to include core stability training as a method of balance development because previous research has shown that performance of core stability exercises improves balance ability and postural control in athletes (McLeod et al., 2009) and healthy adults (Shah & Varghese, 2014). The other areas are plyometric training (Alikhani et al., 2019.; Hewett et al., 1999; McLeod et al., 2009; Myer et al., 2006.; Słomka et al., 2018; Steffen et al., 2008), proprioceptive training as described in Table 1 (McLeod et al., 2009) and balance development training with apparatus, all of which have positive values in balance development. Training took place twice a week for 9 weeks (17 sessions), with a session duration of 45 to 60 minutes. Each session started with a standard warm-up. The sessions were led by a certified fitness trainer who provided verbal and visual feedback on exercise techniques. Furthermore, the fitness trainer stimulated the athletes to focus on movement efficiency. The proportion of sessions attended during the experimental protocol for EG was used to fully comply with the balance program. Participants had to complete 90% of the balance intervention program to be considered compliant.

Table 1. Proprioceptive training adapted from McLeod et al. (2009) (sample)

Exercise	Series and repeats	Time (sec)	Rest (sec)
Balance on two legs on half a foam roll	3	30	A 30
Two-legged balance on half a foam roll by rolling a ball along the torso	3	30	A 30
Maintaining balance on 1 foot on half foam roll inclination A/P	3L – 3R	30	P 30
Maintaining balance on 1 foot on half of foam roll inclination M/L	2L – 2R	30	P 30
Sidestep on the half foam roll, inclination M/L	15L- 15R		P 30
Forward step on half foam roll inclination A/P	15L – 15R	5	P 30
Squat on the half foam roll	2x10		A 30

Notes: P=passive rest; A=active rest; L=left limb; R=right limb

2.4. Statistical Analysis

Statistical processing was performed with Statistical Package for the Social Sciences (SPSS) (version 1.0.0.1275; SPSS Inc, Chicago, IL). Basic descriptive statistics were calculated (mean, standard deviation). To test the assumption of normality of the distribution, we used the Skewness and Kurtosis indicators. We also used multivariate analysis (MANOVA) for the presence of multiple dependent variables. In addition to this, we used partial eta squared (η2) which shows how much of the variance is explained by the independent variable. This is used as the effect size for the MANOVA model to report the magnitude of the effect with the following interpretation: .001-.05 = small effect, .06-.13 = medium effect, ≥.14 = large effect. The significance threshold for the tests used was α = 0.05. We used a MANOVA to see if the experimental group differed from the control group before the intervention because we randomized subjects into two groups (experimental vs. control). Furthermore, we conducted a MANOVA because we had several variables as dependent variables at snow test, including Ski IQ, balance, edging, and pressure, also at balance assessing with ISO FREE force platform the following variables: DSEC (double leg stance eyes closed) both direction FB/ML, LOS (limit of stability), OLSL (one leg stance left limb) both direction FB/ML, OLSR (one leg stange right limb) both direction FB/ML, as well as membership in the control or experimental group as an independent variable.

To compare the experimental group with the control group after the intervention, we decided to create 4 new dependent variables for the snow test, as well as 7 new variables on balance assessment with the ISO FREE, which are equal to the difference between post-intervention (post-test) and pre-intervention (pretest). We did this because, in addition to the difference observed in the experimental group, we observed an increase from the pretest to the posttest in the control group.

3. Results

3.1. On snow testing

Skewness and Kurtosis values range from -1 and 1, which means that there are no significant deviations from the normality of the dependent variables. The differences between the 2 groups in the 4 dependent variables before the intervention are not statistically significant. For example, the difference in Ski IQ between control and experimental is statistically insignificant (F=0.613; p=0.444). The other differences are also not statistically significant, balance (F=0.065; p=0.801), edging (F=1.047; p=0.320), pressure

(F=0.002; p=0.962). Thus, we can conclude that the 2 groups are equivalent before the intervention, and thus, that randomization worked. In order to compare the experimental group with the control group after the intervention, we decided to create 4 new dependent variables, which are equal to the difference between post-intervention (posttest) and pre-intervention (pretest). As a result, by calculating pretest-posttest differences as shown in Figure 1, for both the experimental and the control groups, we can test the extent to which our intervention was effective beyond the "natural" increase observed in the control group. We report a significant difference in Ski IQ ($F_{(1,18)}=34.45$; p=0.000; ηp2=0.65) and can state with a 95% probability that the results obtained are not random and are the effect of the intervention protocol. As for the other dependent variables, the differences are not statistically significant: balance difference ($F_{(1,18)}=1.96$; p=0.178; ηp2=0.98), edging difference ($F_{(1,18)}=2.99$; p=0.101; ηp2=0.143), pressure difference ($F_{(1,18)}=1.32$; p=0.265; ηp2=0.69). Even though these differences are not statistically significant, in terms of effect size they are large and medium.

