



STUDIA UNIVERSITATIS  
BABEŞ-BOLYAI



# EDUCATIO ARTIS GYMNASTICAE

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4/2021

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UNIVERSITATIS BABEŞ-BOLYAI  
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## THE INFLUENCE OF AGE FACTOR AND SPORTS SPECIALIZATION ON THE LEVEL OF AGILITY IN SPORTS GAMES

PAVOL HORIČKA<sup>1</sup>

**ABSTRACT. Objectives:** The aim of the study was to determine the influence of age factors and the type of sports specialization on performances in planned and reactive agility. The object of the research was 129 players of football, volleyball, basketball and handball from sports clubs in Nitra and its surroundings in the categories of boys U15 ( $\bar{x} = 14.95r$ ) and boys U 17 ( $\bar{x} = 16.88r$ ). **Methodology:** The level of planned agility (PA) was diagnosed by the Illinois test and the level of reactive agility (RA) by the Fitro agility Check test. **Results:** The results showed the importance of both factors (Sport specialization and age) on performance in PA and RA, higher values (p) for the age factor ( $p < 0.05$ ). **Conclusions:** The biological mean (age) has affected performance in RA more strongly than a type of sports game. Post hoc tests between groups (sport specialization) confirmed the statistical significance of differences between sports games to the detriment of basketball ( $p < 0.01$ ).

**Keywords:** *planned agility, reactive agility, sport games*

### Introduction

The competitive environment of team sports requires a high level of motor abilities from players with a sufficient degree of accuracy associated with the implementation of game skills. Activities are associated with the perception of stimuli, rapid response and the implementation of sudden movement actions. The ability to make effective decisions and maneuvers seems to be characteristic of some of the best team sports players. Except of it, players perform a variety of movements, such as jumps, reflections, rebounds, rotations, changes of direction, etc., integrated into technical skills (Paul, Gabbet & Nassis, 2016). Despite the fact

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that success is influenced by a number of factors, it is clear that players should have physical, technical and tactical maturity for their sport (Reilly, Williams & Nevill, 2000). "Athletic preparation" comes to the fore as an important indicator, especially since the demands of team sports seem to be greater than in previous years (Barnes et al., 2014). Agility is therefore perceived as an important factor in the structure of a player's game performance in team sports (Scanlan, Tucker & Dalbo, 2014). Young, Dawson and Henry (2015) stated the independence of planned and reactive agility, citing several physical and cognitive components of agility. Although there may be differences in understanding the concept of agility, it is generally defined as the rapid movement of the whole body with a change in speed or direction in response to a stimulus (Sheppard & Young, 2006). It follows from this definition that agility includes not only the speed of change of direction (CODS) but also the cognitive decision-making process and its outcome. These cognitive aspects include perceptual and decision factors, and physical elements are considered as essential during agility. The phrase "reactive agility" is traditionally used in the literature to define movement in response to a stimulus. However, Young, Dawson and Henry (2015) recently expressed the view that the word "reactive" is redundant by the current definition of agility. As a result, we use the word "agility" exclusively to define the process of perceiving decision-making in response to a stimulus.

Each team sport requires specific types of movements and agility. Players must constantly adapt their movements and actions to different game situations (Bloomfield et al. 2007; Brughelli, 2008; Scanlan, Tucker & Dalbo, 2015). The player is constantly in a 1: 1 game, in invasive games in addition the relatively small size of the playing area creates constant pressure from opponents (Vaeyens et al., 2007). The level of agility thus becomes an important indicator of a player's performance in team sports. Finally, it was found that the agility test is sensitive in distinguishing groups of athletes of different sports specializations (Zemková & Hamar, 2014). Although knowledge about the influence of gender (Sekulić et al., 2013), differences between individual and team sports (Mackala et al., 2020), the relationship between age and agility (Andrasić et al., 2021; Horička & Šimonek, 2021) for performance in agility are known. There is a clear lack of data on the influence of potential predictors on various manifestations of agility.

## **Objectives**

The aim of the study was to determine the influence of age factors and the type of sports specialization on performances in planned and reactive agility

## Method

The object of the research was 129 players of sports clubs FC Nitra, BKM SPU Nitra, VKP Bystrina SPU Nitra and MHC Štart Nové Zámky in the categories of boys / U15 ( $\bar{x}$  = 14.95 years; SD = 1.93 years) and boys category / U17 ( $\bar{x}$  = 16.88r; SD = 1.46r.). The set consisted of 61 players of 4 team sports in the category: footballers (U15f = 25); basketball players (U15b = 14); volleyball players (U15v = 12) and handball players (U15h = 10) and 68 players of higher age category in the same sports (U17f = 32; U17b = 11), 23; U17v = 12; U17h = 13). The different number of players in each category was due to objective facts, the availability of the ensemble and the health status of the players. The condition for including the files in the research was age, comparable volume of preparation and participation in the highest competition in the Slovak Republic of the relevant category.

### *Search strategy*

The Illinois Agility Test (Planned Agility, PA; Getchell, 1979) was used to diagnose Planned Agility and the Fitro Agility Check (Reaction Agility, RA; Zemkova & Hamar, 2014).

All the necessary assumptions were confirmed to determine the level of the differences between the medians of the four independent sample groups and the two continuous variables (PA and RA). There were for example variables in the interval and normal data distribution, a two-step analysis of variance (ANOVA) was used with two factors "sports specialization" (F, B, V, H) and "age" (U15 and U17). Finally, a detailed comparison of post-hoc tests (Tukey's test for different numbers of participants) was performed. We tested the null hypothesis of agreement of variance at the 95% (0.05) and 99% (0.01) level of significance.

Records, registration of primary data were processed by using MS Office 2010 software (MS Word, MS Excel). We performed statistical processing according to Borůvková, Horáčková and Hanáček (2014) using analytical tools of licensed software IBM SPSS Statistics® (v. 25.0).

## Results

We focused on evaluating the level of performance of selected factors of agility differences between them in relation to sports specialization in the categories of boys U15 and U17 in this part. The basic descriptive data are presented in Table 1.

**Table 1.** Descriptive data, U15 and U17

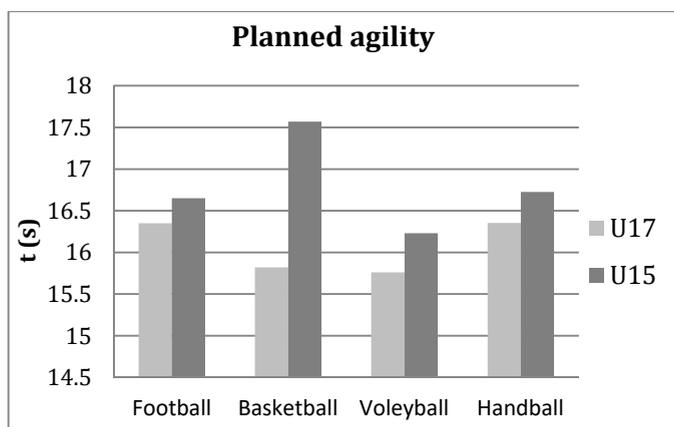
	U15		U17	
	PA	RA	PA	RA
N	61		68	
Mean	16.9367	1485.923	16.1125	1321.881
Median	16.61	1469.23	16.07	1307.425
SD	1.08984	104.5712	0.64911	107.7364
Variance	1.188	10935.14	0.421	11607.13
Minimum	15.52	1291	14.76	1112
Maximum	20.34	1775.63	17.97	1652.9

In a test evaluating the speed of change of direction in response to a standard stimulus (closed skill) - Illinois test, the best performances were observed in U15 in volleyball players ( $\bar{x} = 16.16s$ ), football players ( $\bar{x} = 16.66s$ ), handball players ( $\bar{x} = 16.73s$ ) and basketball players ( $\bar{x} = 18.2082s$ ). In the U17 category were dominated volleyball players ( $\bar{x} = 15.76s$ ), followed by basketball players ( $\bar{x} = 15.79s$ ), footballers and handball players (Fig. 1,2). We also observe greater homogeneity of performance in selected team sports in the test.

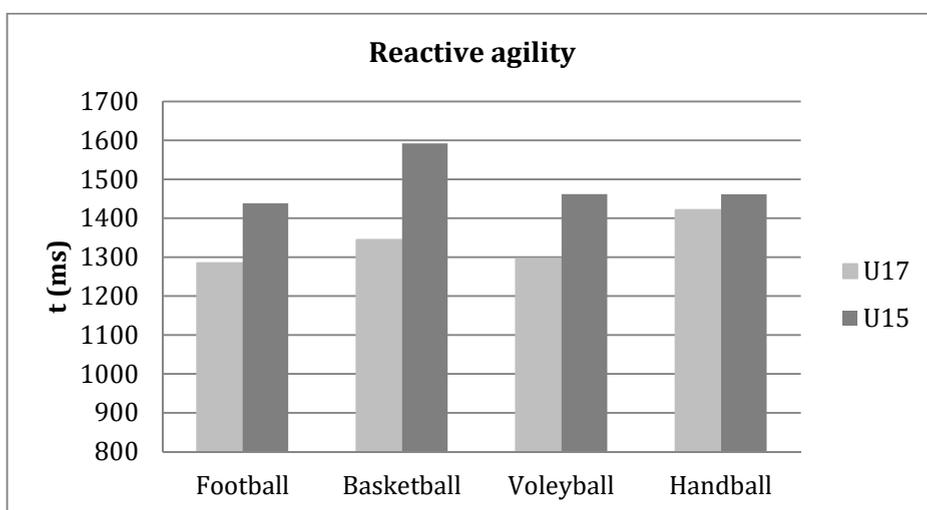
The variability of performances was characteristic in the U15 category by:

a) the dominance of the group of volleyball players and relative lagging behind of the group of basketball players in both diagnosed indicators

(b) the relative balance of the football players, volleyball players and handball players (figure 1);

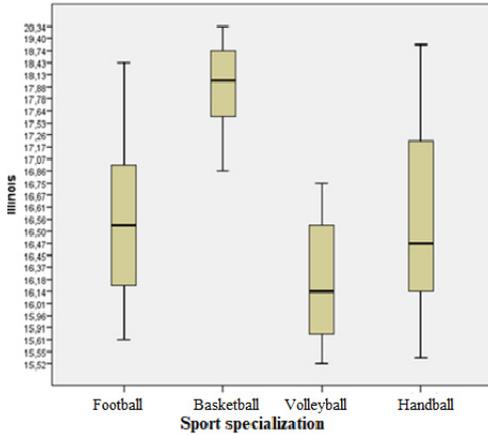
**Fig. 1.** Comparison of players in U15 and U17 category in Illinois test in team sports

We observed less variability in player performance in the diagnosis of reactive (selection) agility and perception in the test with the selection of adequate motor response (FAC, Fig. 2). Differences in player performance were negligible, with the exception of differences between age categories. The best performances were recorded by footballers ( $\bar{x} = 1287.40\text{ms}$ ), followed by volleyball players ( $\bar{x} = 1294.7\text{ms}$ ), basketball players ( $\bar{x} = 1334.3\text{ms}$ ) and handball players ( $\bar{x} = 1420.9\text{ms}$ ). Less variability was observed between team sports in this test. This is probably due to the fact that coordination ability (reactive speed) and cognition is not limited by the level of fitness factors (speed, strength, special endurance), but by the quality of analysers and the central nervous system and its role in controlling of movement from the age of athletes.

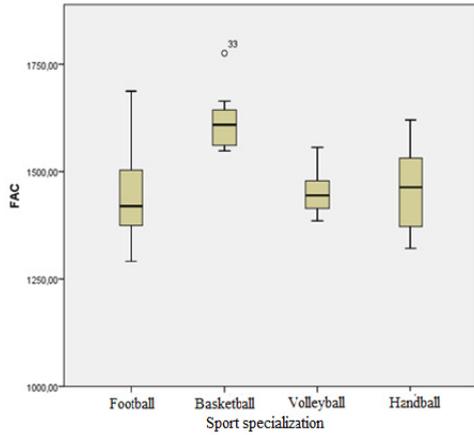


**Fig. 2.** Comparison of players in U15 and U17 category in reactive agility (FAC) test between team sports

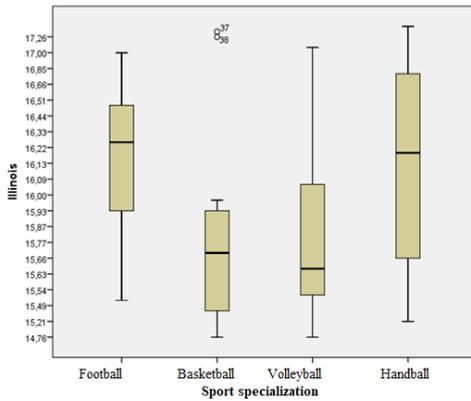
As we expected there were in age differences in the level of performance in favour of U17 category, lower performances are found in basketball. The reason could be the presence of extreme values or other reasons related to the structure of training stimuli, file composition, genetic factors, etc. The best results of the planned agility in terms of the sport specialization were observed in volleyball players in both categories (Figure 3-6). The differences were statistically significant with the exception of football as it was confirmed by detailed post hoc tests (Table 6).



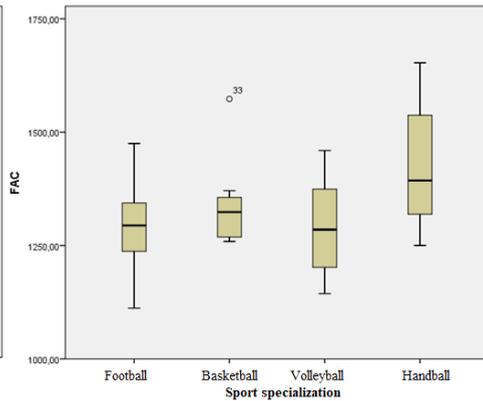
**Fig. 3.** Variability of performances according to Sport - U15 (PA)



**Fig. 4.** Variability of performances to Sport - U15 (RA)



**Fig. 5.** Variability of performances according to Sport - U17 (PA)



**Fig. 6.** Variability of performances to Sport - U17 (RA)

The precondition for finding out the differences in performance between sports specializations was the assessment of the normality of the distribution (Table 2). We consider the observed variables to be normally distributed for all variables except of FAC Basketball /U15 sig = 0.036; U17, sig = 0.003) and in both test procedures  $p < 0.05$ .

**Table 2.** Test of normality – Sport specialization (football, basketball, volleyball, handball)

Sport specialisation		Tests of Normality					
		Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
ILL	Football	0.178	25	0.039	0.920	25	0.051
	Basketball	0.170	14	0.200	0.969	14	0.868
U15	Volleyball	0.236	12	0.064	0.873	12	0.071
	Handball	0.199	10	0.200	0.934	10	0.492
FAC	Football	0.168	25	0.068	0.944	25	0.187
	Basketball	0.162	14	0.020*	0.865	14	<b>0.036*</b>
U15	Volleyball	0.154	12	0.200	0.956	12	0.723
	Handball	0.129	10	0.189	0.980	10	0.967
ILL	Football	0.089	32	0.200	0.972	32	0.546
	Basketball	0.238	11	0.083	0.877	11	0.096
U17	Volleyball	0.170	12	0.212	0.945	12	0.567
	Handball	0.120	13	0.200	0.962	13	0.780
FAC	Football	0.092	32	0.200	0.988	32	0.973
	Basketball	0.253	11	0.048	0.767	11	<b>0.003*</b>
U17	Volleyball	0.180	12	0.200	0.909	12	0.206
	Handball	0.142	13	0.200	0.944	13	0.507

Note: \*. This is a lower bound of the true significance; a. Lilliefors Significance Correction

We wanted to test the hypothesis that sports specialization and age are moderators of the effects on planned agility and reactive agility. Whether this relationship applies regardless of the observed category, a fundamental research question should be resolved: Is the role of sports specialization and age important, or does the type of team sport and the age of the players have a higher effect on planned agility or reactive agility? Both factors (sport specialization and age) were moderators of planned and reactive agility ( $p < 0.05$ ) as shown in Table 3.

**Table 3.** ANOVA with 2 factors

Factor assessed	PA			RA		
	Mean Square	F	Sig. p-value	Mean Square	F	Sig. p-value
Factor_SS	30.090	7.076	0.04*	87601.51	86.920	0.012*
Factor_age	17.966	41.135	0.000**	683898.85	11.134	0.002**
Factor_SS *age	4.518	10.344	0.000**	55288.39	7.027	0.001**

Note: \*\*significance on the level  $\alpha=0,01$ , \* $\alpha=0,01$ ; SS – sport specialization; PA-planned agility; RA – reactive agility

The volume of the effect in ANOVA is measured as a square (MS). Significantly higher MS values for the age factor ( $p = 0.000$  and  $p=0.002$ ) indicated that this biological trait affected both planned and reactive agility more strongly than sport specialization. The comparisons between the groups were statistically significant, especially in comparison with basketball and volleyball, respectively football. The significance did not found in both types of agility (Table 4). In addition to volleyball, the difference in averages was confirmed in 2 cases also for football players. The difference in averages was confirmed mainly between groups F and B ( $p = 0.009$  and  $p=0.000$ ), between B and V ( $p = 0.000$ ). There were no statistically significant interactions observed in all cases, we note only a partial effect of sport specialization. Detailed post hoc tests between the groups of sport specialization confirmed the statistical significance of the differences.

**Table 4.** Comparison between groups / PA and RA – sport specialization factor

Factor SS	Post-hoc test Tukey between SS					
	F vs B	F vs V	F vs H	B vs V	B vs H	H vs V
PA	0.009*	0.021	0.938	0.000*	0.137*	0.021*
RA	0.000*	0.803	0.001*	0.000*	0.193	0.063

Note: \*significance on the level  $\alpha=0,05$ ; SS – sport specialization

Taking into account the age factor, the difference in averages was confirmed as expected for both PA and RA ( $p < 0.05$ ). The effect size (Effect size = 1.66) also indicates a higher effect of the age factor on RA compared to PA. Due to the confirmation of statistical and material significance (Effect size), the difference is evident (Table 5) in both cases.

**Table 5.** Comparison between categories / PA a RA - factor – age  
Dependent variable: PA a RA

Factor - age		Mean Difference	Std. Error	Sig. <sup>b</sup>	Effect Size Cohen's d	95% Confidence Interval for Difference <sup>b</sup>	
						Lower Bound	Upper Bound
PA	U15 vs U17	0.805*	0.126	0.000*	0.95	0.557	1.054
RA	U15 vs U17	157.069*	16.847	0.001*	1.66	123.71	190.423

Note: \* The difference in averages is significant on the level  $\alpha = 0,05$ .

After the subsequent combination of both factors (sport specialization + age), the significance was not confirmed in all pairwise comparisons in the analysis of differences (post hoc) in the averages of all groups (n = 8). Overall, a greater difference was found in PA compared to RA (Table 6).

Differences among the categories in individual sport specialization point to differences especially in sport specialization - basketball, where the difference in both PA and RA (p < 0.05) was confirmed in basketball in 9 (out of 13) cases; in football 5x (out of 11); volleyball 5x (out of 10) and handball 5x (out of 8). The importance of the differences observed in the followed specializations is also supported by the size of the coefficient of effect size (ES). In these cases, we evaluate the effect of sport specialization as evident and we accept the hypothesis statistically and materially (confirmed alternative hypothesis H<sub>A</sub> and strong Effect size).

**Table 6.** Differences between groups for variables PA and RA (with unequal sample size)

Post-hoc test Tukey between groups (SS+age) + Effect size														
Variable	F U15	F U17	B U15	V U15	F U17	F U15	H U15	V U15	H U17	F U17	F U15	H U15	H U17	B U15
	- H U17	- H U15	- V U17	- B U17	- H U17	- B U15	- B U17	- V U17	- B U15	- B U15	- V U15	- V U17	- B U17	- V U15
PA	0.255	0.179	<b>0.000**</b>	0.197	0.601	<b>0.000**</b>	<b>0.032*</b>	0.098	<b>0.000**</b>	<b>0.000**</b>	<b>0.032*</b>	<b>0.014*</b>	0.096	<b>0.000**</b>
ES	0.42	-0.80	1.16	0.55	-0.25	-1.77	1.01	0.71	-2.28	3.43	0.79	1.16	0.77	3.06
RA	0.602	<b>0.000**</b>	<b>0.000**</b>	<b>0.001**</b>	<b>0.003**</b>	<b>0.000**</b>	<b>0.005**</b>	<b>0.001**</b>	<b>0.000**</b>	<b>0.000**</b>	0.643	<b>0.001**</b>	0.071	<b>0.000**</b>
ES	0.20	-1.66	3.53	1.63	-1.17	-2.55	1.38	1.82	-1.89	-3.32	-0.21	1.66	0.77	2.64
	F U17	F U15	V U15	B U17	F U17	V U17	V U15	B U17	B U15	H U17	H U15	V U17	V U15	F U17
	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	V U17	H U15	H U17	V U17	H U15	F U15	H U17	H U15	F U15	B U15	H U17	F U15	F U17	B U17
PA	<b>0.005**</b>	<b>0.032*</b>	0.437	0.923	<b>0.003**</b>	<b>0.012*</b>	<b>0.049*</b>	0.133	<b>0.003**</b>	<b>0.000*</b>	0.365	<b>0.001**</b>	0.550	0.104
ES	1.03	-0.07	-0.35	0.04	1.40	-0.77	-0.92	-0.73	-1.19	-2.90	0.42	-1.34	-1.03	0.85
RA	0.810	0.643	0.413	0.342	<b>0.000**</b>	<b>0.000**</b>	<b>0.013*</b>	0.773	<b>0.002**</b>	<b>0.000**</b>	0.402	<b>0.000**</b>	<b>0.000**</b>	0.114
ES	-0.07	-0.21	0.32	0.39	1.90	-1.64	-1.05	-0.12	-1.40	-3.58	0.35	-1.72	1.71	-0.46

Notes: \*p<0.05; \*\*p<0.01; PA – planned agility; RA – reactive agility; ES – Effect size; F – football, B – basketball, V – volleyball, H – handball

## Conclusions

We have shown that older players and volleyball and football players were more likely to perform in both planned (PA) and reactive (RA) agility. The character of the load of volleyball players probably creates preconditions for the dynamics of the performance of this ability in comparison with other sports. From the findings, we conclude that RA tends to grow more dynamically with age, compared to PA. In both variables (PA, RA) we found the most significant differences between basketball players between the two age categories. The effect of sport specialization was proved in PA in four cases, in RA in three cases. It suggests that PA is more conditioned by the effect of sport specialization than RA. However, the presence of statistically significant interactions suggests potential additive or synergistic effects between sport specialization and age in terms of performance in both PA and RA.

The relationships between the two factors (age and sport specialization) and their effects on RA were partially different from those for PA, observed and described in the article. This confirms the well-known assumption that both types of agility (PA, RA) are relatively independent qualities and are not determined only by motor factors. At the same time, we claim that the structure of the sports discipline (team sports) determines more of the player's motor qualities, which are reflected in the planned agility. On the other hand, reactive agility does not depend exclusively on the nature of the load in a particular game, but is also conditioned by external psychomotor factors.