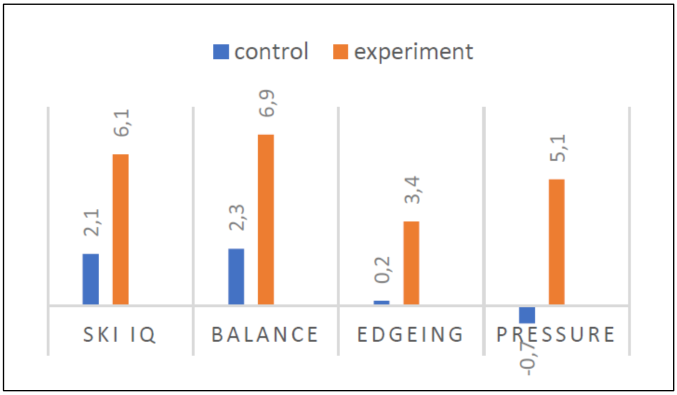

Figure 1. Mean pretest-posttest difference Carv variables

3.2. Balance assessing with ISO FREE force platform

The differences between the 2 groups in the 7 dependent variables are not statistically significant. The difference between DSEC FB between control and experimental is not statistically significant (F=0.778; p=0.387). The other differences are also not statistically significant, DSEC ML(F=2.078; p=0.164), LOS (F=0.065; p=0.801), OLSL FB (F=0.003; p=0.957). Thus, we can conclude that the 2 groups are equivalent before the intervention, and thus, that randomization worked. In the next step, we created 7 new dependent variables (making the difference between the post-test and pretest scores for each participant). Following the MANOVA analysis, we report statistical significance at the $p < 0.05$ threshold for the variable Difference DSEC FB (F=24.952;p=0.000). Also, the balance training induced significant changes after the intervention on the variable difference DSEC ML which shows statistical significance (F=4.891; p=0.038) as described in Table 2. The data indicate an increase in the variable balance on the right leg in the mediolateral (Difference OLSR) following the intervention which shows statistical significance (F=7.307;p=0.13). And in terms of effect size, the values are large and medium in 5 of the calculated variables, except with a small effect size of the variable LOS ($\eta p2$=0.14) and OLSL FB with a medium effect size ($\eta p2$=0.069).

Table 2. Differences between the control group and experiment inferential analysis

Variable	*Sum of squares*	*Degrees of freedom*	*Mean squares*	*F*	*P*	*η2*
Difference DSEC FB	18,096	1	18,096	24,952	0,000*	0,531
Difference DSEC ML	1,955	1	1.955	4,891	0,038*	0,182
Difference LOS	1,021	1	1,021	0,307	0,585	0,14
Difference OLSL FB	2,394	1	2,394	1,624	0,216	0,069
Difference OLSL ML	3,197	1	3,197	3,874	0,062	0,150
Difference OLSR FB	2,660	1	2,660	2,568	0,123	0,105
Difference OLSR ML	3,161	1	3,161	7,307	0,13*	0,249

Notes* sign indicates statistical significance; η2= partial eta squared; p=probability value;

4. Discussion

The study aimed to verify the effect of training for balance development in alpine skiing in ski instructors, in order to develop dynamic and static balance, aiming at increasing sports performance, as well as to verify different training methods for balance development (plyometric, neuromuscular, proprioceptive, balance training with apparatus and core stability training).

We started from the hypothesis that balance development training using various methods would result in significant changes in balance performance in alpine skiing. . Our study finds significant improvements in skier technique, as measured by the SKI IQ variable, which is a weighted average of the other values (balance, edging and pressure) knowing that alpine skiing is a technical sport with significant implications for the athlete's physical and motor abilities (Raschner et al., 2017). Pérez-Chirinos Buxadé et al. (2022) report that the ski turn is an essential technical aspect of speed regulation and the goal is to make turns while losing as little speed as possible. According to Komissarov (2020), the main advantage of the carv turns technique in terms of performance is the significant reduction in energy dissipation, which results in increased speed (Komissarov, 2020). The most important aspect of alpine ski racing, according to Hydren et al. (2013), is to maintain a carv turn while resisting the forces generated while maintaining the edge and balance control.

Hébert-Losier et al. (2014) report that balance ability is important but there are very few publications on balance development in alpine skiing. Furthermore, alpine skiing, according to Noe and Paillard (2005), is a sport that requires great postural stability to achieve balance in difficult conditions. Exercises for balance development were chosen and adapted from other studies that documented positive effects after balance intervention by the following five methods: neuromuscular training (Vitale et al., 2018), core stability training (Myer et al., 2006.; Słomka et al., 2018; Steffen et al., 2008), balance development training with apparatus (Engebretsen et al., 2008; Kovacs et al., 2004; Panics et al., 2008; Słomka et al., 2018; Verhagen et al., 2004), plyometric training (Alikhani et al., 2019.;

Hewett et al., 1999; McLeod et al., 2009; Myer et al., 2006.; Słomka et al., 2018; Steffen et al., 2008) and proprioceptive training.

Several other studies share positive results on balance performance and are similar to our study. There are studies reporting improvement and development of balance as well as improvement of postural stability of junior alpine skiers (Čillík & Rázusová, 2014; Vitale et al., 2018) but with different methods of balance development on dry-land compared to our intervention methods. Thus, Vitale et al. (2018) suggest that an 8-week intervention in which subjects before activity perform a neuromuscular warm-up succeeds in improving balance. Likewise, Čillík and Rázusová (2014) succeed through a 9-week intervention with specific exercises on rollers to positively influence balance in alpine skiers aged 8 to 10 years. In addition, Slomka et al. (2018) report in their study that a complex balance training program (core stability, plyometrics, balance, and stretching exercises) improves dynamic stability variables in young skiers and results in less low extremity asymmetry.

In their review of balance training programs in athletes, Brachman et al. (2017) report that an effective training balance protocol should last 8 weeks with two training sessions per week, while also stating that authors describe balance performance differently, from proprioceptive training to sensorimotor training and neuromuscular training (Paterno et al., 2004).

Some studies report either that both experimental and control groups show similar improvements, or that there are no improvements in balance performance (Mahieu et al., 2006; Malliou et al., 2006). The natural increase of some variables (SKI IQ) in the control group is also present in our study, but following the intervention protocol, the difference between the pretest and posttest is significantly higher in the experimental group than in the control group in our case.

Although balance ability is a performance factor, there are few studies investigating the effect of balance on alpine skiing and the results are different and controversial. The majority of research focuses on the development of aerobic and anaerobic strength and power (Male et al., 2013; Noe & Paillard, 2005.; Raschner et al., 2012). As a result, practical, applied alpine skiing studies on balance are required.

5. Conclusions

Dry-land training is an important component of a skier's overall training. A significant amount of research has been conducted on the importance of muscular endurance and power, anaerobic and aerobic power, while little research has been conducted on the significance of balance in alpine skiing, and the results have been mixed.

Following the intervention protocol, Ski IQ, which is the power average of the metrics that form it (balance, edging, and pressure), increased more from pretest to posttest in the experimental group, compared to a small, natural increase in the control group. The other metrics that form the SKI IQ show increases in means but they are not statistically significant, a consequence of the relatively small sample.

Our study shows statistically significant improvements in two-legged balance with eyes closed represented by lower values of standard deviation from COP in the antero-posterior and medio-lateral plane, as well as in right-legged balance in the mediolateral plane. These improvements are due to the 9-week balance intervention protocol. As testing apparatus, we used a force plate, for the land tests, force plates being a gold standard in balance measurement. On snow, we used the CARV apparatus, our testing protocol, more rigid due to external factors, a protocol that can be improved with better planning. Nevertheless, Koller and Schobersberger (2019) claim that most preseason fitness tests do not necessarily require the same physiological demands as alpine skiing and that alpine skiing requires largely coordinated eccentric muscular contraction that most fitness tests cannot replicate (Koller & Schobersberger, 2019). For example, aerobic capacity tests do not reliably correlate with performance in alpine ski racing (Neumayr et al., 2003; Nilsson et al., 2018).

Thus, the hypothesis of the preliminary research is partially confirmed: as a result of the intervention we have developed certain sides of balance and improved sports performance represented by SKI IQ. This complex of balance development method can improve certain parameters of the static and dynamic balance of alpine skiers.

Finally, the results of our research support the usefulness of balance development exercises to reduce standard deviations of the center of pressure and to improve dynamic balance during descent (SKI IQ) so that balance is efficiently engaged in descent and falls are prevented.

5.1. Study Limitation

Even though the study met its aims, it had some limitations. One of the limitations was access to a small number of subjects in the snow test (n=20) and the dry-land test (n=24), which limited our ability to draw more conclusive results. Another limitation is the lack of reliability in snow tests, which has not been established in previous studies.

Conflicts of interest

The author(s) declared no potential conflicts of interest.

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