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## EXAMINATION OF PERSONALITY DIMENSIONS DETERMINING THE CAREER MOTIVATION OF TRAINEE TEACHERS

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**ABSTRACT.** In our research, we are interested in how personality dimensions can influence the career choices of students entering teacher education and the extent to which sport appears as a preference variable in the strength of career motivation factors. There is a shortage of teachers, and the prestige of teachers is low (Borbély, 2016). The contradictory social situation of teachers is characterised by the incongruence of knowledge and material benefits related to the profession and prestige (Fónai, 2014). The teaching career is preferred among people with repressive personality traits (Figula, 2000). In our study, we used the Eysenck personality test and the Factors Influencing Teaching Choice Scale career motivation test. Our sample is given by 244 trainee teachers participating in the teacher training of the University of Nyíregyháza, whose average age is 21.93 years. The sample includes physical education trainee teachers (56.6%) and non-physical education trainee teachers (43.4%) of the undivided teacher training. Students majoring in physical education are more willing to take risks, are more sociable, more extroverted than non-physical education trainee teachers, and are more emotionally stable and respond more calmly to various stimuli. The risk-taking personality trait has a negative effect on career motivation and increases the secondary career nature of the teaching profession. Impulsivity shows a positive relationship with personal usefulness, secondary career path, and social influence, while social conformity shows a positive relationship with the beauty of the teaching profession and social usefulness. Our studies provide a picture of the motivation of the physical education trainee teachers and other trainee teachers, as well as the differences between the groups. It helped to explore the factors influencing teacher career motivation and the degree of correlation. Our research proved that during the time spent in training, the perspective of trainee teachers about the teaching career changes, and their motivation, and thus the attraction of the career, decreases.

**Keywords:** *teacher career motivation, personality dimensions, teacher training, physical education teacher*

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## **Introduction**

Educational has an essential role in the development of society. The Hungarian public opinion generally agrees that there are severe shortcomings in our training system, the reasons for which can be found, among other things, in the number of teachers. Young educators are missing, and leaving the profession is becoming more common among teachers (Paksi et al., 2015). According to the data of the Central Statistical Office, the number of teachers decreased compared to the number of teachers in the early 2000s (KSH, 2011). Nevertheless, the number of applicants for teacher training shows the opposite direction, as the number of applicants for training increased steadily between 2008 and 2016 (FELVI, 2019). At the same time, during or after their studies, a significant dropout can be detected, or sometimes they start another career. Based on this, it can be stated that the proportion of teachers under the age of 30 and between the ages of 30 and 39 is continuously decreasing while the proportion of those over the age of 50 is increasing. Thus, it can be stated that the pedagogical society is slowly ageing (Hajdu et al., 2019). In addition to dropout, another problem is that the prestige of the teaching career is declining due to the low social and material appreciation (Borbély & Fónai, 2016).

Our research aims to examine the shortage of young teachers and its reasons among the trainee teachers of the University of Nyíregyháza, especially among the students majoring in physical education. For this reason, we would like to examine how the career choices of students entering teacher education can be influenced by the personality dimensions and the extent to which sport, as a preference variable, appears in the strength of career motivation factors.

### **The relevance and theoretical background of the topic**

#### ***The situation of the teaching profession***

Nowadays, the teachers' prestige and financial and social appreciation are low, which is out of balance with the career's difficulty (Paksi et al., 2015). The most significant advantages of the profession are job security, joy in raising and educating children and working in a more compatible way with family. The disadvantage is that the salary is lower and fewer opportunities can be found for professional careers. At the same time, secondary school students choosing a career as a teacher have a better evaluation of the career as a teacher than students choosing other majors, which can positively affect the career choice process (Paksi et al., 2015; Veroszta, 2015). Both educators and trainee teachers consider that the prestige of their profession is lower compared to professions (Borbély & Fónai, 2016). Teachers with a bachelor certificate earn approximately

80%, while teachers with mastery level certificate earn 60% of the salaries of graduates with similar qualifications working in other jobs. The financial appreciation of male teachers is even worse than other male graduates (Hajdu et al., 2019). In the case of professional teachers, those who do not have a large difference between the income available in the teaching and non-teaching positions remain in the teaching career (Bacsá-Bán, 2019). The low esteem of the teaching career also affects the motivational environment of teachers. They are less willing to work and have less pleasure from working (Tóth, 2015). The low appreciation of the teaching career has a negative effect on career choice, and after graduation, the salary of the teacher also plays an essential role in comparison with the salaries of other graduates. The larger the pay gap between teaching and non-teaching occupations, the more likely a person with a teaching qualification will not become a teacher or leave the teaching profession (Varga, 2007). More than half of those who left the teaching profession left the profession due to financial reasons, and two-thirds did not start pedagogical work after completing their teacher training. Those who stayed on the field were motivated to stay by the joy of teaching, the beauty of working with children, and loyalty to the teaching career. Among the most important motives for choosing a job, interesting work comes first, followed by a good salary and then safe working conditions (Kocsis, 2002). Nonetheless, what are the factors that will guide children into the teaching profession? In the next chapter, we map the motivational factors for choosing a career as a teacher.

### ***The choice of the teaching profession and its motivational factors***

The first stage of entering the teaching profession is career choice and the choice of teacher training in higher education (Varga, 2007). Career choice is the process by which an individual selects and decides for which activity or occupation he or she begins to study to prepare for a career (Di Blasio, 2010). Before the 1990s, career choice as a concept was considered a decision between two or more options. In the 1990s, the concept of career guidance emerged. Career orientation is a process of career choice consisting of smaller and larger decisions. Several conditions must be met to select the right track. Of these, adequate self-knowledge and knowledge related to the profession are the most important ones (Kenderfi et al., 2012). Personality also plays a significant role in career choice, so the individual needs a self-defining ability (Di Blasio, 2010). The basic needs of individuals are also important to carry out the activity of their choice in accordance with their values (Tóth, 2015). Choosing a career is a significant decision that can affect our entire lives. In addition to personality, interests, personal desires, and dispositions also play an important role in

career choices, and everyone wants to work in an exciting area and compatible with their personal values (Hegy-Halmos, 2015). It can also be indicated by motivation, which is an external or internal force, urge or drive affecting the individual, which activates, directs and maintains the action (Oláh, 2006). The motifs can be divided into two main groups known as basic motifs and human-specific motifs. Basic motives are essential elements for an organisation to maintain proper physiological functioning. According to the literature, human-specific motivation can be divided into extrinsic and intrinsic motivation. In the case of extrinsic motivation, the activity is initiated by some external reason (e.g. achieving a result, reward, or avoiding punishment), while in intrinsic motivation, the focus is on the self-rewarding nature of the action, i.e. an activity that causes pleasant feeling and joy (Berkes, 2019; N. Kollár, 2011; Tóth, 2015). The literature divides extrinsic motivation into four different groups based on the autonomy of action. These are external regulation, introjection, identification, and integration (Berkes, 2019; Tóth, 2015). However, in our research, examining the different motivational factors, we only distinguish intrinsic and extrinsic motivation due to the available procedures and methods.

The first of the main steps in becoming a teacher is to choose teacher training. This is followed by employment in this profession after higher educational graduation and finally staying in the profession (Varga, 2007). Interest in teaching careers appears among young people at the age of 13-14, and career choice decisions are most common at the age of 16-17 (Dráviczki, 2002). Concerning the attractiveness of the career, it can be said that women, those living in a poorer financial situation and those with poorer academic results, are more likely to choose this career. The most important external motivational factors are prestige, labour market opportunities and expected income (Veroszta, 2015). Certain personality traits may also have a motivating effect on career choice, but this is not true in all cases (Di Blasio, 2010). Choosing a career as a teacher has mostly intrinsic and altruistic motivational factors. The most important and typical of these are working with children, helping children, transferring knowledge, the nature of the occupation's intellectual work, and social utility. Extrinsic motivational factors include job security, summer vacation, good relationships with colleagues, easy access to employment, compatibility of salary, work and time spent with the family (Barmby, 2006). Only almost half of the students of teacher training institutes choose the career due to the love of the profession. The other half presumably choose teacher training due to other external circumstances, motivational factors and social influence. According to the active teachers, the attraction of the profession was the most important as a career choice motivation, and the most important motivating factors were loving children, family values, the joy of knowledge

transfer and positive experiences (Máthé, 2019). Those interested in teacher training have a significantly less important motivation for working abroad, a leadership position, high salary, and a less restricted lifestyle than those interested in other disciplines. Among secondary school students applying for teacher training and those participating in teacher training, the most important motivating factors are individual skills, social expediency, working with children and shaping their future. These motivational factors are somewhat weaker among applicants for the teaching profession, for whom professional interest and previous learning and teaching experience are more important than for other groups of educators. Among women, the time spent with family, working with children, and social influence are more decisive motivating factors. Among the currently working teachers, time spent with the family and job security were not essential factors in their own career choice decision, but they were also not characterised by the profession's secondary career nature (Paksi, 2015).

### ***Pedagogical role and personality***

Teaching career is the most attractive occupation for women. The proportion of women working as full-time teachers is higher than 80%, and their proportion is slightly lower among those working in other forms of employment. The teacher's role aims to educate children, for which society expects the right personality in addition to expertise. Besides teaching the curriculum and knowledge, the teacher's task is to provide children with personalised support, which helps them achieve better results and become successful (N. Kollár and Szabó, 2004). Teaching is a profession that involves serious responsibilities, as one of the most important tasks of teachers is to help and guide the personal development of students. Interest in the subjects and altruistic qualities play an important role in the formation of professionalism and commitment. Under the influence of the purpose of life and the joy of work, the teaching career becomes a profession (Dráviczki, 2002). Teachers must have adequate self-knowledge as well as a commitment to be congruent. Expectations express diversity. Empathy for children and adults is also needed. Instead of repressive behaviour towards children, there is a need for teachers who support children, and a positive attitude towards children is also essential for proper professional preparation. Teachers also set a pattern for children with their manifestations, as well as their behaviour and activities. Therefore, they have to live following these behaviours as this kind of lifestyle cannot be faked (Szebedy, 2005). The personality of teachers is the same as the role required by the teaching profession, and the personality and the role of the teacher interact with each other. Young people can choose a career as a teacher because they think that this activity suits their personality, and the role

of a teacher can also influence their individuality and shape it in the right direction (Zétényi, 1998). The expectation of educators is also not to stick to previous views and practices but to be able to change them if necessary. The development of this attitude of trainee teachers is the task of teacher training, where, in addition to the transfer of theoretical knowledge, it is essential to acquaint students with the rich variety of new methods and procedures (Falus, 2002).

### ***Personality dimensions and characteristics***

Personality plays a vital role in career choice, especially in the case of a teaching career. The development of behaviours begins when the young child first starts to imitate their family members (Kozma 2001). In the following, we will only introduce the personality traits and dimensions that we examine in our research.

Personality is a continually changing system related to the social and natural environment, which contains a set of psychological processes, functions and states characteristic of the individual built up of inherited and acquired characteristics. The state of the nervous system can also affect the personality, which displays two types of personality. These are the introverted and extroverted types. Of these, the introvert is more characterised by loneliness, shyness, sensitivity, and that the individual does not like company and does not feel good in the crowd. In contrast, the extroverted personality type is characterised by a social being who is open, loves social events, and can easily connect with others. However, these personality dimensions are most often mixed in individuals, with the dominance of one of the personality types (Fodor, 2005). Sport also plays a key role in the development of the values represented by education. It increases respect for authority and self-confidence, strengthening the desire for academic success, which can also influence personality traits (Pusztai, 2009). Eysenck's factor analysis was also examined by Fodor (2005), in which the examination of personality types took place on two levels. Depending on extroversion-introversion and emotional stability-lability, four personality types can be developed. These are the stable-introverted, unstable-introverted, stable-extroverted and unstable-extraverted types, between which no sharp line exists, and personality types are value-neutral (Fodor, 2005). Mirnics (2006) also examined the personality dimensions of Eysenck. Three main personality dimensions can be found here, known as extraversion, neuroticism, and psychoticism. Individuals with high level of psychoticism may be characterised by disregarding the rules, insensitivity, aggression harmful for others, and often hostile and strange habits. Neurotic individuals are often worried, anxious, prone to stress, have

mood swings, and are emotionally unstable. In addition to the main personality dimensions, impulsivity, venturesomeness, and social conformity are also essential personality traits. The impulsive person is characterised by thoughtlessness, often doing things due to impetuous impulse, inability to wait, hunger for excitement, and impulsivity. Venturesome people, like impulsive ones, also look for excitement, but at the same time, they are aware of the dangerous nature of their activities, act thoughtfully, and take the possible requirements into account (Mirnics, 2006). The lie scale was initially used to check the authenticity of the responses. Later, Eysenck recognised that its value also measures social conformity, the high value of which indicates the need for meeting social expectations (Batta et al., 2020).

### **Empirical research**

The question arises that if more people have applied or entered teacher training in recent years, how is it possible that the number of young teachers is still decreasing and the shortage of teachers is increasing? Why is the number of young people employed in the teaching profession so low, and where do the young people completing teacher training disappear? We examine which factors most influence the career choice of students entering teacher education today. What personality traits are the most characteristic of trainee teachers? What effect do personality dimensions have on a teacher's career choice?

### **Our hypotheses**

Based on the questions mentioned above, we set up the following hypotheses.

**H1:** Among trainee teachers' personality dimensions, the higher level of extraversion and venturesomeness will be typical for physical educators than for non-physical education majors.

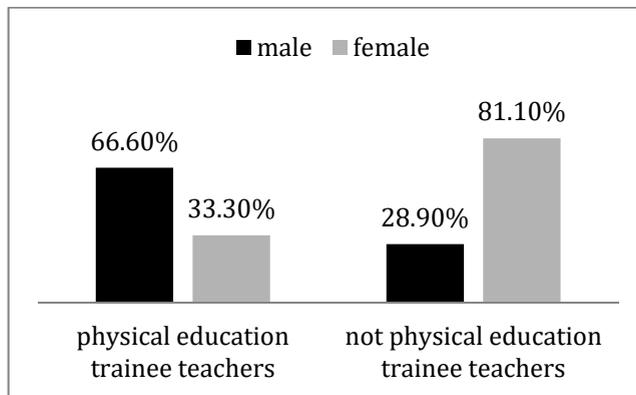
**H2:** Sporting habits will most strongly determine personality dimensions.

**H3:** In the career motivation of trainee teachers, the secondary career character will be more likely for PE trainee teachers than in the case of non-physical education majors.

**H4:** Students' career motivation decreases as the grade increases.

## The introduction and characterisation of the sample

Our sample is given by 244 trainee teachers participating in the teacher training of the University of Nyíregyháza, whose average age is 21.93 years. Among the students learning in undivided training, physical education trainee teachers (56.6%) and non-physical education trainee teachers (43.4%) can be found, among whom there are also undivided non-physical education teacher and pedagogue students. The participating students study in teacher education from grade 1 to 4. In terms of gender, the proportion of women is higher (52.8%) than that of men (47.2%) (Figure 1). The reason for the small difference between males and females is that the proportion of men is significantly higher among physical education students than among non-physical education trainee teachers.

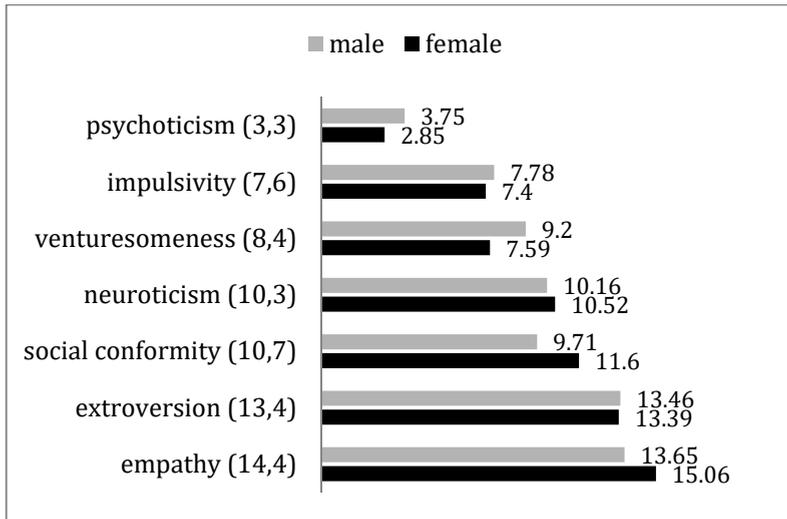


**Figure 1.** The distribution of the sample according to gender and major (%) N=244

Regarding sporting habits, a significant proportion of our sample pursued sports in childhood, and most took part in competitions (118 people). Many pursued sports at the hobby level (95 people), and only a few did not pursue sport regularly (28 people). Current sports habits differ significantly as the number of non-athletes has increased (44 people), the majority of students engage in regular sporting activities at the hobby level (141 people), and the number of students playing sports in the competition system has significantly decreased (58 people).

Our sample is characterised by empathy and extroversion as the most likely personality traits, while not favourable psychoticism appears to a much lesser extent (Figure 2). Significant gender differences can be observed for social conformity, venturesomeness and psychoticism. Men are less likely to be

compelled to live up to societal expectations, are more honest, but at the same time, more psychoticism, more prone to oppose norms and break the rules, to have more extreme behaviours, and much more willing to take risks than women. Women are somewhat more empathetic. However, there is no significant difference in empathy. Concerning extroversion, emotional lability and impulsivity, only minor differences can be observed according to gender.



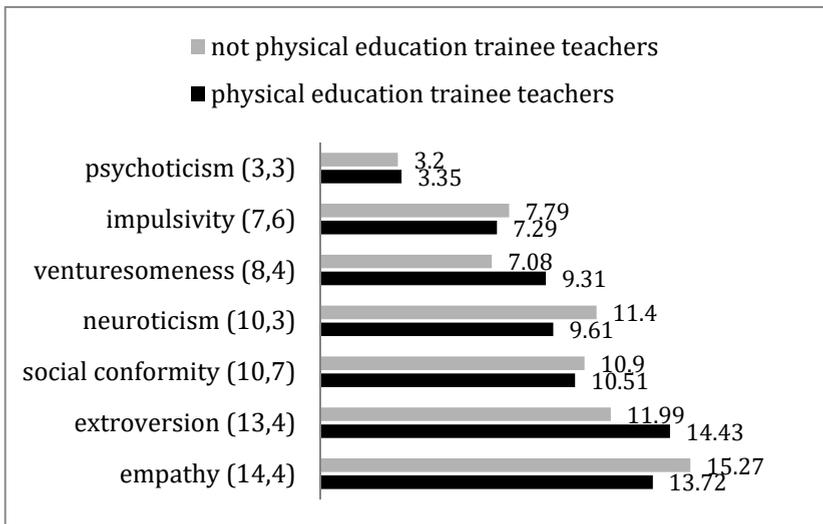
**Figure 2.** The distributions of personality dimensions according to gender (mean) N=244

## Methods

In our research, we used the Eysenck Personality Questionnaire (EPQ), the Impulsivity- Venturesomeness-Empathy (IVE) questionnaire, and the FIT-Choice-scale teacher career motivation test for data collection. EPQ is a psychological test measuring extroversion, neuroticism, social conformity, and psychoticism, while the IVE questionnaire examines impulsivity, venturesomeness and empathy (Arany et al., 1994). The FIT-Choice-scale is a questionnaire suitable for evaluating a teacher's career, which examines the career image, which is formed by the expectations and the benefits of the career, which are determined by the sub-factors of expertise, the difficulty of the career, social status and salary. On the other hand, it examines the main motivational factors influencing the pedagogical career and career motivation by measuring personal utility and social utility factors and 12 sub-factors (Paksi et al., 2015).

### The examination of the hypotheses

Examining the first hypothesis of our research, we were curious to see whether different traits are likely for physical education majors compared to not PE trainee teachers. The results of the two-sample test showed significant differences in personality traits between physical education and non-physical education trainee teachers in extroversion ( $F=0.415$ ;  $p=0.015$ ), neuroticism ( $F=0.016$ ;  $p=0.000$ ), and venturesomeness ( $F=1.912$ ;  $p=0.000$ ;  $p=0.000$ ) personality dimensions. Physical education students are significantly more extroverted, sociable, venturesome, and emotionally stable than non-physical education trainee teachers (Figure 3). Simultaneously, it is more characteristic of non-physical education trainee teachers to be more sympathetic, humane, or more impulsive, more prone to take risks due to an impetuous impulse. However, these differences are not outstanding. There is no significant difference between the two groups in the areas of psychoticism and social conformity either.



**Figure 3.** The investigation of personality dimensions according to major (mean)  $N=244$

According to our second hypothesis, sporting habits have the strongest effect on personality traits (Table 1). We wanted to examine what factors influence personality traits and whether an order can be set among the factors influencing it to determine which factor affects personality dimensions. To examine this, we performed correlation analyses, which partly confirmed and partly refuted our hypothesis. This is due to the fact that some personality traits

show the strongest correlation between current and childhood sporting habits. However, there are personality dimensions where gender, age and physical education correlate. Among the visible correlations, the significant results were highlighted (Table 1).

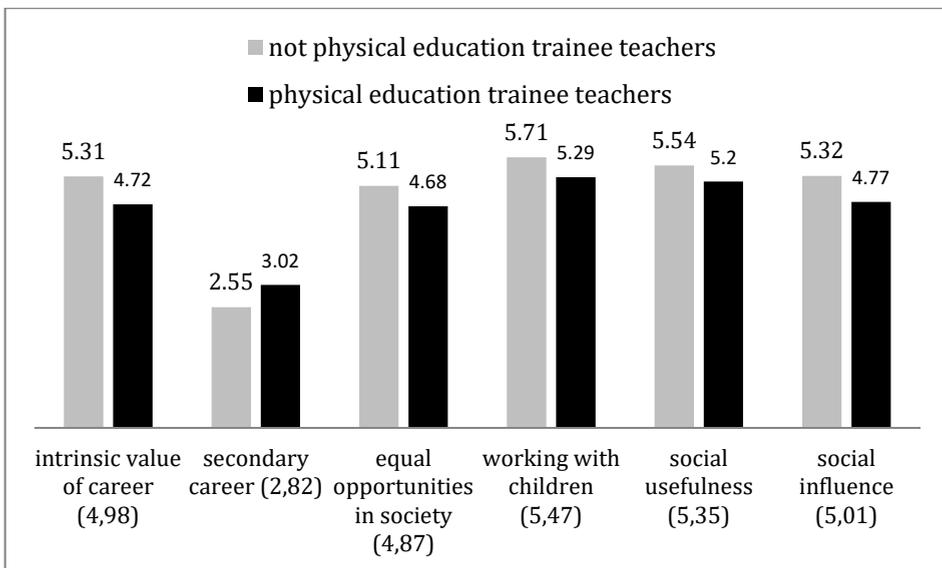
**Table 1.** Significant correlation values of factors affecting personality traits  
(Cronbach alpha=0.864)

	Psycho- ticism	Impulsi- vity	Ventures- omeness	Neuro- ticism	Social confor- mity	Extro- version	Empathy
<b>Level of sport Sport in childhood</b>			0.260	-0.270			-0.126
<b>PE major</b>			0.191	-0.220			
<b>Female (gender)</b>	-0.133		0.315	-0.248		0.161	
<b>Age</b>		-0.130	-0.229		0.250		

Our hypothesis was partly confirmed, as sporting habits together with physical education show a positive, moderately weak correlation with venturesomeness and a moderately weak negative correlation with neuroticism. This means that previous and current sporting activities and studies in physical education increase students' risk-taking habits, and these students are more likely to take risks to gain success or experience. However, at the same time, they are more likely to control their feelings, are emotionally more stable, and their nature is less changeable. Current sporting habits negatively affect empathy; they are less humane or sympathetic, and are more sociable and feel better in larger communities. At the same time, our hypothesis is refuted because impulsivity correlated only with age as the tendency for impetuous impulses and venturesomeness without assessing the consequences decreases by age. Gender also affects personality traits as men are more prone to break the rules and extreme manifestations, while women are less likely to do so. Women are more likely to comply with social rules and moral norms. Being a woman has an effect opposite to sporting habits concerning venturesomeness; they are more restrained and less likely to engage in risky activities. Overall, although sporting habits have a significant effect on several personality traits, they mostly influence venturesomeness and neuroticism, while other factors influence some personality traits, so we were only able to prove our hypothesis partially.

In our third hypothesis, we aimed to examine whether there is a significant difference in career motivation factors between physical education and non-physical education trainee teachers. To demonstrate this, two-sample

independent t-tests were used. When examining the motivational factors, we found significant differences between the two groups, and these differences mostly point out that non-physical education trainee teachers have more positive characteristics as they are more motivated. Among physical education trainee teachers, only the value of the secondary career path achieves a higher score (Figure 4), which means that students in physical education are more likely to have chosen this career not only because of the love of the career but because of the lack of better opportunities or they were motivated by possible second jobs and the opportunity to start a coaching career. This fact is also supported by the fact that other motivational factors show a higher level among non-physical education trainee teachers.



**Figure 4.** The investigation of motivational factors according to majors (mean) N=244

An impressive result is that even for those factors where no significant difference could have been detected between the two majors, there is a general tendency for non-physical education teacher majors to be slightly more motivated. At the same time, based on the sub-factors belonging to the personal usefulness factor, it can be said that the difference in terms of personal usefulness is minimal ( $M_{PE}=4.33$ ,  $M_{non-PE}=4.30$ ). In contrast, a significant difference can be observed regarding the social usefulness factor, which is higher among non-physical education trainee teachers ( $M_{PE}=5.20$ ,  $M_{non-PE}=5.54$ ).

Our fourth hypothesis stated that there is a correlation between grade, gender and motivational factors. It was based on the fact that the majority of teachers are women, and a significant proportion of graduates are not employed in the teaching profession. The reasons for this can be found in career motivation and the attractiveness of the profession. Our research examined the correlation between grade and gender and the value of motivational factors by correlation analysis. We found a negative correlation between the grade and the students' motivation level, i.e. the career motivation of the trainee teachers decreases with the increase of the grade (Table 2).

**Table 2.** Values of correlation of grade and gender with motivational factors (N=244)

<b>Motivational factors</b>	<b>Correlation coefficient of the year</b>
<b>Ability</b>	-0.152 <sup>x</sup>
<b>Intrinsic value of career</b>	-0.141 <sup>x</sup>
<b>Secondary career path</b>	0.091
<b>Job security</b>	-0.064
<b>Time spent with family</b>	-0.084
<b>Workplace mobility</b>	-0.133 <sup>x</sup>
<b>Personal usefulness</b>	-0.112
<b>Shaping the children's future</b>	-0.161 <sup>x</sup>
<b>Strengthening equal opportunities in the society</b>	-0.104
<b>Social contribution</b>	-0.142 <sup>x</sup>
<b>Work with children</b>	-0.117
<b>Social usefulness</b>	-0.149 <sup>x</sup>
<b>Previous teaching experience</b>	-0.128 <sup>x</sup>
<b>Social influence</b>	-0.102
<b>Teaching career motivation</b>	-0.158 <sup>x</sup>

This means that trainee teachers lose motivation already during the time spent in teacher training. Thus, the level of motivation after the training is lower than that observed when entering the training. Significant values are

highlighted in the table. Several reasons can cause a decrease in motivation. The individual may recognise his/her unsuitability for the career during the training. However, during the time spent in the training, the intrinsic value of pedagogical work and the social usefulness of the teaching status also decrease in the eyes of the students, which change the image of the students. Based on our results, it can be said that this change is negative, and this significant difference can be found even in career motivation as a main factor. Only the secondary career path sub-factor shows a positive direction, which indicates that the teacher candidate did not choose the profession due to the beauty and attractiveness of teaching. Although these results give a picture of trainee teachers' career motivation, they serve as basic information as the creators of the Fit-Choice-scale measuring career motivation did not take into account career motivation as a main factor and personal or social benefit factors, only their sub-factors.

In addition to grade, personality traits also have a significant effect on motivational factors, which was confirmed by correlation analysis (Table 3).

**Table 3.** The correlation between personality traits and motivational factors (N=244)

	Psychoticism	Impulsivity	Venturesomeness	Social conformity	Extroversion
<b>Ability</b>			-0.140		
<b>Intrinsic value of career</b>			-0.228	0.192	
<b>Secondary career path</b>	0.208	0.153	0.182		
<b>Workplace mobility</b>		0.149			
<b>Personal usefulness</b>		0.128			
<b>Strengthening equal opportunities in the society</b>			-0.137		
<b>Social contribution</b>					0.156
<b>Work with children</b>	-0.174		-0.187	0.147	
<b>Social usefulness</b>				0.150	
<b>Social influence</b>		0.141	-0.147		

As venturesomeness increases, career motivation factors change in a negative direction. Intrinsic motivational factors are less important for risk-takers, and the profession's secondary career nature is more important. On the other hand, the increase in social conformity and the desire to meet social expectations positively affect career motivational factors. According to them, teaching is a value; they prefer to deal with children and consider the social

usefulness of pedagogical work more significant. Among the personality traits, impulsivity also has a positive effect on motivational factors. They are those being prone to make rash decisions, which is confirmed by the results because they can be influenced more easily, have a higher level of social influence, and in addition to the social influence, they are motivated mainly by personal usefulness and workplace mobility, but also by secondary career path. On the positive side, the secondary career path, which expresses that the person did not choose a career because of the beauty of the teaching work or the social usefulness, is the most noticeable to those personality traits that are less characteristic of trainee teachers.

### **Discussion and conclusion**

Before starting our research, it was typical that the number of young teachers decreased despite the increase in the number of students enrolling for teacher education. This can be traced back to the lack of material and social appreciation of the pedagogical society. According to the teachers and the students participating in teacher training, the difficulty of the career is not proportional to the salaries. The wage of teachers compared to other graduate jobs plays an important role when applying for training or after graduation, which can reduce the attractiveness of the teacher career. However, intrinsic and altruistic motivational factors are more important for applicants of teacher education. The teaching career is mostly attractive for women, which is also confirmed by the gender distribution of teachers, as approximately 80% full-time teachers are women. In addition to knowledge transfer, educational tasks and personality development are also part of the pedagogical profession, which requires a mature personality. Personality dimensions also influence teaching career choice motivation. Concerning motivation, it is crucial to carry out activities following our values.

In our research, the sample was given by 244 trainee teachers of the University of Nyíregyháza, whose personality traits and career motivation were examined by a questionnaire. In our study, applying two-sample independent t-tests, we proved that the personality traits of physical education trainee teachers significantly differ from those of non-physical education trainee teachers. Physical education trainee teachers are more willing to take risks, are more sociable, more extroverted than non-physical education trainee teachers, and are more emotionally stable and respond more calmly to various stimuli. Our study confirmed previous research findings (Batta et al., 2020) with correlation analysis between sporting habits and personality traits, according

to which sporting habits have a positive effect on venturesomeness and extroversion and reduce emotional lability and empathy. However, we did not find a significant relationship between sporting habits and physical education concerning other personality traits. It does not show a significant relationship with psychoticism. Men are much more prone to extreme behaviour, while in the case of impulsivity, age shows a negative correlation as the degree of impulsivity decreases with age.

Regarding career motivation, we found that there is a significant difference between the two groups. Physical education trainee teachers are less motivated than non-physical education trainee teachers, and the secondary career nature of the profession is more important for physical education trainee teachers than for non-physical education trainee teachers. This may be due, among others, that the proportion of men in physical education is higher than that of women and that gender also has a significant effect on motivational factors. This is evidenced by the fact that the correlation between gender and motivational factors is stronger than the correlation between physical education and motivational factors. Women are much more motivated, and the nature of the teaching profession and the social benefits of work are more important for them. For non-physical education trainee teachers, the secondary career nature shows a negative relationship, indicating that they are more attracted to the beauty of the career. We also examined the relationship between grade and motivational factors with correlation analysis which showed that career motivation significantly decreases by grade, and the level of input motivation is higher than the level of output motivation. We also found a significant correlation concerning the effect of personality traits on career motivation. We observed that venturesome personality traits negatively influence career motivation and increase the secondary career character of the teaching profession. Also, impulsivity shows a positive association with personal usefulness, secondary career path and social influence, while social conformity correlates with the beauty of the teaching profession and social usefulness.

Our research confirmed the significant differences between athletes and non-athletes concerning personality. Also, it shows the appearance of this among both physical and non-physical education trainee teachers. Our research provides a picture of the motivation of the physical education teacher and other trainee teachers, as well as the differences between the groups. It helps to explore the factors influencing teacher career motivation and the degree of correlation. Our research proved that during the time spent in training, the image of trainee teachers about the teaching career changes, their motivation and thus, the attractiveness of the career decreases.

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## PERFORMANCE MODEL IN SITTING VOLLEYBALL: THE RIO 2016 PARALYMPIC GAMES CASE

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**ABSTRACT. Objectives.** Sitting Volleyball has been a Paralympic discipline recognized by the IPC since 2004 and has been part of the FIPAV sports disciplines since 2013, under the aegis of CONI and CIP. **Material and Methods.** This research aims to identify the Performance Model in Sitting Volleyball and define the correlations between gestures or phases of the game and victory. The sample includes the eight male and the eight female finalists of the competition for the gold medal of Rio 2016 Olympics Games. **Results.** The results confirm Sitting Volleyball as an attacking sport in both the male and female sectors. **Conclusions.** The efficiency of the attack turns out to be correlated to the victory of single sets. In the female sector, the serve is a winning tactical weapon; the block is more consistent in the male one. Ultimately, the quality of the side-out and breakpoint phases is correlated to the victory of the single set.

**Keywords:** *sitting volleyball, Paralympics, adapted sport, performance, model.*

### Introduction

Sitting Volleyball has been a Paralympic discipline since 1980 but its history has distant roots in time. It was in the wake of the Stoke Mandeville International Games, when Sitting Volleyball was introduced in 1956 in the Netherlands, by Tammo Van de Scheer and Anton Albers, as a new sport that could bring together the characteristics of traditional volleyball and Sitzball.

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The aim was to allow wounded or amputated soldiers of the Second World War to practice sports. The bet was that constant physical activity could have improved social relationships and the physical recovery of injured people. Sport proved to be a fantastic catalyst for increasing people's physical well-being, both from a physiological (endorphin) and emotional (Matthews, Sukeik, Haddad, 2014) (Interaction with others) point of views (Bragaru, Dekker, Geertzenm Dijkstra, 2011). Thousands of war veterans needed to get out of their homes, to socialize.

In the same period, there were several attempts to practice volleyball while sitting on a wheelchair, but it wasn't successful, perhaps due to the excessive static nature of the game. Also, in England, Standing Volleyball was being developed: a game played by amputated athletes while standing. The two disciplines under the aegis of the ISOD (International Sport Organization of the Disabled) were performed as exhibition disciplines, only for the men's tournament of the 1976 Toronto Paralympic Games, but later included as official disciplines in 1980 in Arnhem, Netherlands.

Until the 2000 Sydney Games, the two sports had a parallel development. However, in 2004, Standing Volley was removed from the Paralympics to make room for women's Sitting Volleyball. Today, Sitting Volleyball is known all over the world and played not only in Europe, but also in America, Africa, Asia and Oceania, coordinated in each continent by the relevant organizations: ECVD (European Committee Volleyball for Disabled), PACVD (Pan -American Committee Volleyball for Disabled), ACVD (African Committee Volleyball for Disabled), AOCVD (Asia Oceania Committee Volleyball for Disabled); organizations that respond to the WOVD (World Organization Volleyball for Disabled) and the I.P.C. (International Paralympic Committee).

Sitting Volleyball is a sport in which disabled and able-bodied people can play together at a very high technical level and it represents an opportunity for cooperation and integration. As numerous scientific studies suggest, sports activities involving children with disabilities can reduce negative attitudes towards disability in able-body children.

This discipline is widespread internationally. Now, the most important worldwide representatives are Italy, Brazil, Iran, USA, Russia and Serbia. In these countries, for various socio-cultural reasons, there is a very strong and significant movement involved in the Paralympic disciplines, attributable to the sports, military and public health heritage of these contexts.

## **Research objectives and hypotheses**

The aim of this paper is to define Performance Model in Sitting Volleyball and useful parameters for the achievement of victory. Sitting Volleyball is still in a pioneering phase and it lacks many performance analysis tools. Furthermore, the performance model is not well defined and formalized yet. Fortunately, volleyball, from which it has borrowed many aspects of the game, is on the contrary at a very advanced stage in terms of match analysis and definition of the performance model.

Match analysis in volleyball has become standardized worldwide and it is a fundamental engine of teams. It allows to monitor the game informing the players about their performance, through an objective tool.

"Until these operations were entrusted to the sensations of the coaches, the interventions were conflicting and above all not very convincing, because they lacked the fundamental requirement of objectivity" (Lombardozzi et al., 2000).

Many parameters are available to Sitting Volleyball. In detail, this research aims to identify:

- The parameters to establish a Performance Model in Sitting Volleyball in terms of effectiveness and efficiency of technical gestures, ball change and breakpoint systems.
- Specific sport correlations between the aforementioned gestures or systems and victory / defeat.

## **Material & methods**

The match analysis focused on the matches played during the 2016 Paralympic Sitting Volleyball Games. The 6 final matches of women's competition were analyzed. Data Volley was the software used to build the performance analysis in Sitting Volleyball; it is normally used in volleyball and beach volleyball. This software is set on the volleyball rules; it was therefore necessary to create some customized parameters (so-called "customizations") to comply with some different rules (e.g. the block on the serve).

A very important process for the construction of a Performance Model in Sitting Volleyball has been the construction of "universal" parameters that can be adopted as valid indicators of the performance. For this reason, during the research, interviews with privileged witnesses were used, such as coaches, players, referees from the world of Sitting Volleyball, both at national and international level. From these elements, it was possible to build a first set of tools useful to highlight the main characteristics of Sitting Volleyball and to underline the most critical points with the statistical analysis software.

## **Results**

### ***The serve and its directions***

The serve represents the beginning of the game and therefore assumes a strategic importance. The study did not reveal, in line with what was hoped, a particular direction of the serve, but a very varied range both of the starting point and of the arrival point emerged. The most used serve in the competition is the float, followed by the "hybrid" and lastly the "spin". These serves differ greatly from each other:

- Float: this effect literally makes the ball float in the air, making its oscillatory trajectory difficult to receive. It is often used as a tactical weapon.
- Spin: this effect, typical of a powerful hit, makes the ball spin from top to bottom with a powerful wrist movement.
- Hybrid: serve that starts with one of the two effects and ends in the other; often used to hide real intentions to the opponent.

Hybrid serve is interesting in women. Players pretend to throw the "float" ball, stationary, without rotation, and then perform a spin, often top-spin (ball rotation from top to bottom). Other times, more rarely, the opposite happens. This much greater use, compared to volleyball or beach volleyball, is probably due to the extreme speed of the game and the small size of the field that make it essential to use a lot of feints to hide intentions from the opponent.

The low presence of spin serves, widely used in volleyball especially by men, is probably due to the constant presence of the opponent's block. This type of serve is effective if it passes close to the upper belt of the net. The block forces the player to raise serve parable. In the following graph, you can see the uses in women's teams of the serve. Only two national teams use the "spin", confirming what was said previously.

The quality of the serve is measured according to the canonical standards of volleyball evaluation. The management of this aspect shows numerous similarities with the serve of other similar sports. Errors represent an important part of the performance especially for women. Furthermore, it is very interesting to notice that women take more risks (more errors) but then score more points (indeed, there is a higher efficiency). With men, however, the lower efficiency stands out probably due to the presence of the block.

### ***Serve-block correlation***

Another very important part of the performance is the serve-block correlation, which, in the case of Sitting Volleyball, is a unique feature among the return sports. In these sports the serve is usually performed without

obstacles; the ball passes over the net into the other court and the opponent often intercepts it at considerable distances from the net. This prevents the attack construction or makes it more difficult to approach the net. In Sitting Volleyball, the server must take into consideration the presence of the block and its organization. From the data collected it emerges that in women about one block out of six (16%) is made after the opponent's serve. This is a significant data considering the usual comparison with other sports. With men the percentage lowers but we must not forget that the number of attacks is almost double (n male attacks = 1909; n female attacks = 1095) with the number of serve that instead remains with similar values (male = 1125; female = 844). However, it is important to consider as well that the data analysis is based on one match (5 sets) more with men than with women.

By analyzing the video, the authors realize that the block is extremely important for the economy of the game. Indeed, the efficiency is very high. The block represents a fundamental strategic key.

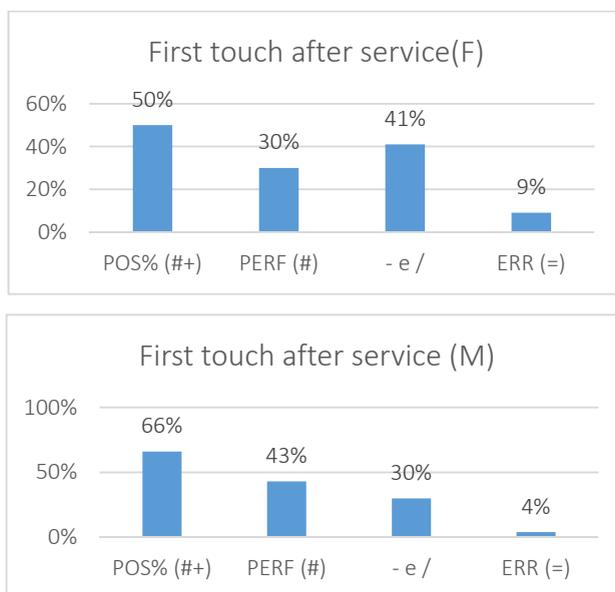
The number of players on the block is another important performance factor. Rarely there is not any person on the block, while there are many occurrences of 3-player blocks, especially with women. As expected, due to the difficulty of moving, this type of block is carried out mainly against the opposing middle-hitter or by spikes from the center of the net.

The block has a high efficiency in relation to the number of touches made and considering that in indoor volleyball it is often difficult to reach 10% efficiency in this fundamental.

### ***Receiving and related schemes***

Through the video analysis, various receiving schemes were observed. The trend is to keep three people on the second line to make the first touch and three people on the front line very close to the net to make the block on the serve. In Sitting volleyball, the execution techniques are very specific and related to the athlete disability. Furthermore, the serve is often directed towards the setter to force him making the first touch, thus preventing him from carrying out his task on the second touch.

The quality of receiving, the first touch after the opponent's serve, is very interesting. As shown in the graph, most of the first touches received a positive or perfect evaluation, while less than one out of 10 was a direct or indirect ace.

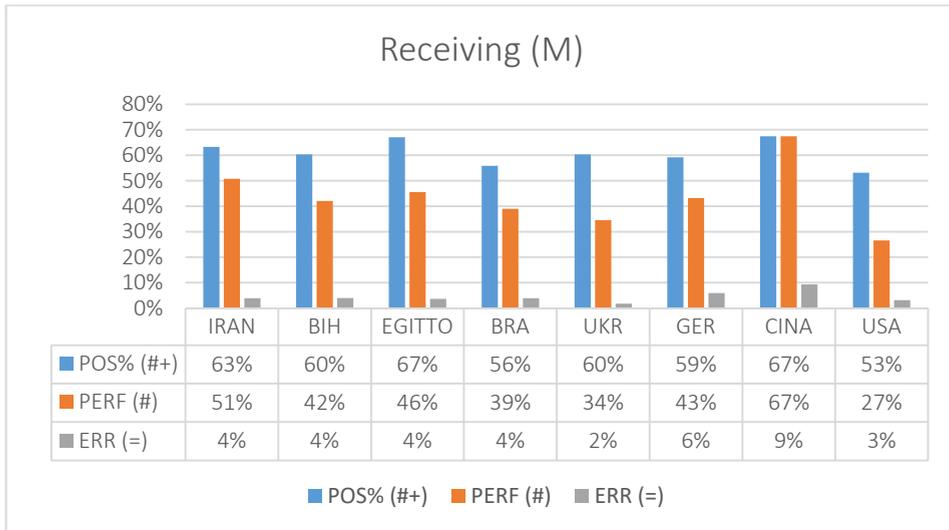


**Figure 1.** Quality of female (n=696) and male (n=988) receiving.  
Note that the perfect receiving is part of the positive receiving.  
The Data Volley software also reports within the positive receiving (POS) the perfect receiving (PER).

Since the Sitting volleyball court is very small compared to its participants, there are less chances of error. In addition, the block on the serve greatly influences the strength of the opponent's serves, making them less incisive. In fact, a positive increment in performance can be seen with men. By regulation, it is allowed to receive both in set and in bagher. Sitting volleyball players prefer for ease of execution to perform mainly the set receiving; however, one out of three first touches is performed in bagher, especially in the case of powerful or short serve. Therefore, both techniques are useful and functional to the game of sitting volleyball and both must be trained. With men it is evident that Egypt and China are the teams that performed higher quality receiving. With women, Brazil achieved better quality on the first touch, followed by the USA and China.

The figure below is very useful to allow national teams in comparing their performance with their competitors. One of the elements widely used in match analysis is the performance comparison to see any congruence or non-congruence of the Performance Model of each team.

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**Figure 2.** Receiving in Male, a comparative analysis.

### ***Identification of the setter(s)***

This aspect of the game is not easily standardized. The setter, the manager of the second touch, in volleyball and beach volleyball has a very high importance in managing the game. He is an equally important figure in the game of Sitting volleyball. There is a general tendency to have only one player managing the second touch. Each team evolves its game based on the characteristics of both the setter and the team itself in a constant adaptation aimed at maximizing the ability to score in each situation. Indeed, in some teams two or three players set the ball for hitters.

### ***Distribution of the second touch***

This study allows understanding which player attacks the most and how effectively and efficiently the attacks were carried out. Usually, the percentages of effectiveness and efficiency of the attack areas decrease as the number of balls increases, a phenomenon that occurs also in volleyball and beach volleyball, due to a physiological decrease in performance during the match. Thanks to this analysis, it is possible to easily identify the trends of setters, automatically highlighted by the program with black squares, or non-trends (e.g. areas with low quantities, where few balls arrive) automatically circled in red.

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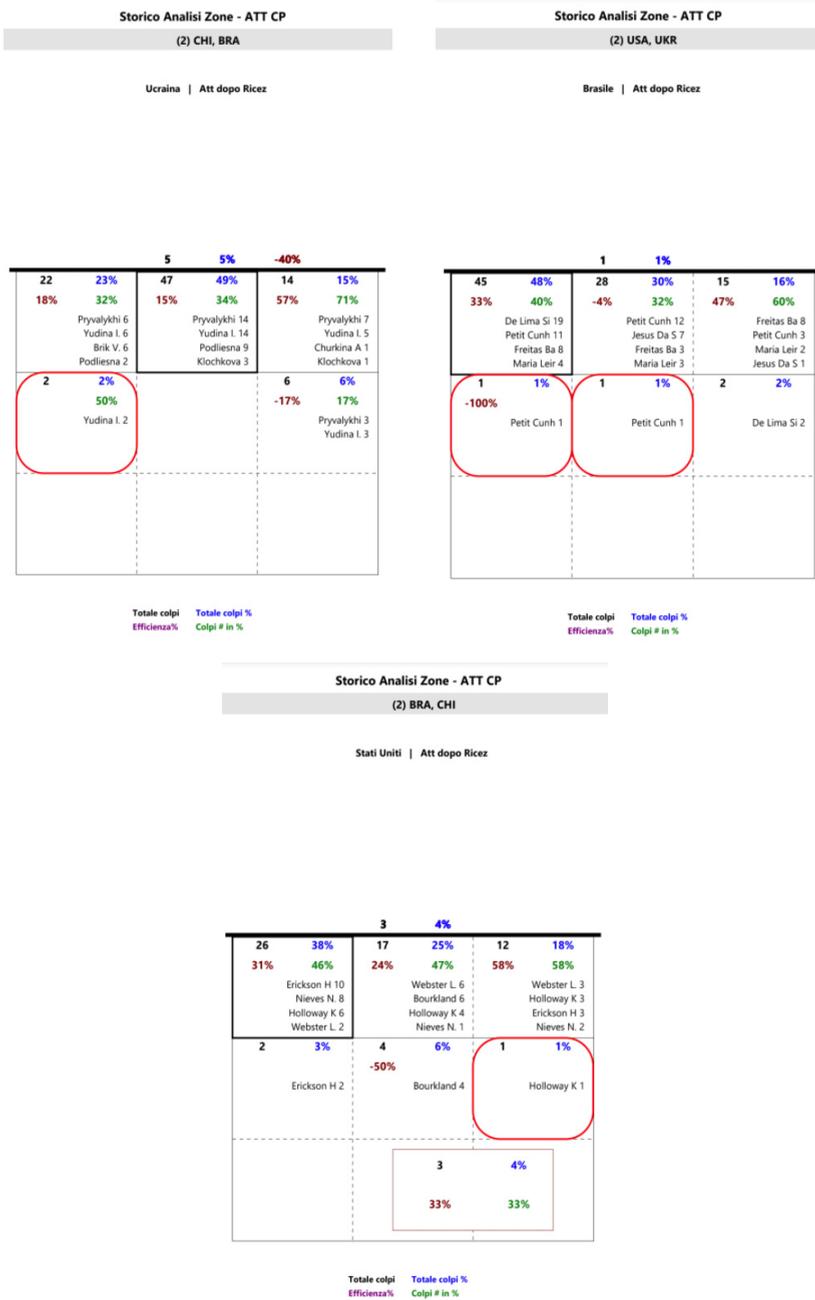


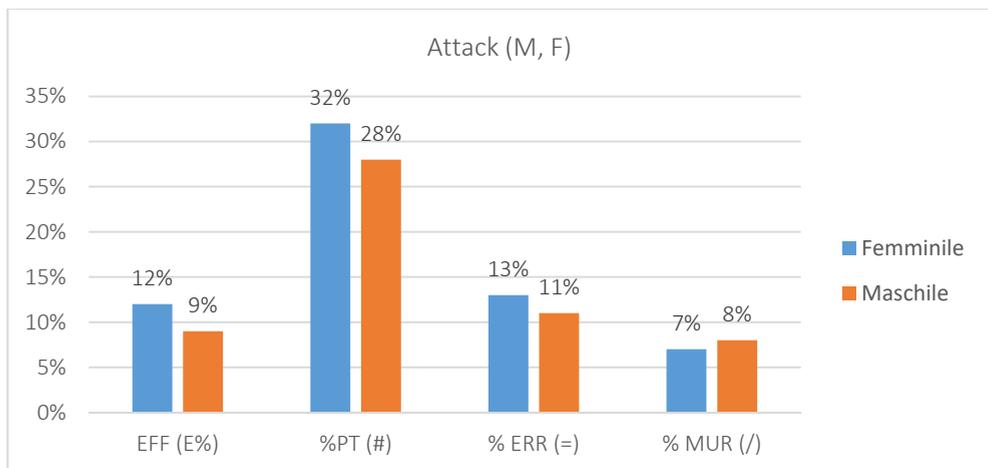
Figure 3. Distribution of the setter (Ukraine, Brazil and USA)

It has been noted that the distribution of setters tends to be balanced in some cases and to be unbalanced in other areas of the field for others. This is certainly due to individual and team characteristics. For example, teams like Iranian men rely on a single player in attack, while other teams have more players on a homogeneous level.

***Attack and its directions (with a particular focus on first and second intention attacks)***

The spike in Sitting Volleyball is the most used gesture to win a point. All the efforts of the team, as well as the organization and division of roles within the team, is aimed at being able to attack. On the other hand, the opponent tries to prevent it in all ways or to limit its effects, through the block and the serve.

Comparing the quality of spikes, a lower efficiency emerges with men, due to a greater difficulty in performing the spike while sitting and the constant presence of the opponent's block too. Very interesting features of Sitting Volleyball are spikes performed before the third touch. In volleyball and beach volleyball, there are many types of attacks called first intention often performed by the first line setter.



**Figure 4.** Attack, a comparative analysis between Male (M) and Female (F)

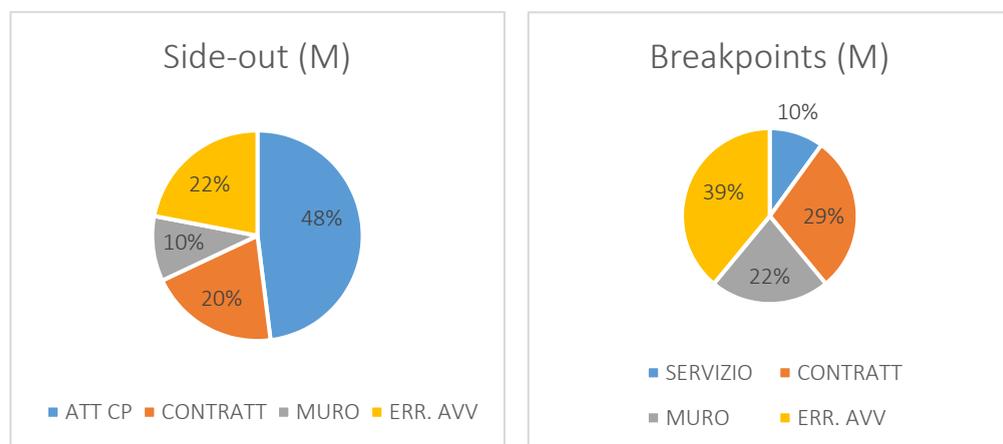
In Sitting Volleyball, due to the speed of the game and the difficulty of moving, there is a very high frequency of spikes performed on the second touch (13%), on the first touch (7%) and even on the first touch after the opponent's

serve (1%) in women. Focusing on men, the spike on the third touch (86%) rises, even if first or second intention spikes are still important variables (9% and 4,9% respectively).

### ***Side-out and breakpoint***

Side-out is the game phase where players do the three (or less) touches after the serve. Breakpoint is the game phase after the side-out. Conventionally, the serve is part of the breakpoint. Points during the side-out and breakpoint phases are usually scored with spikes. The side-out data are very similar for men and women. This is very different from volleyball or beach volleyball where men perform better than women. The breakpoint phase in during the interview with privileged witnesses, it emerged that fouls represent a very important variable of performance. As previously seen, the difficulties of the game, both physical ones and those deriving from the game itself (e.g. quick actions) lead to various situational errors. Most of them are attack fouls, followed by lifting fouls, and serve fouls. In men, the increase in receiving errors stands out. However, it is not possible to say that fouls are so crucial for the performance. On the other hand, the competitions analyzed are part of a Paralympic final, so athletes are well trained and do not generally commit fouls. Stead differs between men and women, especially the block and the counterattack.

In the breakpoint phase, almost half of the points are scored thanks to opponent's errors.



**Figure 5.** Side-out and break-point in Male.

Within an international competition of this level, such many errors were not expected.

***What are the performance factors that determine a winning performance?***

For this last analysis we want to proceed for two research lines:

- What happens in the field of a winning or losing team?
- Is there any correlation between victory and a technical gesture or between victory and a phase of the game (side-out or breakpoint)?

From the analysis of the data, it emerged that the quality of serve, receiving, attack and blocking is important for women. The US team, which won the competition, can be a performance benchmark. In the male sector, Iran is the winning team and its performance can be taken as a performance model. The high quality of receiving, attack and block can be compared to the losing teams. Attached to this document there are two tables for men and women.

In the previous analysis, the authors described the performance. Nevertheless, is there a correlation between some fundamentals or phases of the game and the victory of a set?

Different aspects of the game were analyzed, such as serve, receiving, side-out, breakpoint and block. The aim is to understand if these factors were connected or not with the overall performance. The analysis was divided into the female sector and the male sector.

First, summary tables were created with all the values of the performance of the winning team and the respective loser in the women's and men's sectors. An arbitrary value was then attributed to the set won or lost:

- 0 (zero) in case of a lost set
- 1 (one) in case of a won set

Giving a number to victory or loss makes it easier to identify any correlations between sets won and the fundamental taken into consideration. The correlation was calculated through the Pearson correlation index obtained by comparing the won/lost sets (which correspond for convenience to the values 1 and 0) to a certain aspect of the game. The table below shows a brief example of how the data analysis was set up. A similar table was created for the female teams.

The different aspects of the game didn't show any strong correlation, but there are several correlations for the serve and the efficiency in attack. This was expected for a complex game such as sitting volleyball. Indeed, it must be considered that the Performance Model is not universal as each team can find its own way to achieve victory. It depends also on the individual characteristics of its components, and on many measurable, intangible, or even random variables.

**Table 1.** Set analysis (M)

		Serve	Receiving		Attack		Attack Side-out		Attack Breakpoint		Block
Match	Set	EFF%	POS%	(PRF%)	EFF%	PT%	EFF%	PT%	EFF%	PT%	EFF%
<b>EGI-BOS1</b>	0	42%	44%	33%	3%	19%	18%	18%	-4%	19%	-6%
<b>EGI-BOS1</b>	1	54%	76%	52%	6%	20%	29%	33%	-9%	12%	0%
<b>EGI-BOS2</b>	0	56%	79%	50%	-10%	16%	-8%	15%	-11%	17%	32%

Sport excites above all for its high degree of unpredictability and this must be taken into consideration for research. On the other hand, at very high levels, the structure of the game, the level expressed by individual players and the evolution of the game itself bring out common features that play a key role for victory. A single aspect of the game cannot be deeply linked to victory; otherwise, the game would be dominated by only one aspect of the game.

**Table 2.** The drawn up for the women's sector

Serve	Receiving		Attack		Side-out		Breakpoint		Block
EFF%	POS%	(PRF%)	EFF%	PT%	EFF%	PT%	EFF%	PT%	EFF%
0.47	0.22	0.29	0.45	0.39	0.28	0.29	0.34	0.3	0.3

**Table 3.** The drawn up for the men's sector

Serve	Receiving		Attack		Side-out		Breakpoint		Block
EFF%	POS%	(PRF%)	EFF%	PT%	EFF%	PT%	EFF%	PT%	EFF%
0.22	0.18	0.31	0.61	0.65	0.50	0.58	0.48	0.50	0.32

Subsequently, graphics were created for every aspect of the game considered relevant. The serve is the starting point of the game and one of the first things to be learned. It is no coincidence that in all return sports it has a very high strategic importance. The following graph shows that for women the possibility of winning a single set (blue line) increases as the efficiency in serve also increases (orange line).

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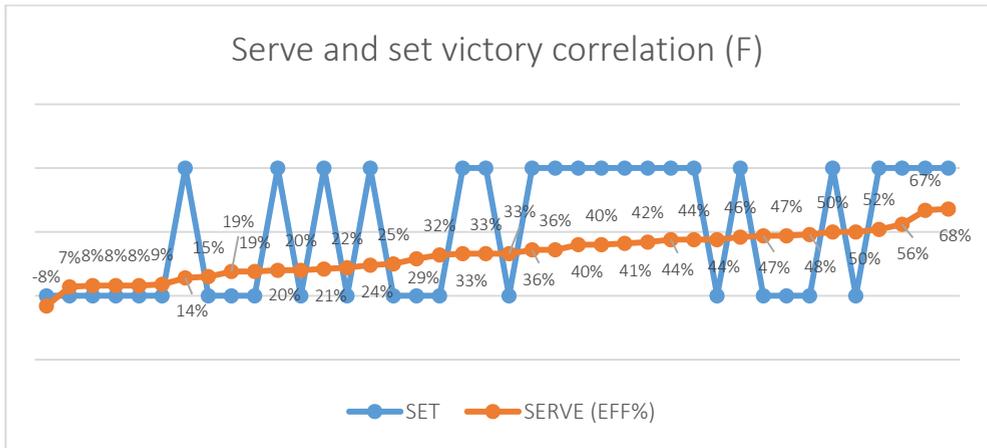


Figure 6. Serve and set victory correlation

The same phenomenon can be observed in the attack. As the attack efficiency increases, the probability of winning a single set in both the male and female sectors increases. The correlation is stronger for men than for women.

In the men's sector, there is a correlation between points scored in attack and the victory of a set. The Victory of a Set, in terms of Attack Points, can be identified in three moments:

1. Lost Point: Under 20% the team has a high probability of losing.
2. Uncertainty plateau: between 20% and 29% the performance is unstable.
3. Win point: above 30% there is a high probability of winning the set.

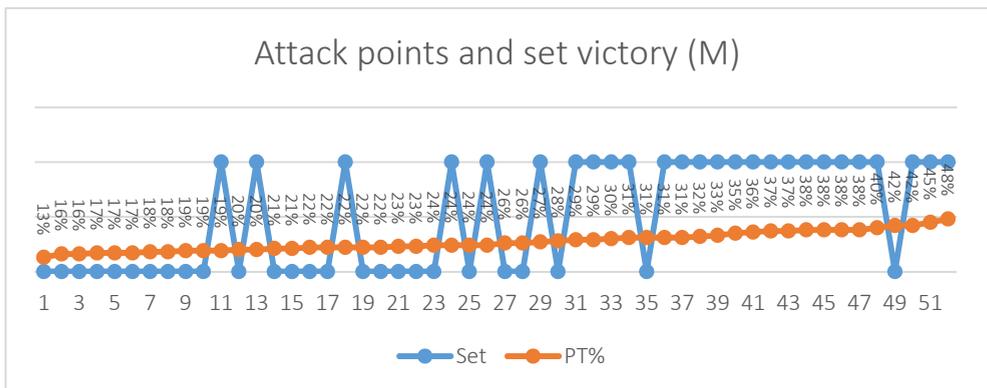


Figure 7. Attack points and set victory in male

Concerning other aspects of the game, no significant correlations were found that could clearly influence the game. For this reason, another type of analysis was used. Julio Velasco<sup>3</sup> used to say that in Volleyball “you don’t have to play well, but better than others”, underlining a recurring concept of Sports Games. The performance expressed depends on and it is greatly influenced by the opponent. For this reason, another set of data has been created starting from the previous analysis, highlighting the difference in performance in that gesture or phase of the game. This “Differential” algebraically subtracts the performance of one team from that of the other; for example, the serve efficiency of team “A” subtracts from the serve efficiency of team “B” and vice versa.

**Table 4. Male differential**

Differential	Serve	Receiving			Attack		Side-out Attack		Breakpoint		Block
		Match	Set	EFF%	POS%	(PRF%)	EFF%	PT%	EFF%	PT%	
<b>EGI-BOS1</b>	0	-12%	-32%	-19%	-3%	-1%	-11%	-15%	5%	7%	-6%
<b>EGI-BOS1</b>	1	12%	32%	19%	3%	1%	11%	15%	-5%	-7%	6%
<b>EGI-BOS2</b>	0	24%	29%	14%	-28%	-20%	-53%	-40%	-11%	-7%	-9%

The next table shows the connection between the differentials of the gestures and the game phases and the victory of a set.

**Table 5. Female Differential**

Differential	Serve	Receiving		Attack		Side-out		Breakpoint		Block
	EFF%	POS%	(PRF%)	EFF%	PT%	EFF%	PT%	EFF%	PT%	
<b>Correlation</b>	0.73	0.38	0.40	0.6	0.55	0.35	0.40	0.48	0.42	0.48

<sup>3</sup> Julio Velasco is an Argentine sports manager and volleyball coach naturalized Italian, technical director of the youth sector of the FIPAV. His fame is linked to his role as head coach of the Italian national men's volleyball team, a position he held from 1989 to 1996: under his management the Azzurri, who had previously been on the fringes of world volleyball, during the 1990s became one of the strongest teams of all time, in what has gone down in history as the epic of the “generation of phenomena”.

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**Table 6. Male Differential**

Differential	Serve		Receiving		Attack		Side-out		Breakpoint		Block
	EFF%	POS%	(PRF%)	EFF%	PT%	EFF%	PT%	EFF%	PT%	EFF%	
Correlation	0.29	0.22	0.42	0.82	0.76	0.68	0.70	0.66	0.65	0.46	

A summary table with all sitting volleyball performance indicators was then created. Achieving these benchmarks can indicate whether one's team has a high chance of winning or not.

**Table 7. Performance values**

	Lost point	Uncertainty	Win point
Serve diff (F)	< -20%	-20% / 20%	> 21%
Attack diff (F)	< -4%	-4% / 3%	> 4%
Attack Eff diff (M)	< -4%	-4% / 3%	> 4%
Side-out diff (M)	< 10%	9% / 10%	> 11%
Break-point Eff diff (M)	< 10%	9% / 9%	> 10%

## Conclusions

In the female sector, the fundamentals that considerably determine performance are the serve and the attack. In the male sector, the attack in all its forms, both general and in the ball change phase and in the breakpoint phase, acquires a significantly more important dimension than in the female sector. The serve loses its value also considering the higher number of centimeters that the men block manages to oppose.

In both areas it is interesting to note that the accuracy in the first touch is not so indicative of the ability to win the set, even if the error number can affect his defeat. In fact, it can be said that the first receiving touch is a technical prerequisite without which it is impossible to build the action and organize an effective third touch. In fact, all the teams manage to express a good average level in this fundamental; when the opponent's serve manages to make consecutive aces, they gain a considerable advantage in winning the set and the game.

The high correlation regarding all attack phases lead to classify Sitting Volleyball as a game devoted to attack, which makes the third touch, in the classic form of the dunk, one of the foundations of the Performance Model. The block also has a very important value. Like receiving, it can be seen as a

block also has a very important value. Like receiving, it can be seen as a requirement, in this case a tactical one, without which it is impossible to think of limiting the opponent's attacks and serves. In particular, the structuring of modern Sitting volleyball, with the low net and one of the smallest fields among all the Sports Games, requires its constant presence both on the serve and on the opponent's attack.

All these analyses are based on the final matches of the Rio 2016 Paralympic Games, which, despite representing the highest competition level in sitting volleyball, must not be seen as a representative number to generate absolute truths and it cannot represent the entire model of sitting volleyball performance. This study represents the beginning of a much longer process that could have lasting effects on the increase in the performance capabilities of sitting volleyball teams, taking them out of their pioneering stadium towards a more professional dimension. Furthermore, it is always worth remembering that

Performance Models are not absolute laws as the game itself evolves continuously; this is especially true for young and growing sports such as sitting volleyball seems to be. Given that team performance essentially depends on the performance of individuals, the turnover of a few elements is sufficient to generate new Performance Models. This does not mean, however, that it is not possible to categorize or reconstruct these models. If the rules and structures on which the game of sitting volleyball remains unchanged over time, it is therefore possible to build forecast performance models.

The institutions on their side must foster this growth. The parent companies producing the Software can easily integrate some Sitting volleyball rules into the Statistical Analysis software, thus allowing easier access from an economic point of view in a truly inclusive perspective.

The organizing bodies and the Federations in charge must support the transition from a niche phenomenon based on the goodwill of individuals, to a sport movement organized with a championship and active recruitment. The constitution of national groups was an excellent step towards this direction, but there is still much to do to equalize the performance towards other international competitors.

However, the performance must not cloud the Sitting volleyball context. Sport in general must not be aimed exclusively at performance, but we must know that transforming sport into a purely inclusive phenomenon risks deflecting its mission in the same way. Sport is fun, participation, performance, group, the joy of learning, challenges with one's limits and many other positive and negative aspects that must all be weighed to use sport as a moment of inclusion in our society.

In conclusion, this study brings significant innovations in the world of Sitting volleyball that can be implemented immediately with a little training and organizational effort.

**Conflicts of interest:**

The authors have not conflicts of interest to declare.

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## THE EFFECT OF INTRODUCING VISUAL FEEDBACK ON SPORTS TRAINING

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**ABSTRACT. Introduction:** Mobile devices are always close to today's young people, contributing to a sedentary lifestyle, but also to the efficiency of sports lesson and training. **Objective:** In this paper we have proposed to analyze the effect of using equipment that provides athletes with visual feedback on the yield in boxing training. **Materials and methods:** The research was carried out between 19/04/2021 – 24/05/2021, being included in the study 27 athletes, divided into two groups: the experiment group (N = 13, the age M = 15.61 (0.31) years)) and the control group (N = 14, age M = 15.28 (0.35)). Equipment was used to record the number of punches performed on the punching bag and the heart rate of the subjects. The data were analyzed with the help of the SPSS 22 program. **Results:** In the sample the maximum number of punches transmitted in 30 seconds, in the initial test the control group recorded averages significantly higher than the experiment group (t = - 2.65, df = 25, p = 0.01). In the final test, the experiment group recorded an increase in the average by 35.7 punches, while in the control group the average increased by 1.71 punches, the difference between the averages the two groups being significant (t = 4.97, df = 25, p < 0.001). **Conclusions:** The results of this study show us that the motivation elements and the visual feedback introduced in the case of the experiment group had the effect of increasing the number of punches transmitted in the boxing bag, compared to the control group.

**Keywords:** *boxing, visual feedback, sports training*

**REZUMAT. Efectul introducerii feedback-ului vizual în antrenamentul sportiv. Introducere:** Dispozitivele mobile sunt mereu în apropierea tinerilor din zilele noastre, contribuind la un stil de viață sedentar, dar și la eficientizarea lecțiilor și antrenamentelor sportive. **Obiectiv:** În prezenta lucrare ne-am propus să analizăm efectul utilizării echipamentelor care oferă sportivilor feedback vizual asupra randamentului în antrenamentele de box. **Materiale și metode:** Cercetarea s-a desfășurat în perioada 19/04/2021 – 24/05/2021, fiind incluși în studiu 27 de sportivi, împărțiți în două grupe: grupa de experiment (N = 13,

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vârsta  $M = 15,61$  ( $0,31$  ani)) și grupa de control ( $N = 14$ , vârsta  $M = 15,28$  ( $0,35$ )). A fost folosit un echipament pentru înregistrarea numărului de lovituri efectuate la sacul de box și frecvența cardiacă a subiecților. Datele au fost analizate cu ajutorul programului SPSS 22. **Rezultate:** La proba număr maxim de lovituri transmise în 30 de secunde, la testarea inițială grupa de control a înregistrat medii semnificativ mai mari decât grupa experiment ( $t = -2,65$ ,  $df = 25$ ,  $p = 0,01$ ). La testarea finală, grupa experiment a înregistrat o creștere a mediei cu 35,7 lovituri, în timp ce la grupa de control media a crescut cu 1,71 lovituri, diferența dintre mediilor cele două grupe fiind semnificativă ( $t = 4,97$ ,  $df = 25$ ,  $p < 0,001$ ). **Concluzii:** Rezultatele acestui studiu ne arată că elementele de motivare și feedbackul vizual introduse în cazul grupei experiment au avut ca efect creșterea numărului de lovituri transmise în sacul de box, față de grupa de control.

*Cuvinte cheie:* box, feedback vizual, antrenament sportiv

## Introduction

In the last decade, a wide variety of devices have emerged that provide information about the health and fitness level of people who perform physical activities for leisure, or for assessing sports performance (Statista, 2014). Coaches are pushed to look for new methods of integrating technological means in sports training, given that there is an almost intrinsic connection between young people and their mobile devices - tablet, phone (Elmore, 2010). However, excessive use of mobile devices can lead to attention deficits among users, including athletes, who are also a category of consumers of IT technology. Analyzing the literature we can see that the vast majority of devices come from or are closely related to the field of fitness, health or sports performance (Lara & Labrador, 2013; Patel, Park, Bonato, Chan, & Rodgers, 2012).

One strategy that physical education teachers and coaches implement in lessons is the introduction of competing elements that have the effect of motivating athletes or students, engaging them in competitions with others or even with themselves.

In order to evaluate and increase performance, athletes need constant feedback in relation to their training program. Feedback can be offered in many forms. Current technology allows the very precise evaluation of many parameters specific to sports performance and, at the same time, their transmission, in real time, to athletes and coaches, who thus have access to a "new world of information" (Phillips, Farrow, Ball & Helmer, 2013). In addition to exact quantification of the monitored parameters, it is possible to obtain, through the specific adaptation of the trainings, the improvement of the respective parameters with

the afferent increase of the sports performance. The real-time feedback given to athletes can - through intrinsic, neuro-physiological and individual psychological mechanisms - effectively complete the training program.

The visual feedback obtained in real time has been used mainly in recent years both to evaluate sports performance and to increase training performance. Significant results in this regard were obtained in many disciplines or branches of sport, and the aspects related to the technology used, the type of feedback used and the monitored parameters were adapted to the general or specific performance objectives in the respective sport discipline. Thus, real-time visual feedback is currently used successfully in many sports. Recent studies confirm the effectiveness of the method in: rowing - with visual feedback of developed power (Lintmeijer, Robbers, Hofmijster & Beek, 2019), artistic gymnastics - with monitoring muscle strength and intersegmental synchronization (Puiu, Dragomir & Bidiugan, 2018), rugby - by assessing the speed of the bar used in endurance training (Weakley et al., 2019), hockey - to develop anaerobic power by highlighting power developed during the Wingate test (Stastny et al., 2018), in learning the optimal technique of running in performance athletes (Eriksson, Halvorsen & Gullstrand, 2018), swimming - for speed control by providing information about the speed of opponents (Szczepan, Zaton & Klarowicz, 2016).

## **Objectives**

In the present research we aimed to analyze the effect of using the visual feedback provided to athletes. We also aimed to evaluate the effects that the introduction of motivating elements in the boxing training program has on the performance and involvement of athletes in each training session.

The hypothesis from which this study has started refers to the fact that the introduction of motivational elements and visual feedback in boxing training will contribute to its efficiency, by increasing the number of punches thrown at the punching bag.

## **Materials and methods**

### ***Subjects***

The study was performed on a sample of 27 athletes from Timișoara, whose selection was made based on the criterion of experience in boxing for at least one year. The selected athletes were divided into two groups: the experiment group (GE) - consisting of 13 subjects with a mean age of 15.61

( $\pm 0.31$ ) years - and the control group (GC) - 14 subjects with a mean age of 15.28 ( $\pm 0.35$ ) years. The experimental protocol was implemented for a period of five weeks, between 19/04/2021 - 24/05/2021, which included the following stages: stage I - initial testing performed on 19/04/2021; stage II - experimental intervention; stage III - the final test performed on 24/05/2021. During this period, the athletes were not performing any kind of training at their clubs, due to the restrictions imposed by the pandemic context.

### ***Equipment used***

The assessment of the maximum number of punches transmitted in the boxing bag in 30 seconds was achieved using a set of sensors composed of an accelerometer and three-axis gyroscope (Hykso sensors). Spss software - version 22 was used to analyze the data, using descriptive analysis tests, data distribution verification and mean comparison (student "t" test for independent samples and student "t" test for paired samples).

### ***Intervention programme***

The intervention consisted in applying the same training program to both groups of subjects. The training program that the athletes went through was designed as a five-week mesocycle, with a frequency of five workouts a week. The workouts included in this mesocycle have been designed in such a way as to gradually increase the complexity and intensity of the effort in the training lessons. In this regard, in the first microcycle the athletes had to perform combinations of punches consisting of two, three or four punches, without using any defense techniques which will be introduced in the following microcycles. A weekly training cycle was composed of five sessions of training. Workouts one and five were composed of six monitored rounds, and workouts two, three and four out of eight rounds for each training session. The total number of punches transmitted to the bag and the average heart rate for each athlete were recorded. The training facility was equipped with a sufficiently large number of punching bags, assigning one athlete to a punching bag, and throughout the trainings to carry out his activity in the same place. At the beginning of each training, the athletes performed 10 minutes of warm-up, consisting of static and dynamic stretching exercises, but also specific dynamic movements. After the warm-up, both groups performed two rope jumping rounds, two rounds of punches and two shadow boxing rounds. Each round last two minutes, at an intensity of 60 to 70% of the maximum heart rate. The monitoring of these trainings was carried out with the help of a boxing punch monitoring equipment (Arnăutu, Buruntia, Hanțiu, 2020).

In the GE group, during the trainings, the subjects had the possibility to constantly view, in real time, on a monitor the number of shots transmitted in the boxing bag (Figure 1).



**Figure 1.** Workout data playback monitor

The subjects were informed that at the end of each training they will be evaluated by a scoring system, and at the end of the training the athlete with the most points will be declared the winner. The standings were made according to the number of punches transmitted to the bag as follows: 1st place – 10 points, 2nd place – 8 points, 3rd place – 6 points, 4th place – 4 points, 5th place – 2 points. Also, a general ranking of athletes was made based on the points accumulated at each training. The control group did not have access to the monitor providing this information and the scoring system was not applied. Instead, they were asked at the end of each round to evaluate themselves by appreciating the number of punches they had sent to the boxing bag.

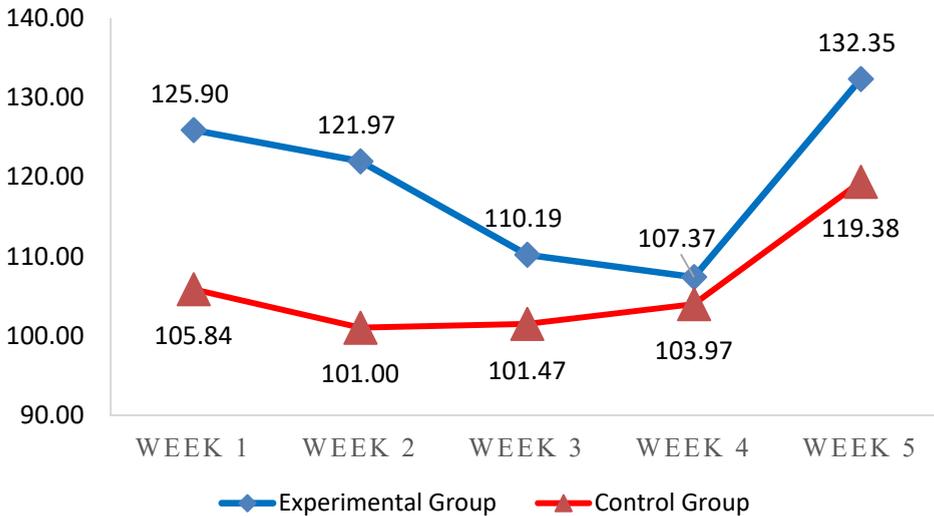
## Results

Evaluating the maximal number of punches transmitted in 30 seconds, GC recorded significantly higher mean than the GE at the initial testing ( $t = -2.65$ ,  $df = 25$ ,  $p = 0.01$ ), the effect size being 0.5, which indicates a medium effect. In contrast, in the case of the final testing, the GE recorded an increase in the mean by 35.7 punches, while in the GC the average increased by 1.71 punches. The difference in the averages between the two groups was 19.25 punches in favor of the GE, resulting in significant differences between the two groups ( $t = 4.97$ ,  $df = 25$ ,  $p < 0.001$ ), the size effect being 0.95 which indicates a strong effect (Table 1).

**Table 1.** Comparison of the means of the punches transmitted to the bag in 30 seconds according to the evaluation time (N=27)

Variable	Time	Group (N)	Mean	SD	Independent t-test			
					t	df	p	d
Number of punches in 30 sec.	T1	GE (13)	91.77	8.992	-2.656	25	0.014	-.511
		GC (14)	106.50	17.999				
Number of punches in 30 sec.	T2	GE (13)	127.46	8.263	4.970	25	0.000	.956
		GC (14)	108.21	11.464				

Regarding the weekly average number of punches to the punching bag, the analysis of the data showed a decrease in the number of punches transmitted in a round from the first week to the fourth week for the experiment group, while the control group recorded a decrease in the mean in the second week, and then increases until the fifth week (Figure 2). The combinations of simple punches, without the introduction of other defense elements, were executed in greater numbers than those combinations that had defensive techniques.

**Figure 2.** Weekly means of the punches of the subjects from the two groups

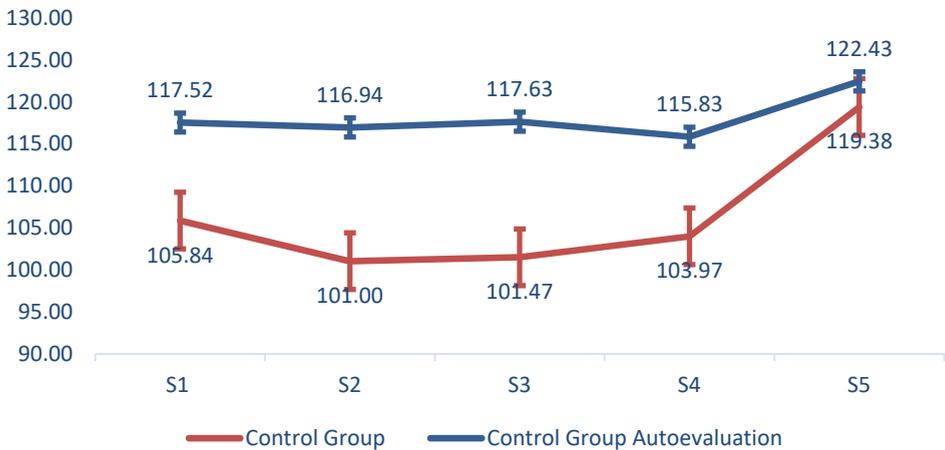
Comparing the results of the experiment group in the initial testing with the final one, we notice that the differences that occurred after the training were significant. The mean value of the maximum number of punches transmitted in 30 seconds in the initial test was 91.76 (8.99), and in the final test 127.46 (8.26), the difference of 35.7 punches being significant ( $t = -10.79$ ,  $df = 12$ ,  $p < 0.001$ ). In the case of the control group, an increase of 1.71 punches could be observed

between the two testing moments, the average of the initial testing being 106.50 (17.99) and that of the final test being 108.21 (11.46). the value of the test “t” being  $t = -0.32$ ,  $df = 13$ ,  $p = 0.75$ . Comparing the average weekly heart rate we could see that the two groups recorded significantly different values only in weeks one and two (Table 2).

**Table 2.** Comparison of weekly heart rate means for the experiment group and control group

Variable	Group (N)	Mean	SD	Independent t-test			
				t	df	p	d
S1	GE (13)	141.70	3.41	2.78	25	0.01	0.53
	GC (14)	138.50	17.999				
S2	GE (13)	145.44	3.75	6.97	25	0.00	1.34
	GC (14)	137.95	1.39				
S3	GE (13)	140.86	2.75	0.60	25	0.55	0.11
	GC (14)	140.11	3.56				
S4	GE (13)	138.18	2.27	-1.25	25	0.22	0.24
	GC (14)	139.55	3.27				
S5	GE (13)	144.38	2.53	0.44	25	0.66	0.08
	GC (14)	143.92	2.77				

Analyzing the number of punches transmitted by the athletes of the control group and the self-assessment carried out, it results that the entire GC overestimated its effort. An appreciation closer to the actual situation can be seen in the last week of training (Figure 2).



**Figure 3.** Weekly round means of the punches transmitted by the athletes to the control group and their self-assessment

The sum of the punches transmitted in the boxing bag during all halves was significantly lower than the estimate made by the control group athletes 17,826.28 (221.82) compared to 19,905.71 (279.59),  $t = -26.24$ ,  $df = 13$ ,  $p < 0.001$ ]. An interesting fact is that the athlete who accumulated the highest number of punches transmitted in the boxing bag did not accumulate the most points. He managed to accumulate 80 points with a total of 20,399 punches, while the athlete who scored a total of 20,357 punches scored 88 points.

Discutions In boxing, the evaluation of the strength and frequency of the punches, as well as the determination of the reaction time are extremely useful in assessing the level of performance, for tracking the evolution of the physical and technical-tactical training of the athletes and, at the same time, for their selection in the performance sport (Chadli, Ababoua & Ababoua, 2014).

Deochand, Costello & Fuqua (2020) analyzed the effect of using visual feedback (related to the force and speed of punches) and auditory feedback (using the rhythm and volume of music preferred by each subject as a measure of performance) on boxing punches; the intervention was performed on a group of subjects who did not practice boxing previously. Mixed feedback, auditory and visual, determined the increase in the frequency of punches from 63.5 to 87.5 punches per minute and at the same time, an average increase in their force by 468 N. Subjects considered as motivating, in descending order, the following elements: 1 - the rhythm of the music, 2 - its volume, 3 - the color of the visual stimulus and 4 - the visualization of the timer. In our study, a decrease in the averages of punches in rounds in weeks two, three and four could be observed, which confirms those mentioned by Havlucu et al. (2021). During these three weeks, a decrease in the average weekly heart rate could also be observed, resulting in a lower working intensity compared to the first week. This effect may be due to distraction as mentioned by Havlucu et al. (2021), but at the same time it can also be attributed to the fact that subjects could see the scores of their peers, thus the emphasis was placed on overcoming the other and not on improving their own performance. In the last week of training the increase in the average of punches was significant compared to previous weeks.

It is worth noting that the athlete who transmitted the most punches to the boxing bag was not also the athlete who accumulated the most points. This may suggest a new direction of research on the influence (if any) of the type of strategy chosen by each individual athlete in the approach to training on individual performance. The present study did not follow this direction, which is a limitation in terms of the results obtained, and it is not possible to confirm that they were obtained as a result of such an organized approach or were accidental. In the literature of the preferences are available questionnaires that can evaluate the athletes' strategy regarding their approach during competitions: Intrinsic

motivation inventory, Test of performance strategy, Psychological skills inventory for sports, Athlete coping skills inventory. Thomas, Murphy & Hardy (1999) have implemented a questionnaire with which you can evaluate the mental strategies and abilities that athletes turn to in training and competition (TOPS - Test of performance strategy). The authors have shown that elite athletes differentiate themselves from others through a high level of self-confidence, increased attention, systematically use goal setting, visualize the performance they want to reach and have high levels of motivation and involvement.

Gill (1988) observed that male athletes are victorious-oriented and comparing their results with others, so they turn to strategies that focus on problem solving (Hammermeister & Burton, 2004; Thomas et al., 1999). Katsikas, Argeitaki & Smirniotou (2009) analyzed with the help of the TOPS questionnaire how athletes turn to their psychic abilities to achieve maximum performance. Thus, elite athletes recorded higher scores than other athletes in terms of emotional control but also the ability to set goals. It is well known that in order to achieve maximum performances athletes adjust their working intensity (Abbiss & Laursen, 2008). Tucker (2009) examined the ways in which athletes adjust their working tempo in advance in order to achieve good results by developing psychological models of perception of exhaustion. Thus, he observed that in the case of athletes who have been incorrectly informed about the duration of an exercise, they will work at a lower or higher intensity depending on how each individual perceives exhaustion.

## **Conclusions**

In this study it was intended to analyze the introduction of two elements that could influence sports training. These two elements were real-time visual feedback and the elements of motivation introduced in sports training. The tests of statistical significance showed us that the differences between the means recorded by the two groups were significant, thus suggesting that the implementation of the two elements led to the improvement of the performance of the experiment group. During the trainings we were able to observe different approaches of the subjects, some athletes aiming for a large total number of punches, while others took into account the score. This can give us information about the strategy of each athlete during training at the time of planning a goal. However, further research into this project should contain an assessment of the motivation and strategies they apply in training and competition.

The results of this study show us that the motivation elements introduced in the case of the experiment group have the effect of increasing the number of punches transmitted in the boxing bag, compared to the control group. The reason for the decrease in the mean number of punches transmitted in the boxing bag for the experiment group in the second, third and fourth weeks is not well known, but we can consider that the possibility of viewing the results of all subjects and the increase in the complexity of the series of punches influenced this aspect.

### **Research limitations**

The research presents certain limits, caused by the small number of subjects involved, the duration of the research, but also by the use of other methods of motivating the subjects.

### **Conflicts of interest:**

There is no conflict of interest.

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## OVERWEIGHT AND OBESITY PREVALENCE IN YOUNG STUDENTS

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**ABSTRACT. Introduction.** Globally, there is a growing prevalence of overweight and obesity in both developing and developed countries. Until recently, it was perceived that obesity mainly affects middle-aged adults. However, there is a growing trend towards obesity among young adults, especially university students. **Objective.** This study aims to assess the overweight and obesity prevalence and its related factors in a random sample of students selected from 10 faculties of “Babeș-Bolyai” University. **Methods.** This transverse study included a self-administered questionnaire and gathered anthropometric measurements. The population subject of study consisted in 1430 students, of which 694 (48.5%) men and 736 (51.5%) women, aged between 20 and 25 years, (69.4%) from urban environment and (30.6%) from rural environment. The body mass index (BMI) has been used for assessing the weight. **Results.** Amongst women, 64.4% had normal weight, 18.9% were overweight and 5.8% were obese, while amongst men 62.1% had normal weight, 14.1% were overweight and 5.2% were obese. Generally speaking 22% of participants were overweight or obese (24.7% women and 19.3% men). In multivariate regression in younger men coming from a region with higher incomes, conscientiously avoiding fats, alcohol and tobacco consumption, physical inactivity and in older women coming from a region with higher incomes, avoiding fats consumption, cholesterol and post-traumatic stress symptoms have been associated to overweight or obesity. **Conclusions.** The study found a high prevalence of overweight / obesity among university students. Several gender-specific health risk practices that can be used in health promotion programs have been identified.

**Key words:** *obesity, overweight, physical inactivity*

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**REZUMAT. Prevalența supraponderalității și obezității la tinerii studenți.**

**Introducere.** La nivel global, există o prevalență în creștere a supraponderalității și a obezității atât în țările în curs de dezvoltare, cât și în cele dezvoltate. Până de curând, s-a perceput că obezitatea afectează mai ales adulții de vârstă mijlocie. Cu toate acestea, devine evidentă o tendință de creștere constantă a obezității în rândul tinerilor adulți, în special studenți în cadrul universităților. **Obiectivul.** Acest studiu evaluează prevalența supraponderalității/obezității și a factorilor asociați acesteia în rândul unui eșantion aleatoriu de studenți din 10 facultăți din Universitatea „Babeș-Bolyai”. **Metode.** Acest sondaj transversal a cuprins un chestionar autoadministrat și a colectat măsurători antropometrice. Populația studiată a fost de 1430 de studenți din care bărbați 694 (48,5%) și femei 736 (51,5%), cu vârste cuprinse între 20 și 25 de ani, proveniți din mediul urban (69,4%) și mediul rural (30,6%). Indicele de masă corporală (IMC) a fost utilizat pentru starea greutateii. **Rezultate.** În rândul femeilor, greutatea normală a fost de 64,4%, supraponderalitatea 18,9% și obezitatea 5,8%, în timp ce în rândul bărbaților greutatea normală de 62,1%, supraponderalitatea 14,1% și obezitatea 5,2%. În general, 22% erau supraponderali sau obezi (24,7% femei și 19,3% bărbați). În regresia multivariată în rândul bărbaților, vârstă mai tânără, provenind dintr-o zonă cu venituri mai ridicate, evitând în mod conștient grăsimile și colesterolul, inactivitatea fizică, iar în rândul femeilor în vârstă, provenind dintr-o zonă cu venituri mai mari, evitarea grăsimilor și a colesterolului au fost asociate cu supraponderalitatea sau obezitatea. **Concluzii.** Studiul a constatat o prevalență ridicată a supraponderalității/obezității în rândul studenților universitari. Au fost identificate mai multe practici de risc pentru sănătate specifice genului care pot fi utilizate în programele de promovare a sănătății.

**Cuvinte cheie:** obezitate, supraponderalitate, inactivitate fizică

## Introduction

Obesity represents a major concern in the field of public health in developed countries. The excessive weight has been associated with several main negative effects on health included, but not limited to cardiovascular diseases, diabetes, some forms of cancer and musculoskeletal disorders (Jensen, Ryan, et al., 2014).

There is a worldwide increasing prevalence of overweight and obesity, both in developing and developed countries (Haidar & Cosman, 2011). Over the past 20 years, obesity rates have tripled in developing countries as they are rapidly becoming more urbanized, due to increase of the consumption of high-calorie foods while adopting a more sedentary lifestyle (Popkin et al, 2012).

Certain studies revealed that the first year undergraduate students experience a significant weight increase (Vella-Zarb & Elgar, 2009) followed by a slowly but constantly weight increase (Gores, 2008).

Young adults aged between 18 and 25 years are in a „transition” phase from teenage to adulthood. Until recently, it was thought that the obesity affects usually the middle aged adults. However, a tendency in constant increase of obesity rate in young adults, especially in undergraduate university students became obvious. (Anderson et al., 2003; Lowry et al., 2000). Many young adults experience significant changes in their lifestyle, leaving their homes and going to university (Butler et al., 2004), starting to work, developing relationships (Burke et al., 2002), pregnancy (Linne, 2003) and raising children (Burke et al., 2004). These transitions are seen as a displacement moment, when young people deal with a feeling of „loss” and „disruption in identity” occurred as they leave their family environment (Scanlon, Rowling & Weber, 2007) and independently initiate new things. These key moments during lifetime cause young adults to become vulnerable to energy imbalance, often resulting in weight gain, that might be ignored at that moment, but leads to further weight gains. It is known that the interaction of social, psychological and biological factors during these transition years can make young adults vulnerable to many risk assuming behaviours (Aucott et al., 2014). However, the effect of these factors can be diminished by positive changes in the behaviour using the constructive experience of their childhood and teenage years (Poobalan et al., 2014). Nevertheless, both positive and negative wellness behaviours formed during this transition to adulthood often persist later in life (Parcel, Muraskin & Endert, 1988) and therefore this represents a crucial phase in the life of an individual (Howarth & Street, 2000). Despite this assumption, young adults have been neglected until recently from the perspective of both research and policies.

The American Heart Association Task Force on Practice Guidelines and The Obesity Society (AHA/ACC/TOS) recommends a 3-5% weight loss of initial body weight for managing the obesity in adults. (Jensen et al. 2014).

Only recently, the developed countries started to recognize the young adults aged between 18 and 25 years as a „vulnerable group” to unhealthy lifestyles leading to overweight and obesity (Jekielek & Brown, 2005). However, in the developing countries, obesity in all age groups has not even been considered as a public health concern until the beginning of 1980-1990 and has been perceived as an issue of the developed countries. In the last two decades, several diet and social-economic transitions changed the anthropometric measurements and health patterns of populations in developing countries (Popkin, Adair & Ng, 2012). While tuberculosis, diarrhea and sub nutrition are

far from being solved especially in some developing countries, the obesity rate is increasing and it is considered as a challenge for health care infrastructure and medical care providing services in developing countries (Unnikrishnan et al., 2012). This current obesity epidemics is more observable in the developing countries enduring fast epidemiological transitions (demographic, social and economic), with a predictable tripling increase of the obesity incidence in the near future (Jones-Smith et al., 2012).

In cross-sectional studies, for both men and women, BMI, waist circumference and waist hip ratio increase with age from 15-19 years to 20-29 years, however this has been observed especially in men (Gupta et al., 2009). The incidence increase with age trends have been observed not only in terms of weight gain, but also in terms of other cardiovascular risk factors (Gregory CO. et al. 2009).

One study analysing 22 low- and middle-income countries, was conducted among 15,746 students with an average age of 20.8 years from 22 universities. This study revealed that in general, 22% of young adults were obese, with men (24.7%) being more than women (19.3%) (Peltzer et al. 2014). In addition, the researchers concluded that men have an average age younger (16-19 years) than women (22 years or over). However only in sub-Saharan Africa and Latin America, the female obesity was higher, while in Asia and North Africa (excepting Egypt and Tunisia), male obesity was higher than female obesity. It is not yet clear whether this relates to the social disadvantages that women in Asia/North Africa might face.

### **The goal of study**

The goal of this study is to assess the prevalence of overweight and its related factors among the young students of “Babeș-Bolyai” University of Cluj-Napoca.

### **Research methods**

A cross-sectional study was carried out on a sample of Romanian students (N = 1430, men = 694, women = 736) young population aged between 20 and 25 years. The sample was selected from urban and rural areas: urban area (69.4%), rural area (30.6%). The students are enrolled in 10 faculties within “Babeș-Bolyai” University.

The study methods used consisted in:

- *Anthropometric measurements*

The method used for measuring the two body indicators: height and weight. The students were weighed and measured using standardized protocols. The height in standing position was measured at the closest to 0,1 cm without shoes, using a stadiometer. The participants wearing light clothes were weighted at the closest to 0.01 kg using a digital weighting machine, first calibrated using a standard weight and then re-checked daily. The body mass index (BMI) was computed as weight in kilos divided to height in square meters, according to WHO (World Health Organization, 2007).

- *Social variables*

Three elements of the Social Support Questionnaire were used to assess the perceived social support (Brock, 1996).

As in previous researches, the questions were selected to evaluate the perceived tangible and emotional support: "If I were sick and needed someone to take me to a doctor, I would have trouble finding someone (reversed); I feel that there is no one to share my most private concerns and fears (reversed); and I feel a strong emotional connection with at least one person." – The alpha Cronbach for this social support index was 0.95.

The social-demographic questions included the age, the gender and marital status. The social and economic background was assessed using the average household income of each area considered as high (the highest income 25% of incomes), above average (income between 50% - 75% of incomes), below average (income between 25% - 50% of incomes), and low (the lowest income of 25% income).

- *Health risk behaviour*

Physical activity was evaluated using short self-administered version of the International Physical Activity Questionnaire (IPAQ) for the last 7 days (IPAQ-S7S). I used the instructions in the IPAQ manual for reliability and validity, detailed in another chapter (Craig et al., 2003). I ranked the physical activity (short form) according to the official scoring protocol (IPAQ) as low, moderate and high.

- *Eating behaviour variables*

Fruits and vegetables (F&V) consumptions was rated using two questions "How many fruit servings do you typically eat in a day?" and "How many vegetable servings do you typically eat in a day?" and I used the data from the last 24 hours

as standard data (Hall, 2009). The Alpha Cronbach for this measurement of fruits and vegetables consumption was 0.74. Insufficient consumption of fruits and vegetables has been defined as less than five servings of fruit and/or vegetables per day.

Supplementary variables included: the frequency of red meat consumption (daily, 2-3 times a week, once a week, less than once a week, never); the attempt to avoid the consumption of aliments rich in fat (yes, no); the attempt to eat aliments rich in fibres (yes, no); frequency of snacks between meals and number of meals per day.

- *Data analysis*

The data of individual measurements were statistically processed on the computer using the statistical package for social sciences: version 20.0 SPSS Inc. (SPSS). Sociodemographic factors, social and diet variables, health risk behaviours, and BMI categories were calculated as percentages. Multivariate logistic regression was separately performed in men and women, using the overweight/obesity as dependent variable. Potential multicollinearity between variables was assessed using variance inflation factors, none of which exceeded the recommended critical value of 4.0. Social and demographic characteristics, social and health risk behaviour were considered as independent variables.  $p < 0.05$  was considered as being significant.

## Results

A total number of 1430 students, 49.5% were men ( $N = 694$ ), and 50.5% were women ( $N = 736$ ). The average age was 22 years ( $22.88 \pm 1.39$  young men and  $22.60 \pm 1.39$  young women). 69.4% participants came from urban area while 30.6% came from rural area. In this study, the prevalence of overweight and obesity was 16.3% and 10.2%, respectively. As we notice in the data presented in Table 1, women have a higher percentage of overweight and obesity than men (17.8% -13.1% vs. 13.3% -7.9%,  $p < 0.05$ ).

**Table 1.** Distribution of BMI depending on the reported average age, measured height and weight and calculated BMI and weight status among urban and rural students, males and females.

Zone	N	Age	Height m.	Weight Kg.	BMI	Normal weight BMI 18.5-24.9(%)	Over weight BMI 25-29.9(%)	Obesity BMI >30(%)
<b>Men</b>								
<b>All</b>	694	22.88 (1.39)	1.73 (0.09)	67.2 (13.1)	22.5 (4.1)	75.9	13.3	7.9

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Zone	N	Age	Height m.	Weight Kg.	BMI	Normal weight BMI 18.5-24.9(%)	Over weight BMI 25-29.9(%)	Obesity BMI >30(%)
Men city	402	21.6 (2.6)	1.75 (0.08)	77.2 (17.5)	24.9 (5.0)	75.3	13.4	8.1
Men village	247	21.4 (3.7)	1.72 (0.06)	69.2 (12.1)	23.5 (3.6)	76.9	11.7	6.3
<b>Woman</b>								
<b>All</b>	736	22.7 (2.6)	1.60 (0.08)	57.1 (11.9)	21.9 (4.2)	64.3	20.5	12.8
Woman city	459	21.6 (3.0)	1.64 (0.07)	68.4 (21.3)	25.5 (7.7)	64.3	20.5	12.8
Woman village	277	20.8 (2.8)	1.59 (0.06)	58.3 (9.2)	23.0 (2.8)	71.0	15.9	10.1

No significant differences were found between the average BMI values of students coming from rural and urban areas, either in young men ( $p = 0.70$ ) or in young women ( $p = 0.630$ ); instead, there is a significant difference between the average BMI rates in young women ( $20.28 \pm 3.73$ ) and young men ( $19.8 \pm 3.64$ ) ( $p = 0.19$ ).

**Table 2.** The prevalence characteristics of subjects considering the overweight by gender among students

Variable	All	Men	Woman	Statistics
	M	M	M	P-value
<b>Socio-Demographics</b>				
Age (years)				< 0.001
20-21	21.9	18.9	26.5	
22-23	19.6	18.3	21.5	0.004
24-25	25.6	24.5	26.6	
<b>Health risk behaviour</b>				
Wealth				
Wealthy	25.8	31.8	19.6	
Good enough	22.1	25.7	19.6	< 0.001
Not too well	22.1	23.4	21.3	< 0.001
Not good at all	21.1	21.6	20.5	
Physical Activity				
Low	22.5	26.6	20.5	
Moderat	20.9	24.2	18.5	< 0.001
High	22.0	22.8	20.9	
<b>Dietary</b>				
Number of meals per day	0.7	0.7	0.7	< 0.001
Number of snacks	0.8	0.8	0.7	< 0.001
Vegetables and fruits (time/day)	22.0	24.8	19.9	< 0.001
Eats meat at least once a day	22.7	25.1	23	< 0.001
Avoid fat	25.0	28.0	23.6	< 0.001
Eat fiber	23.9	26.4	22.9	< 0.001

In general, 22% were overweight or obese; women (24.6%) were significantly more overweight or obese than men (20.1%).

**Table 3.** Associations between overweight/obesity BMI and health and eating behaviour

Variable	Men		Woman	
	UOR	AOR	UOR	AOR
<b>Socio-Demographics</b>				
Age (years)				
20-21	1.00	1.00	1.00	1.00
22-23	0.78***	0.76***	0.99	0.91
24-25	1.00	0.95	1.40***	1.37***
<b>Health risk behaviour</b>				
Wealth				
Wealthy	1.00	1.00	1.00	
Good enough	0.75*	0.95	1.00	
Not too well	0.66***	0.85	1.09	
Not good at all	0.60***	0.73	1.10	
Physical Activity				
Low	1.00		1.00	
Moderat	1.08		0.97	
High	1.06		0.89	
<b>Dietary</b>				
Number of meals per day	1.04		0.98	
Number of snacks	1.02		1.02	
Vegetables and fruits (time/day)	0.93		0.95	
Eats meat at least once a day	1.03		1.04	
Avoid fat	1.35***	1.30***	1.37***	1.27***
Eat fiber	1.15*	1.03	1.31***	1.15

Bivariate analysis among men found that the younger age, 20-21 years, the eating behaviour (aliments rich in fibres, avoidance of fats), health risk behaviour (physical inactivity) were associated with overweight or obesity, while in the multivariate regression analysis the younger age 20–21 years, the eating behaviour (avoidance of fats), the health risk behaviour (physically inactive) were associated with overweight and obesity.

Bivariate analysis among women revealed that the older age, 24-25 years, the eating behaviour (aliments rich in fibres, avoidance of fats) were associated with overweight and obesity, while in the analysis of multivariate regression the older age and the eating behaviour (avoidance of fat) were associated with overweight or obesity.

## Discussions

Most of developing countries face a higher prevalence of overweight/obesity in women, with some exceptions. Obesity increases with age, but among young adults from developing countries the average weight gain of 1 kg per year is higher than that observed in young adults from developed countries (0.4-0.9 kg / year) (Lahmann et al., 2000). Once with the increase of obesity observed in such short period of time, between 16-25 years, a logical observation would be to intervene earlier. However, the young people in the transition period are very different from their younger selves with parental influences. Between 16-25 years, they are sufficiently independent to assume the risks involved by their lifestyle behaviours, and their future health is not a priority for them. The ideal age to make an intervention to this heterogeneous age group is a problem faced by other researchers of diseases, however around the age of 21, they realize that they should improve their lifestyle (Poobalan et al., 2014).

Economic progress and industrialization in many developing countries have caused massive transitions from rural to urban regions, which led to many lifestyle-related changes, resulting in increased obesity rates and cardiovascular risk factors.

Of the young adults aged 18 to 22, the BMI was significantly higher in men and women living in urban area than the ones living in rural areas, with a tendency to higher waist-hip ratios among young adults in urban areas, although this was significant only in men (Bhongir, Nemani & Reddy, 2011).

The studies revealed that while 70% of young people in rural areas and 13.8% of young people in urban areas were underweight (data are not presented), 3.5% of young people in rural areas and 31.9% of young people in urban areas were overweight or obese (OW/obese).

The tenfold increase in the prevalence of OW/obesity in young people in urban areas is a cause of concern. By contrast, in Guatemala (Torun et al., 2002), both urban women coming from rural areas (migrants) and women (non-migrants) living in rural areas tended to be overweight; however, only men living in urban areas were more overweight than the men living in rural areas. Regardless of the BMI, men and women living in rural areas had more abdominal fat than those living in urban areas and all of them, regardless of gender or location, had lower level of physical activity.

It has been observed that the women living in rural areas (non-migrants) had lower HDL compared to migrants, and that is another indicator of cardiovascular diseases. No difference was found in Uganda in what concerns the prevalence of overweight between urban and rural areas (Baalwa J. et al., 2010).

In the adult population of Romania, the prevalence of overweight and obesity is extremely high compared to the world average published by the WHO. According to a study made by (Popa et al. 2020) on 900 people aged 18 to 65 years, 29.56% were overweight and 21.33% were obese.

In 2016, another study reported a higher incidence, according to which 34.7% of the population in Romania aged 20 to 79 years were overweight and 31.9% were obese. (Popa et al., 2016).

An unexpected discovery of this study was that making a conscious effort to avoid fat and cholesterol and an attempt to eat food rich in fibres were associated with overweight/obesity. It is possible that students who were overweight or obese in this study, could have already adopted a healthier eating behaviour to lose weight and be accepted by their peers. As the study project was cross-sectional, the relationship cause-effect between diet variables and overweight/obesity could not be established.

The finding in this study that the lack of physical activity was associated with overweight/obesity was also found in a number of previous studies. In this study, the male students were physically more active than women, and physical inactivity was linked to overweight/obesity among men, but not among women.

Other researchers did not find a connection between physical inactivity and overweight/obesity in either male or female students, despite the fact that men are more likely to engage in exercise in their spare time (Arroyo et al., 2000).

Other studies reveal that the relationship between BMI and physical activity occurs only in males (Gómez, 2009). Despite these differences, it was established that there is a connection between obesity and a sedentary lifestyle.

## **Conclusions**

Young adults (18-25 years) are prone to overweight and obesity during the transition from adolescence to adulthood in developing countries, in the same measure as in developed countries. The prevalence of overweight and obesity was 26.5% in the study among students aged 20 to 25 years.

The prevalence of overweight and obesity was higher among young women than among young men. The prevalence of overweight is higher in young women living in urban areas (33.3%) than in young men living in urban areas (23.5%). Even in this period of age (18-25 years), the overweight and obesity levels increase with age. We can observe in our study that the overweight and obesity among young people aged 20 to 22 years increase, while at the same time there is a gradual decrease of overweight and obese people aged 23 to 25 years, in both sexes.

The study revealed a high prevalence of overweight/obesity in undergraduate students. Several gender-specific health risk practices have been identified that can be used in health promotion programmes.

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## POWER OUTPUT DIFFERENCES IN THE CONTEXT OF DYNAMIC STRETCHING IN YOUNG MALE ATHLETES

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**ABSTRACT. Introduction.** Static stretching is generally performed in sport and clinical settings, although dynamic stretching is increasingly being used before exercise and competition. There is strong evidence that a decrease in muscle strength can be the result of longer durations of static stretching, a phenomenon called stretching-induced force deficit. **Objectives.** The aim of this paper was to determine the jumping power output differences before and after dynamic stretching in young male athletes. **Materials and Methods.** The participants in this study were young male athletes (N = 18), aged from 14 to 16 years old that underwent two measurements on the MGM-15 carpet. **Results.** There was a significant statistical difference in the scores between the control and after dynamic stretching conditions. This means that the dynamic stretching had an influence over the power output of the subjects. **Conclusion.** The results revealed that the power output was significantly improved (increased) after dynamic stretching compared to control measurement. Furthermore, dynamic stretching should be performed in order to increase the power output performances of jumping.

**Keywords:** *dynamic stretching, power output, male, athletes, jumping*

**REZUMAT. Diferențele de putere în contextul stretchingului dinamic la tinerii sportivi. Introducere.** Stretchingul static este folosit de obicei în activități sportive și în recuperare dar stretchingul dinamic este folosit din ce în ce mai mult în încălzire și în competiții. Există probe că poate exista o scădere a forței ca urmare a unor perioade lungi de stretching static. **Obiective.** Scopul lucrării este de a determina diferențele de putere în săritură înainte și după stretchingul dinamic la sportivi tineri. **Materiale și metode.** Participanții au fost sportivi tineri (N=18), cu vârstele între 14 și 16 ani care au fost mășurați cu covorul MGM-15. **Rezultate.** S-a constatat o diferență statistică semnificativă

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În scorurile între cele două situații experimentale fapt ce ne face să constatăm că stretchingul dinamic are efect. **Concluzii.** Rezultatele au arătat că puterea a fost semnificativ mai mare după stretchingul dinamic. Mai mult stretchingul dinamic ar trebui să fie utilizat pentru creșterea puterii în sărituri.

*Cuvinte cheie: stretching dinamic, putere, sportivi băieți, sărituri.*

## Background

The power capabilities of lower limbs have been assessed and trained through the use of maximum vertical jump (Markovic, 2007). Therefore, the effect of different loading styles during training on production of the maximal power output in jumping has been a constant research topic (Bevan et al., 2010). Loading spectrum used, the methods used for load determination, different kinetic and kinematic variables evaluated and the influence of body size on the calculated power have been related to failure to reach an optimal loading to maximize the power output in vertical jumping (Cormie et al., 2007).

Static stretching is generally performed in sport and clinical settings, although dynamic stretching is increasingly being used before exercise and competition (Takeuchi et al., 2019). Increases in the range of motion and decrease muscle stiffness have been shown to be the result of static stretching (Ryan et al., 2008). Moreover, there is strong evidence that a decrease in muscle strength can be the result of longer durations of static stretching, a phenomenon called stretching-induced force deficit (Kay and Blazevich, 2012; Simic et al., 2013). Therefore, it is recommended that the longer duration during warm-up should be avoided generally to this deficit (Behm et al., 2016; Behm and Chaouachi, 2011; Kay and Blazevich, 2012; Simic et al., 2013). The two primary factors of stretching-induced force deficit that explain it have been considered to be: neural factors (altered motor control strategies or reflex sensitivity) and mechanical factors (changes in muscle stiffness) (Cramer et al., 2007).

## Objectives

The aim of this paper was to determine if dynamic stretching influences the power output during jumping of young male athletes.

## Methods

### *Subjects*

The participants in this study were young male athletes (N = 18), aged from 14 to 16 years old that underwent two measurements on the MGM-15 carpet: the power output test before and after dynamic stretching.

### *Methods and the Steps of the Research*

We used the MGM-15 Jumping Carpet for test. The test consists of 15 jumps on both legs that must not be bent during the execution. The software from the MGM-15 Jumping Carpet laid out, among others, one measurement for each subject named Average Unit of Power.

P.U. (Average Unit of Power) – it is measured during the jumps on both legs and offers data regarding: (a) the level of conditional training in sport performance; (b) information regarding the relation between force and speed.

For dynamic stretching, each participant assumed a standing upright position and began to perform the exercises under the verbal guidance of the experimenter. The exercises were performed in the following order: plantar flexors, hip extensors, hamstrings, hip flexors, and quadriceps femoris. Each stretching session was performed by repetitively bouncing the stretched muscle to its limit of motion range with 15 repetitions, each lasting 2 s. The procedure was performed on the right leg and subsequently the left leg. There was a 10–15 s rest period taken between exercises while the total time of the session was  $7 \pm 1$  min.

## Results

**Table 1.** Average values of power output for each of the subjects for control and dynamic stretching measurement

Subject	Power_Control	Power_Dynamic
1	3.20	3.87
2	2.85	3.05
3	4.18	4.57
4	1.77	2.63
5	4.69	5.06
6	3.79	4.04
7	4.32	4.68

Subject	Power_Control	Power_Dynamic
8	5.34	5.69
9	4.20	4.48
10	3.89	4.16
11	5.11	5.33
12	2.78	3.32
13	2.99	3.80
14	3.15	3.98
15	3.78	4.15
16	1.90	2.53
17	5.60	6.22
18	4.23	4.80

**Table 2.** Descriptive statistics for the control and dynamic stretching measurement of the power output

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Power_Control	3.7650	18	1.08407	.25552
	Power_Dynamic	4.2422	18	.99375	.23423

**Table 3.** Correlation between the control and dynamic stretching measurement of the power output

Paired Samples Correlations					
			N	Correlation	Sig.
Pair 1	Power_Control	&	18	.982	.000
	Power_Dynamic				

**Table 4.** Paired sample t test for the measurements (control and dynamic stretching) for the tested variable: power output

		Paired Samples Test						
		Paired Differences			95% Confidence Interval of the Difference			
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper		
Pair 1	Power_Control - Power Dynamic	-.47722	.21857	.05152	-.58592	-.36853	-9.263	.000

A paired-samples t-test was conducted (Tabel 4) to compare the power output before and after using dynamic stretching. There was a significant statistical difference in the scores between the control (M=3.765, SD=1.084) and after dynamic stretching (M=4.242, SD=0.993) conditions;  $t(17)=-9.263$ ,  $p = 0.000$ . This means that the dynamic stretching had an influence over the power output of the subjects as recorded by the MGM-15 Jumping Carpet.

### Conclusion

The aim of this study is to examine the power output during anaerobic jumping in two distinct scenarios: before and after dynamic stretching. The results revealed that the power output was significantly improved (increased) after dynamic stretching compared to control measurement.

This study examined the effects of dynamic stretching method on power output performance in young male athletes. This study showed that dynamic stretching may improve performance in regards to power output. According to our results, coaches and sport scientists should take into account selecting stretching type after the warm-up session. Furthermore, dynamic stretching should be performed in order to increase the power output performances of jumping. Based on these results, as shown in many studies in the literature, dynamic stretching exercises should be select in order to create a positive effect on the performance.

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## THE IMPORTANCE OF CARDIORESPIRATORY FITNESS AND PHYSICAL ACTIVITY AMONG ADULTHOOD STAGES—REVIEW

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**ABSTRACT. Introduction:** Adulthood is a period of development and transformation, though it may not be as dramatic as childhood and adolescence. Physical changes, for example, from youth to adolescence, are transformative. The body proliferates and develops secondary sexual characteristics as adolescence progresses. Exercise training for the elderly has been linked to a variety of health benefits, including a reduction in cardiovascular mortality. Changes in the balance of the cardiac autonomic nerves result in an increase or relative innervation of the vagus nerve, an explanatory mechanism that may be involved after exercise. Regular physical activity has also been linked to improving mental health (for example, reducing stress, anxiety, and depression). Mental health is critical for preventing and managing cardiovascular disease, but it also impacts other chronic diseases (such as diabetes, osteoporosis, hypertension, obesity, cancer, and depression). **Conclusions:** Finally, this review unifies the relationship between physical activity, cardiorespiratory health, and adulthood across the life span. In adulthood, changes in daily physical activity have a significant impact on overall health and well-being. As people's corporeal and psychological health care deteriorates with age, regular physical activity becomes crucial for well-being.

**Key words:** *Physical activity, Cardiorespiratory fitness, adulthood.*

**REZUMAT. Importanța fitness-ului cardiorespirator și a activității fizice în rândul adulților—review. Introducere:** Vârsta adultă este o perioadă de maturizare și schimbare, deși poate să nu fie la fel de dramatică precum copilăria și adolescența. Schimbările fizice, de exemplu, de la copilărie la adolescență, sunt transformatoare. Antrenamentul pentru vârstnici a fost legat de o varietate de beneficii pentru sănătate, inclusiv o reducere a mortalității din cauza bolilor cardiovasculare. Modificările în echilibrul nervilor autonomi cardiaci au ca rezultat o creștere sau o inervație relativă a nervului vag, un

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mecanism explicativ care poate fi implicat după efort. Activitatea fizică regulată a fost, de asemenea, legată de îmbunătățirea sănătății mintale (de exemplu, reducerea stresului, anxietății și depresiei). Sănătatea mintală este esențială pentru prevenirea și gestionarea bolilor cardiovasculare, dar are un impact și asupra altor boli cronice (cum ar fi diabetul, osteoporoza, hipertensiunea, obezitatea, cancerul și depresia). **Concluzii:** În cele din urmă, această recenzie unifică relația dintre activitatea fizică, sănătatea cardiorespiratorie și vârsta adultă de-a lungul ontogenezei. La vârsta adultă, schimbările în activitatea fizică zilnică au un impact semnificativ asupra sănătății și bunăstării generale. Pe măsură ce sănătatea fizică și mentală a oamenilor se deteriorează odată cu vârsta, activitatea fizică regulată devine crucială pentru obținerea bunăstării.

***Cuvinte cheie:** Activitate fizică, Fitness cardiorespirator, vârsta adultă.*

## Introduction

An emerging theory and research line show that thriving growth is essential for successful adolescent development and transition to adulthood. A thriving orientation can be defined as a positive process—internal promotion and relationship support—individuals shaping and participating in their development environment, no matter what environment they live in, to develop the life trajectory of the list of abilities, skills (Szabo et al., 2020a; Szabo et al., 2020b; Szabo et al., 2020c; Tulbure et al., 2020), and behaviors. At the identical moment, it is appropriate for self and society (Benson & Scales, 2009; Benson et al., 2006; Lerner, 2004; Scales et al., 2000; Scales et al., 2015).

Due to the significant impact on adult socioeconomic achievements, family life, and health, the changeover to maturity has recently received much scholarly attention (Shanahan, 2000; Settersten et al., 2005; Benson & Furstenberg, 2007; Settersten & Ray 2010; Waters et al., 2011; Booth et al., 2012). This transformation in the US is characterized by its long-term nature and increasingly personalized quality, making it more unstable and uncertain than the previous queue (Shanahan, 2000). Higher education increases youth's living and financial dependence on their parents and delays full-time employment and people establishment (particularly parenting). The loose institutional link among university and job (Schneider & Stevenson 1999; Kerckhoff, 2002; Shanahan et al., 2002) is accompanied by a general increase in non-standard employment relationships, which reduces the remuneration for dynasty establishment in obtaining and maintaining the ability to provide sufficient work (Kalleberg et al., 2000; Kalleberg, 2011; Eliason et al., 2015).

The stage of development from adolescence to adulthood is itself a necessary stage of life, but it is also important because it lays the foundation for later adulthood (Arnett, 2000; George, 1993; Hogan & Astone, 1986; Shanahan, 2000). Think of young or emerging adulthood as the period among 19 and 26 phases of age. It is also believed that emerging adulthood can last until 29 (Arnett et al., 2011). The worldwide adolescent advancement discipline generally believes that youth refers to the phase from premature youth to 30 years of age or later (United States Agency for International Development, 2012). However, the age range is not an entirely satisfactory sign because it has been found that different people in the same age range consider themselves to be real adults. For example, the “emerging” label applies to people who do not think they are fully grown-ups, while “young adult” applies to people of the same age who think they are adults. (Blinn-Pike et al. 2008; Scales et al., 2015).

## **The adulthood stages**

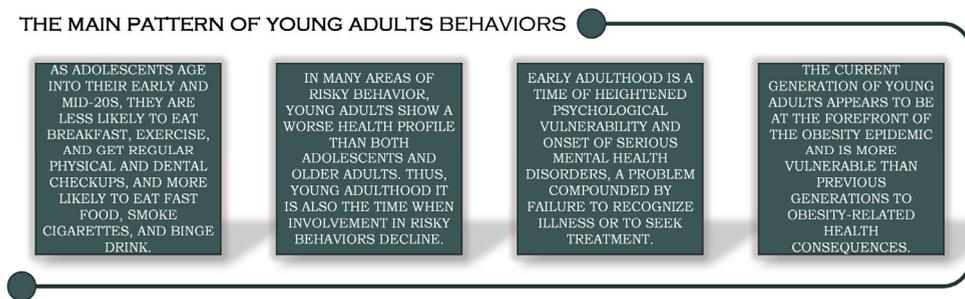
### ***The early/emerging adulthood stage***

Teenage maturity is a period of maturity and alteration, even though the level of transformation might not be as dramatic as childhood and adolescence. For instance, the corporeal transformations from childhood to adolescence are transformative. As adolescence progresses, the body proliferates and develops secondary sexual characteristics. As an adolescent’s transition from adolescence to manhood, corporeal transformations occur, but gradually. Individuals begin to gain a steady weight, which will define adulthood, but the transformations appear not as sudden as when puberty begins (Cole, 2003; Zagorsky & Smith, 2011; Committee Improving the Health, Safety and Well-Being of Young Adults, 2015).

Except for infancy, no other life stage will experience such energetic and challenging transformations at the private, societal, sentimental, neuroanatomical, and educational levels. Most emerging adults have changed their living conditions, significant relationships, complete education or career preparation, marriage, childbirth, and transition from adolescent/dependent roles to adult/independent roles in the ten years between 20 and 30. Emerging adults usually depend on others at the commencement of a phase, are between 17 and 18, live by their begetters or caregivers, establish romantic relationships, and go to high school. In the mid to succeeding 20-s, particularly evolving grown-ups are self-sufficient, have long-run friendships, and enjoy a clear career path at the close of this phase. When they penetrate this phase of existence, their private, relative, and societal resources, the dynamics and interactions between emerging adults and their surroundings, and their assistance will affect how they pass a phase of existence. Therefore, at this stage, young people and young people can take a variety of ways to achieve stable adulthood (Wood et al., 2018).

Arnett defines emerging adulthood as the life stage between adolescence and mature adulthood and is characterized by unique demographic, social and subjective psychological characteristics (Arnett, 2000; Arnett, 2010). This stage of life applies to people among 19 and 26 seasons of age, during which time they gain financial independence through training and education. Previously, psychodynamic theoretician Erik Erikson pinpointed a phase of teenage individuals in industrialized communities called prolonged puberty or psychosocial suspension (Erikson, 1968). Hopwood and colleagues investigated the congenital and ecological consequences of the personality development of same-sex male and female monozygotic and fraternal twins evaluated during late adolescence (approximately 17 years), adulthood (approximately 24 years), and adult adolescence. (Approximately 29 years old) (Hopwood et al., 2011). Their genetic information research outcomes endorse a lifestyle program point of view on temperament growth through adolescents' transition to adulthood (Hochberg et al., 2020).

Emerging adulthood, also known as early adulthood, is critical for transition and life-long health protection. Despite some positive factors, the main pattern of teenage grown-ups nowadays is decreasing health care, as evidenced by healthy behaviors and related health conditions (listed below), (Committee Improving the Health, Safety and Well-Being of Young Adults, 2015), (Figure 1):



**Figure 1.** The pattern of young adults behaviors (Committee Improving the Health, Safety and Well-Being of Young Adults, 2015)

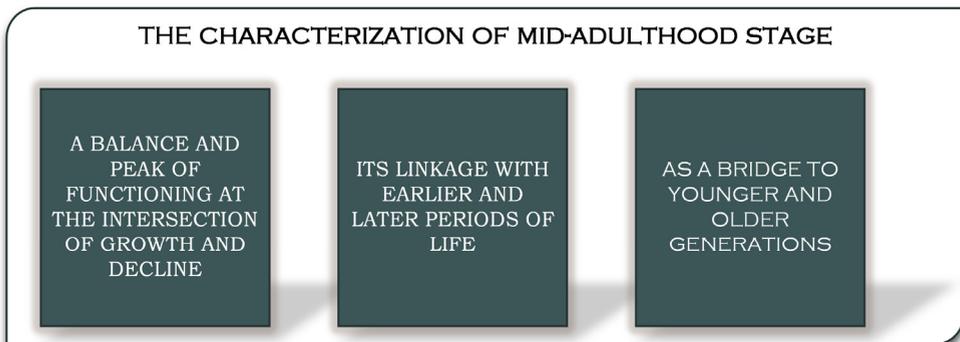
### ***The mid-adulthood stage***

The term mid-adulthood is neither well defined nor well understood. The dictionary defines it as a period between youth and old age, a state of vagueness and no difference. According to one author (Cohen, 2012), the concept of middle age was invented about 150 years ago. Nevertheless, the image of middle age can

be found in the artistic expression of the life cycle as early as the 16th century. The Middle Ages were not given a special place in the artistic conception of life courses in the 13-th, 14-th, and 15-th centuries. They usually depict circular representations of the life cycle, or in some cases, linear or even seemingly random positions represent individuals of different ages (Lachman et al., 2015).

Middle age or mid-adulthood only appeared in the 20th century as an era of explanatory development in the existence trajectory (Moen & Wethington, 1999). The current longitudinal middle-aged development research is entering a new stage because, for the first time, data on actual life span development across middle-age and old age has been obtained from the critical resources of life-long development such as brain plasticity, cognition, personality, health, and subjective representation. Related evaluations are now available (Widaman, 2008). In this case, it was evident that to understand better the development of middle age and its functional significance to the development of later years, and it is necessary to go beyond the traditional average-oriented age development norms and the assumption that middle age is regarded as a sound stage (Willis & Martin, 2005; Willis et al., 2010).

A key goal of promoting our understanding and narrowing the middle-aged/mid-adulthood research gap is to create philosophical and observational designs of the development process, including the middle-aged. We use mid-period as a crucial time frame in the life course as an illustration that can mentor prospective analysis (Lachman et al., 2015). The dictionary's definition of a key is "a bridge between the young and old" (Lachman et al., 2015) "is essential in order to the evolution or accomplishment of other things, very important or critical." We regard middle age as the critical pivotal in terms of (Figure 2):



**Figure 2.** The characterization of the mid-adulthood stage (Lachman et al., 2015)

### ***The late-adulthood stage***

According to lifespan development theorists, development continues into late adulthood. Well-known theorists (Carstensen et al., 2003; Charles, 2010; Erickson, 1982; Tornstam, 2005) have shown that older adults face significant challenges in later adulthood, which can be achieved by promoting their mental health and well-being. Ways to solve these challenges. In particular, in her integrated prototype of toughness and vulnerability, Charles suggested that elderly grown-ups are more likely to participate in strategies limiting negative experiences. Eriksson proposed that the developmental stages of integrity and despair occur in old age and include regrets about missed opportunities, unachieved goals, or lack of productivity (i.e., despair), or the sense of meaning, continuity, and satisfaction of life (i.e., completeness). Tornstam's Gerotranscendence theory believes that as people age, they become less self-centered, more other-oriented, and transcend their viewpoints. Carstensen proposed in the theory of social-emotional selectivity that as people age, they will emphasize constructive objectives and speculate in partnerships and individuals systematically that provide positive emotional results (Toussaint et al., 2021).

The current generations of seniors are expected to age, maintain bodily and psychological welfare and improve the quality of their old age (Montross et al., 2006). Although the necessary drivers for successful aging are not yet fully understood, the characteristics of population aging are apparent. Accomplished maturing completes not only mean longevity or independence from disorder and impairment; it requires health, physical functioning, and mental health (Bowling & Iliffe, 2011; Musich et al., 2018). Since then, long-term prospective studies have documented the benefits of middle-aged physical activity and healthy lifestyle behaviors as reliable predictors of disease onset and disability in later life (Fries, 1980; Daviglius et al., 1998). With the development of successful aging models, more in-depth research has been conducted on the impact of mental health on physical health (Bowling & Iliffe, 2011; Musich et al., 2018).

This review aims to briefly summarize the effects and advantages of physical behavior among the adult population. Given our articles that are being published, where we have created a "whole" from a chronological point of view, where we have managed to stage the period of childhood and adolescent development chronologically, as we propose here, from the perspective of adulthood as it follows (Figure 3):



**Figure 3.** The adulthood development stages

### **The benefits of cardiorespiratory fitness and physical activity**

“All parts of the body, if used moderately and exercised in the labor that everyone is accustomed to, will become healthy, develop well, and age slowly; but if they are not used and left unused, they will be prone to illness and growth defects, and will age rapidly,” Hippocrates wrote during the 5-th C, BC. However, by the 21st century, people’s perception of the value of exercise for health has weakened, so that lack of exercise has now become a significant public health problem (Booth et al., 2012). Similarly, lack of exercise has been identified as the direct cause of chronic illness and death in adults (Mokdad et al., 2004; Rueggeger & Booth, 2018).

*Physical activity or physical fitness?* —Physical fitness is a physical state of health that enables people to meet the needs of daily life or as the basis for sports performance, or both. Physical fitness components (Sopa & Pomohaci, 2021; Szabo et al., 2021) related to health statuses, such as cardiovascular health, musculoskeletal health, body composition, and metabolism, are all included in health-related physical fitness. The terms *physical behavior* and *bodily fitness* are frequently used interchangeably in a wide range of epidemiological studies, and physical fitness is often seen as a more precise (albeit incidental) indicator of bodily behavior than self-reporting (Williams, 2001; Warburton et al., 2006).

Cardiorespiratory fitness (usually measured by the maximum oxygen uptake, VO<sub>2</sub>max) is arguably the most crucial health indicator (Blair et al., 1989). In favor of, Myers et al. (2002) found that for every metabolic equivalent (1 MET) in exercise test performance, the survival rate would increase by 12%. They pointed out that “compared with other established cardiovascular disease (CVD) risk factors, the maximum oxygen uptake is a more effective predictor of male mortality. “Low cardiorespiratory fitness is also an autonomous threat element for T2D and CVD sickness and fatality (Booth et al., 2002; Kodama et al.,

2009; Gupta et al., 2011)". Similarly, other researchers (Kokkinos et al., 2010) commented that males which enhanced their cardiorespiratory health from soft to supreme reduced the risk of death within eight years; On the other hand, men with high-to-low cardiorespiratory health have an increased risk of death by 50%. (Ruegsegger & Booth, 2018).

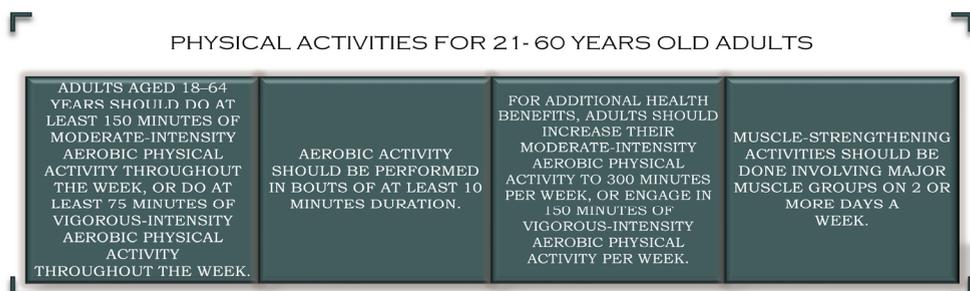
Recent studies use standardized exercise regimens to assess cardiorespiratory health. Such agreements are designed to gradually increase the workload until the maximal core frequency predicted by the participant's age is reached, or the participant cannot continue. This level of aerobic workload is called peak exercise capacity and is measured in metabolic equivalents (MET). One MET equals 3.5 mL of O<sub>2</sub>/kg/min, which is the amount of energy consumed per kilo of corpse load during one minute of rest. Any activity that requires more oxygen consumption than rest will result in higher MET levels (Kokkinos, 2010; Kokkinos, 2012). Since this exercise test is designed to exhaust participants, this health assessment method is more objective than questionnaires. The following are selected studies whose results support vocational and recreation moment research and, more importantly, enrich our understanding of the relationship between exercise or increased physical activity and health benefits (Kokkinos, 2012).

Exercise training for the elderly is correlated through health care assistance such as reduced cardiovascular mortality (Laukkanen et al., 2004). Changes in the balance of the cardiac autonomic nerves lead to an increase or relative innervation of the vagus nerve, which is an explanatory mechanism that may be involved after exercise. In addition, endurance exercise training can reduce the relaxing and sub-maximal workout core rate, systolic and diastolic bloodstream strain of the elderly, and increase thrombosis quantity (Eynon et al., 2008). This is most pronounced during maximum effort when thrombosis quantity, cardiological productivity, contractile force, and oxygen uptake increase while complete peripheral insurgency and systolic and diastolic bloodstream strain decline (Langhammer et al., 2018).

Regular physical exercise is also associated with improving mental health (for example, reducing stress, anxiety, and depression) (Warburton et al., 2001; Dunn et al., 2001). Mental health is essential for preventing and managing cardiovascular disease, but it also impacts other chronic diseases (such as diabetes, osteoporosis, hypertension, obesity, cancer, and depression) (Warburton et al., 2006).

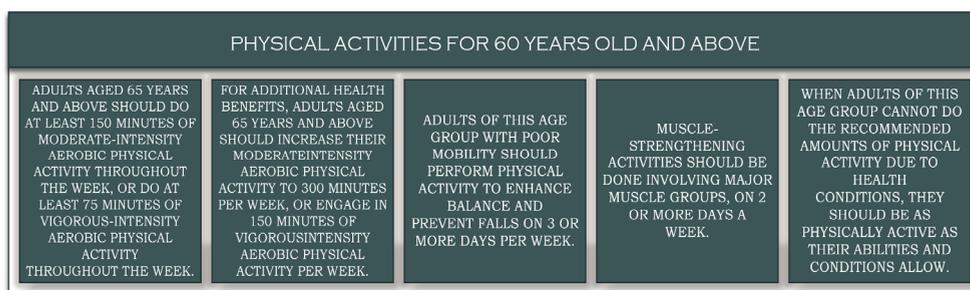
**21–60 years old.** Physical activities include leisure or leisure-time sports activities, transportation, profession (i.e., work), housework, play, games, sports, or planned exercise in everyday, group, and population behaviors.

Adults of different ages. The following activities are recommended to enhance cardio-respiratory and muscle health, skeleton health care and decrease the threat of non-communicable diseases and depression (World Health Organization, 2010; Yang, 2019) (Figure 4):



**Figure 4.** Physical Activities for 21–60 years old adults (World Health Organization, 2010; Yang, 2019)

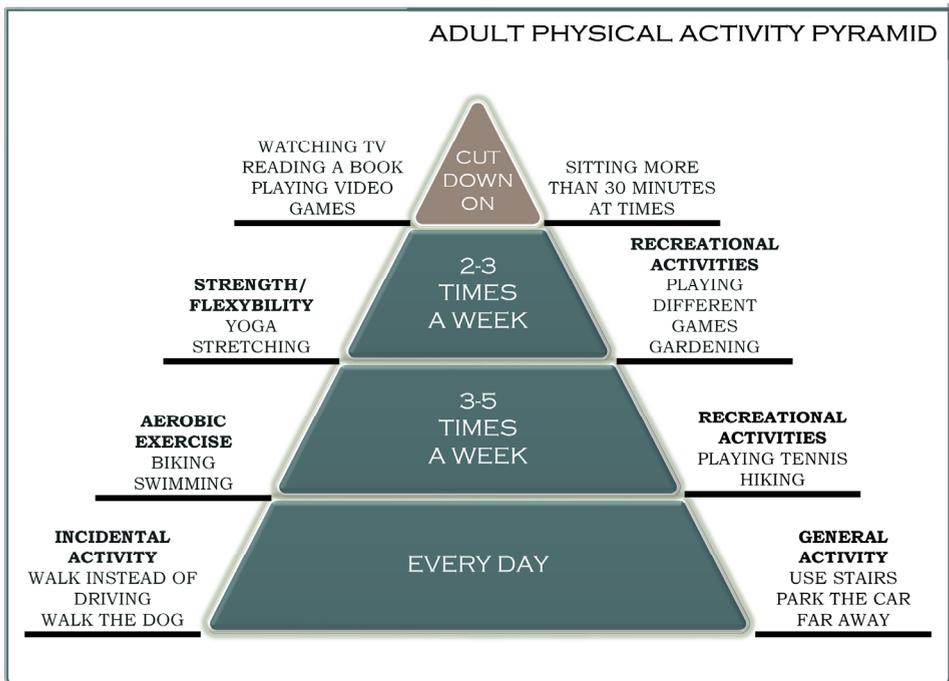
**60 years old and above.** Physical activity includes physical activity during recreation or leisure time, transportation, housework, interplay, events, athletics or in daily life, family, and adults of that age community activities. The following activities are recommended to enhance cardio and muscle health, bone and functional health, as well as lowering the risk of non-communicable diseases, depression, and cognitive decline (World Health Organization, 2010; Yang, 2019) (Figure 5):



**Figure 5.** Physical Activities for 60 years old and above (World Health Organization, 2010; Yang, 2019)

In general, for people of all ages, the benefits of following the above recommendations and doing physical exercise outweigh the risks. Musculoskeletal injuries seem to be uncommon at the suggested degree of 150 minutes of mild-hardness activity per week. To reduce the possibility of musculoskeletal injury, in a community-founded strategy, it is appropriate to encourage a moderate start and gradually increase to a higher level of physical activity (World Health Organization, 2010; Yang, 2019).

Some researchers (Maher et al., 2013) found in two independent samples of emerging adults that emerging adults' days of participation in the *physical movement pyramid* (Figure 6) were more significant than their typical situation (i.e., interpersonal association). This model is recreated while employing instant evaluations of physical behavior (i.e., accelerometer) (Maher et al., 2014). Even though this relationship has not been studied in-depth, later adulthood, it seems that the inherent process of linking daily changes in life satisfaction with physical activity seems to be applicable through maturity since the rejuvenating consequence of sharp physical behavior might assist stimulate goal pursuit and life satisfaction Degree, has nothing to do with age (Puetz et al., 2006; Maher et al., 2015).



**Figure 6.** Adult physical activity pyramid (<https://theworldbook.org/physical-activity/>)

Conclusive scientific evidence from a wide range of well-developed studies shows that, compared with inactive adults, physically active adults 60 years of age and older have a higher level of cardiorespiratory fitness and have a lower risk of a variety of disabling diseases. Chronic non-communicable diseases are also lower (World Health Organization, 2010).

## Conclusions

Finally, this review harmonizes the relationship between physical activity, cardiorespiratory health, and adulthood throughout the life cycle. Changes in daily physical activity have a significant impact on overall health and well-being in adulthood. As age-related decline affects people's physical and mental health, regular physical activity is becoming more and more important for well-being.

One of the secondary conclusions from this review is that physical activity has consistent and robust effects on the brain, which mediate improvements in cognitive performance at various stages of adulthood.

The equilibrium and advancement of communities depend on the collective performance of any group of young people. Of course, this is true for every group of youngsters and youths, but the switchover to maturity marks the end of the trial period and the commencement of some meaningful action. Young people's successful transition to independent and healthy adulthood, entry into the workforce, sustained productivity, and successful parenting can contribute to the security and well-being of the country.

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## EFFECTS OF DYNAMIC STRETCHING ON NEUROMUSCULAR REACTION TIME OF YOUNG FEMALE ATHLETES

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**ABSTRACT. Introduction.** Reaction time is the ability to perform a single (non repeated) movement in the shortest time and it is a crucial skill in sports. It has been shown that using different warm-up strategies can improve performance output. Recently it has been discovered that static stretching may temporarily decrease the muscle's ability to perform. **Objectives.** The aim of this paper was to determine if the neuromuscular reaction time during jumping is influenced by dynamic stretching. **Materials and Methods.** The participants in this study were young female basketball players (N = 22), ages from 16 to 18 years old that underwent two measurements using the MGM-15 carpet in two situations: without doing dynamic stretching and after doing dynamic stretching. **Results.** There was a significant statistical difference in the scores between the control and after dynamic stretching measurements. This means that the dynamic stretching had an influence over the reaction time. **Conclusion.** The results of the present research demonstrated that local neuromuscular reaction time increased significantly after dynamic stretching compared to the baseline condition.

**Keywords:** *dynamic stretching, reaction time, female, athletes, neuromuscular*

**REZUMAT. Efectele stretchingului dinamic asupra timpului de reacție neuromuscular la tinere sportive. Introducere.** Timpul de reacție este abilitatea de a realiza o singură mișcare în cel mai scurt timp posibil și este crucială în sport. S-a demonstrat că folosind diferite rutine de încălzire se poate îmbunătăți performanța. Recent s-a demonstrat că stretchingul static poate scădea temporar performanța musculară. **Obiective.** Scopul lucrării este de a determina dacă timpul de reacție în săritură este influențat de stretchingul dinamic. **Materiale și metode.** Participanții în studiu au fost baschetbaliste (N=22) cu vârsta între 16 și 18 ani care au fost măsurate în două situații

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experimentale: fără stretching și cu stretching dinamic, folosind covorul MGM-15. **Rezultate.** S-a observat o diferență statistică semnificativă între condițiile experimentale fapt ce demonstrează influența stretchingului dinamic asupra timpului de reacție. **Concluzie.** Rezultatele au demonstrat că timpul de reacție neuromuscular a crescut semnificativ în urma stretchingului dinamic.

*Cuvinte cheie: stretching dinamic, timp de reacție, sportive, neuromuscular.*

## Background

It has been shown that using different warm-up strategies can improve performance output. Widely regarded as an integral part of sport conditioning programs and warm-up routines static stretching can reduce muscle soreness and improve athletic performance while decreasing the risk of injury (Walsh, 2017). Recently it has been discovered that static stretching may temporarily decrease the muscle's ability to perform (Costa et al., 2009). Other forms of stretching have been proposed to be used during warm up to avoid this loss (Galazoulas, 2017). Considering that most of these studies have investigated the loss in muscle strength and power output in the context of stretching of biomechanical parameters, it is therefore interesting to examine the effects of dynamic stretching on neuromuscular reaction time.

Cognitive abilities and efficient awareness processes considerably saturate technical performance in sports by ensuring quick and correct responses to external stimuli and allowing more time for preparation and organization of motor behavior (Mori et al., 2002; Kim & Petrakis, 1998; Scott et al., 1993; Williams & Elliot, 1999; Fontani et al., 2006). Therefore, to achieve a high quality performance of sport techniques, reaction time is crucial (Mori et al., 2002; Kim & Petrakis, 1998). Little is known about the effects of dynamic fatigue on neuromuscular reaction time, even though it has been recently shown that reaction time was affected by some factors such as age, gender and number of stimuli (Magill & Anderson, 2016; Chang et al., 2012).

Reaction time is the ability to perform a single (non repeated) movement in the shortest time and it is a crucial skill in sports. Quantifying the performance of professional athletes during lateral plyometric exercises has been done recently (Wong et.al., 2012), as an effective way to evaluate athletes' acyclic rapidity through the analysis of contact times.

Dexterity creates the optimal environment to learn complex movements in a relatively rapid way (Atan and Akyol, 2014). It is composed of movement control and other regulation processes. Moreover, coordinative abilities are crucial in many sports, allowing for an easier control of motor actions.

High performance of the physical and motor skills translates into a higher probability for an athlete to be successful in sport events. Reaction time is one of the parameters that may empower an athlete to have such performance (Koç et. al., 2006). The time that elapses between a stimulus and the reaction given to it is defined as reaction time. There are a lot of factors and variables that influence reaction time such as age, gender, fitness, training (Colakoglu et. al., 1993).

## **Objectives**

The aim of this paper was to determine if dynamic stretching influences the neuromuscular reaction time of young female athletes.

## **Methods**

### *Subjects*

The participants in this study were young female basketball players (N = 22), ages from 16 to 18 years old that underwent two measurements using the MGM-15 carpet in two situations: without doing dynamic stretching and after doing dynamic stretching.

### *Methods and the Steps of the Research*

We used the MGM-15 Jumping Carpet for test. The test consists of 15 jumps on both legs that must not be bent during the execution. The software from the MGM-15 Jumping Carpet laid out, among others, one measurement for each subject named Reaction Time (R.T.).

R.T. (Average reaction time) – it is measured during the jumps on both legs and offers data regarding the overall average reaction time the subject had.

For dynamic stretching, each participant assumed a standing upright position and began to perform the exercises under the verbal guidance of the experimenter. The exercises were performed in the following order: plantar flexors, hip extensors, hamstrings, hip flexors, and quadriceps femoris. Each stretching session was performed by repetitively bouncing the stretched muscle to its limit of motion range with 15 repetitions, each lasting 2 s. The procedure was performed on the right leg and subsequently the left leg. There was a 10–15 s rest period taken between exercises while the total time of the session was  $7 \pm 1$  min.

## Results

**Table 1.** Average values of neuromuscular reaction time for each of the subjects for both the control measurement and the one preceded by dynamic stretching

Subject	React_Time_Dynamic	React_Time_Control
1	0.325	0.410
2	0.458	0.530
3	0.390	0.470
4	0.452	0.510
5	0.332	0.410
6	0.377	0.460
7	0.489	0.560
8	0.462	0.530
9	0.401	0.450
10	0.385	0.450
11	0.490	0.540
12	0.442	0.520
13	0.311	0.380
14	0.372	0.420
15	0.313	0.390
16	0.436	0.530
17	0.374	0.450
18	0.430	0.520
19	0.320	0.410
20	0.363	0.410
21	0.461	0.520
22	0.436	0.490

**Table 2.** Descriptive statistics for the control and dynamic stretching measurement of the reaction time

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	React_Time_Dynamic	.4009	22	.05803	.01237
	React_Time_Control	.4709	22	.05605	.01195

**Table 3.** Correlation between the control and dynamic stretching measurement of the reaction time

Paired Samples Correlations				
		N	Correlation	Sig.
<b>Pair 1</b>	React_Time_Dynamic & React_Time_Control	22	.968	.000

**Table 4.** Paired sample t test for the measurements (control and dynamic stretching) for the tested variable: reaction time

Paired Samples Test									
Paired Differences									
95% Confidence Interval of the Difference									
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
<b>Pair 1</b>	React_Time_Dynamic - React_Time_Control	-.070045	.014627	.003118	-.076531	-.063560	-22.461	21	.000

A paired-samples t-test was conducted (Table 4) to compare the reaction time before and after using dynamic stretching. There was a significant statistical difference in the scores between the control ( $M=0.4709$ ,  $SD=0.056$ ) and after dynamic stretching ( $M=0.4009$ ,  $SD=0.058$ ) conditions;  $t(21)=-22.461$ ,  $p = 0.000$ . This means that the dynamic stretching had an influence over the reaction time of the subjects as recorded by the MGM-15 Jumping Carpet.

## Conclusion

The aim of this study is to examine the acute effect of dynamic stretching on the local neuromuscular reaction time during a series of anaerobic jumps. The results revealed that the reaction times were significantly improved (decreased) after dynamic stretching compared to control measurement. A significant increase was shown with the large effect size in all subjects. Previous studies on the effects of dynamic stretching on the performance have primarily focused on neurophysiological aspects such as strength and power performance.

The results of the present research demonstrated that local neuromuscular reaction time increased significantly after dynamic stretching compared to the baseline condition.

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## THE FOUNDING AND FIRST YEARS OF ACTIVITY OF NAGYVÁRADI ATLÉTIKAI CLUB FOOTBALL TEAM 1910 – 1914

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**ABSTRACT.** The year 2020 marks one hundred and ten years since the founding of Nagyváradi Atlétikai Club (in Romanian: Clubul Athletic Oradea), which in matter of football was one of the reference sports groups in the city of Nagyváradi in the first half of the 20<sup>th</sup> century. Due to this anniversary, we set out to present the history of this team, from the moment when it was founded up to the outbreak of World War I. Through its contents, this paper contributes to a better understanding of the past of this sports team and, in the same time, it represents an acclaim of its founders, leaders and players. The first part of this paper presents the founding of Nagyváradi Atlétikai Club team, its first years of activity, its attendance to competitions, international matches, its contribution to shaping iconic players for local football and for the national teams of Hungary and Romania, and then it presents the headquarters, playing fields, coaches and main leaders of the team. Through its contents, this paper is of interest, not only for those who just want to expand their general knowledge, but also for people who study Nagyváradi's football history.

**Keywords:** *Nagyváradi Atlétikai Club, Clubul Athletic Oradea, football*

**REZUMAT.** *Constituirea și primii ani de activitate a echipei de fotbal Nagyváradi Atlétikai Club 1910 – 1914.* În anul 2020 s-au aniversat o sută zece ani de la constituirea echipei de fotbal Nagyváradi Atlétikai Club care a fost una dintre grupările sportive de referință ale fotbalului din orașul Nagyváradi în prima jumătate a secolului al XX-lea. Având în vedere acest moment aniversar, ne-am propus să prezentăm istoria acestei echipe, începând cu înființarea ei și până la izbucnirea Primului Război Mondial. Prin conținutul său, lucrarea contribuie la mai buna cunoaștere a trecutului acestei formații sportive și, în același timp, reprezintă o recunoaștere a celor care au înființat echipa, a

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conducătorilor și a jucătorilor ei. În prima parte, lucrarea se referă la constituirea echipei Nagyváradi Atlétikai Club, primii săi ani de activitate, participarea ei în competiții, meciurile sale internaționale, contribuția la formarea unor jucători reprezentativi pentru fotbalul local și pentru selecționatele Ungariei și cea a României, apoi prezintă sediile, terenurile, antrenorii și conducătorii săi mai importanți. Prin conținutul său, lucrarea prezintă interes, atât pentru cei care doresc doar să-și lărgescă aria de informare, dar și pentru cei care studiază trecutul fotbalului orașului Nagyvárád.

**Cuvinte cheie:** *Nagyváradi Atlétikai Club, Clubul Athletic Oradea, fotbal*

### **The Founding of Nagyváradi Atlétikai Club Football Team**

In addition to its cultural, architectural and ecclesiastical values, Nagyvárád (in Romanian: Oradea) is a city of interest in matter of sports as well. The 20<sup>th</sup> century was called the century of sports because the sport phenomenon has become universal and it amplified. The founding of sports associations and football departments in Nagyvárád contributed to the development of the round ball game.

The football department of Nagyváradi Atlétikai Club (NAC) (in Romanian: Clubul Athletic Oradea) was founded when Transylvania was still part of Austria-Hungary. At that time, a young journalist named Pásztor Bertalan was working in Nagyvárád, who had initiatives with liberal features and a fiery look in his eyes. A good friend of the poet Ady Endre, he showed a special passion for sports and looked for ways to develop local football. He gave examples from Budapest, where sports associations such as Magyar Testgyakorlók Köre (MTK), Ferencvárosi Torna Club (FTC), Budapest Atlétikai Klub and Vác Futball Club already existed (Schön, 1981).

The young footballers led by Mikló Béla, Szabó Andor and Friedländer Sándor won the moral trust and financial contribution of four personalities of the time: Dr. Dénes Sándor (lawyer), Dr. Kovács Kálmán, Dr. Jónás Emil and Lakatos Béla (physical education teacher) in order for Nagyváradi Atlétikai Club to be founded.



**Picture 1.** Emke Cafe ("Emke Kávéház", 1911) between 1910-1920 ("Insigne", n.d.)



**Picture 2.** Crest of NAC

In the center of Nagyváradi, in a booth of Emke Cafe (set up on the ground floor of the current Hotel Astoria) on May the 26<sup>th</sup>, 1910, on Thursday, at 20:30, the founding meeting of the Nagyvárad Atlétikai Club took place (Picture 1). The founding members were: Grünstein Béla (Bernát) (lawyer), Jancsó Béla, Szabó Andor (corporate director), Kovács László, Dr. Jónás Emil, Kovács Károly, Engel Dezső (dentist), Schmidt Béla, Rosenfeld Henrik (officer at Egyesült Nagyvárad László és Hunyady Gőzmalom), Horváth Ferenc, Dr. Kovács Kálmán, Lebovits János, Mikló Béla, Dr. Marton János, Kun Ármin, Elekes and Rónay. They voted on the members of the club's board of directors: director: Dr. Jónás Emil (president), Dr. Kovács Kálmán (cashier), Szabó Andor (chief secretary) and Mikló Béla (football department coordinator). The latter was the one who knew best the "football" phenomenon. The club's crest and colors were chosen: white-green (Picture 2) (Török, 1937).

The regulation regarding the organization and functioning of the club was published in the Official Gazette of Hungary no. 118, 298 ("A Nagyvárad Atlétikai Club", 1910).

The purpose of the club was: "educating the members, promoting physical education, maintaining good terms, providing material support, developing feelings of camaraderie, sports training of young forces" (Fleisz, 2007, p. 101).

In the first year of the club's activity, the playing field of NAC team was in Városliget - Bunyitai Liget (today I.C. Brătianu Park), with a stony surface that caused many injuries, and starting with August the 20<sup>th</sup>, 1911, the football team moved to the new location at Grădina Rhédey, called "Sporttér" (which now is called Stadionul Tineretului) (Sas, 1911).

During the period preceding World War I, NAC was active locally and regionally through inter-city and inter-club matches.

### **Matches of Nagyváradi Atlétikai Club football team throughout 1910**

In its first year of activity, NAC applied to join the Magyar Labdarúgó Szövetség (MLSZ) (Hungarian Football Association). The main criterion for joining was to play match - rematch with a team already registered with the association (Deák, Gecse, S. Tóth, Simon, Szilágyi & Thury, 2010).

In 1910, NAC had a total of four friendly matches: two with Debreceni Torna Egylet (DTE) and two with Kolozsvári Vasutas Sport Club (KVSC). The DTE football team was founded in 1899, one of its players being the Hungarian poet Ady Endre (Fésüs, 1994).

The first official match took place on July the 31<sup>st</sup>, 1910, in Bunyitay Liget, at 17:00, between the NAC and KVSC teams. The score was 2-1 for the away team (Földessy, 1926).

We must mention the tenured players of the NAC team because that was the first page of a glorious 34-year-long era: Welzer II, Welzer I, Muharos, Palocsay, Mikló Béla, Kalmár, Dietrich, Winkler, Róna, Balázs, Kont. In the second half of the season, in the autumn of the same year, the team from Nagyváradi won against KVSC by 5-1 (Török, 1937).

### **The selected teams of Nagyváradi, Kolozsvár and Debrecen**

Up until the outbreak of World War I, the selected teams from Nagyváradi and Debrecen met five times. NAC obtained four victories and one defeat. Often, the meetings brought about many accidents, but also violent incidents.

The sports dailies of Debrecen called the Grădina Rhédey "Mészárszék" (Slaughterhouse), and the players of Partium called the athletes of Debrecen "barbarians". Many times, at the end of the match, the players were chased away with stones thrown by the spectators (Dénes & Sándor, 2011).

In the spring of 1912, NAC Chief Secretary Pásztor Bertalan asked the presidents of the football teams of Debrecen to make a selection of footballers to organize a series of friendly inter-city matches between Nagyvárad and Debrecen. The mayor of Nagyvárad, Rimler Károly, was a great football fan, who watched the team's matches every weekend. After a few weeks of discussions, the presidents of the football teams from the two cities agreed that the players should wear the colors and the coat of arms of their hometown on their shirts (Szegeci, 2005).

The first inter-city match held in Nagyvárad on June the 23<sup>rd</sup>, 1912 was watched by more than 4000 spectators and was won by NAC with the score of 4 -1. The team from Debrecen was supported by about 100 football fans. Tents and a small buffet were set up for the match (Szép, 1912). A comic incident took place during the match refereed by Vámos Soma. After he ruled offside, Nagyvárad's mayor Rimler Károly, who was also present at the match, asked MLSZ secretary Steinhübel Ödön why the match had been interrupted. Ödön replied that the player had been in the "out of play" position. The irritated mayor exclaimed, "How can he rule offside if I dind't seen it?" (Röser, 1912).

In the five matches played, the team of Debrecen was made up, in a similar proportion, of the players of the teams DTE, Debreceni Kereskedelmi Alkalmazottak Sport Egyesülete (DKASE) and Debreceni Munkás Testedző Egyesület (DMTE) while out of the total of 55 players selected to represent Nagyvárad, 46 were players of the NAC team, many of them residing in Vienna or Budapest (Dénes & Sándor, 2011).

In a match held on the banks of Sebes Körös river (in Romanian: Crișul Repede river), the selected team of Nagyvárad won with the score of 3-1 against the selected team of Kolozsvár. The players of the selected team of Nagyvárad: Standing: Hirsch (NAC), Katona Béla (NAC), Kürschner (NAC) (coach-player), Kucsera (NAC), Stepán (Nagyvárad Sport Egylet) (NSE), Oblátt Imre (NAC), Niessner (NSE), Strasszer (NAC). Sitting: Lassingleitner (Nagyvárad Sport Club) (NSC), Jakobovits (NAC) and Kovács (NAC). Pásztor Bertalan – chief-secretary NAC (in a suit) (Picture 3).



**Picture 3.** The selected team of Nagyvárád and of Kolozsvár in 1913 (Demjén, 1989)

### **The attendance of NAC team to the regional championships of Hungary**

From the first year, the NAC management also set up the second team for junior training for the big team. In 1912, NAC had 3 football teams (NAC I, NAC II and the junior team).

Between 1910 and 1911, the cities of Arad, Timișoara and Cluj organized their own championships, after which the competition was extended, becoming the championship of Transylvania (Luchide, Gațu, Mihăilescu, 1968). In reality, it was called the regional championship (vidéki bajnokság). It needs to be noted that MLSZ organized football championships since 1901 for teams from Budapest, and the 1907-1908 season was the first championship for teams from outside of Hungary's capital. The winners of the zonal series played a final tournament, played in eliminatory system.

The 1911 - 1912 football season meant the first time attendance of the NAC football club to the football championship of Hungary, Central Zone, along with the teams: NSE, DKASE, DMTE, DTE, Miskolci Munkás Testedző Egyesület (MMTE) and Miskolci Sport Egyesület (MSE). Led by coach Szabó Andor, it ended the season on the second place, ahead of the local team, NSE ("Vidéki Bajnokság - Középmagyarországi kerület", n.d.).

The Nagyváradi Törekvés Munkás Testedző Egyesület (in Romanian: Asociația de Cultură Fizică a Muncitorilor Stăruința Oradea) was founded in 1912 under the management of the director Lőweinstein Zsigmond. In the same year, Egyetértés Sport Egylet was established. In the following period, the two teams represented a rivalry for the NAC team (Picture 4). The establishment of the Törekvés football section meant a growing popularity of the sport among the workers, and the expenses of playing football were minimal in comparison to fencing or horse riding, considered to be the sports of the aristocrats.



**Picture 4. a - b.** Medal of the Törekvés rematch – NAC (without year)  
(collection of Lukács Imre Róbert)

The front side of the item shows an attack in front of the goal, watched by the spectators. The back side features a wreath of olive branches and, in four rows, the inscription Törekvés - N.A.C. Revans IX. 15. Size: 40x40 mm. Weight: 27.6 g.

In the meantime, in the Kingdom of Romania, towards the end of 1912, along with the founding of the Federation of Romanian Sports Societies (FSSR), football received a new organization. In the FSSR, the activity was led by the Football-rugby Commission. In 1919 the two branches separated into the "Union of Football Clubs Association" and the "Rugby Commission". The FSSR had as president King Ferdinand - founding member - and as general secretary Prince Carol (Postolache, 1979). Later, the "Association of Football Clubs" joined the "Football Association Committee" (after Ghibu & Todan, 1970) and the "Central Football Commission" (after Luchide, Gațu & Mihăilescu, 1968).

As the sport with the round ball was spreading, the interest in winning the title of the best team of the region began to increase as well. The transfer of valuable players from the Hungarian first division was a vital factor for sports associations outside Budapest. So did the NAC team, which in the season of 1912-1913 bought a record number of players with whom they could line up a complete team (Földessy, 1926).

The most distinguished players were Hanny from Vienna (Dénes & Sándor, 2011), Strasser Emil who had played at Kereskedelmi Alkalmazottak Országos Egyesülete (Polónyi, 1912) or Kürschner Izidor from MTK. The latter became the captain of the white-greens and opened a café, the "Kürschner Club Kávéház", and a sports equipment store in little Paris on the banks of Pece (in Romanian: Peța) (Herendi, 1912).

In order to stop the exodus of players from other cities and to support amateurism, in 1913, MLSZ introduced a new regulation against professionalism: the transfer of a player could take place only after they have played at least 6 months for their new team (Földessy 1926).

In the 1912-1913 edition of the football championship, East Zone, the Nagyváradi vidéki group out of a total of 16 NAC matches, won 15 + one by default, accumulating a maximum score of 32 points with 137 goals scored and only 6 conceded (Dénes, Sándor & Bába, 2013).



**Picture 5.** Czuvinán Andor & **Picture 6.** The NAC team in 1913 (Luncz, Rédiger, Raditz, Katona, Hoffmann Árpád (Kabos, 1913) Kürschner, Strasser, Nyúl, Kovács, Busi, Postarik, Máthé) (Speidl, 1920)

NAC won the East Zone final against Ungvári AC with the score of 7-2. In this match, the striker Czuvinán Andor (NAC), who was 14 years old and the shortest player of the team, scored 4 goals (Picture 5). On July the 13<sup>th</sup>, 1913, in the final of the regional championship, NAC was defeated at home by 3-0 by the champion of the North Zone Kassai Athletikai Klub (Dénes & Sándor, 2011).

Kürschner Dóri, the captain of the team, had a significant contribution to the performance. The first team was made up of the following players: Kürschner Dóri, Strasser Emil, Katona Béla, Oblatt Imre, Kovács, Hirsch Elemér, Máthé, Kucsera, Schossi and Jakab (Speidl, 1913). Bakos, Oblatt, Kürschner, Strasser, Katona formed the line of attack. Kucsera István was a two-time champion of the national football division with the FTC team (1908 - 1909 and 1909 - 1910).

In the East Zone Championship, Nagyvárad group, 1913 - 1914 season, NAC finished on the first place with a maximum score of 32 points, qualifying themselves to the East Zone finals. NAC played a tied match (1-1) (90 minutes + 2 x 15 minutes extra time) with the Ungvári AC team. NAC challenged the result as the coach of Ungvári AC sent three players on the field who were not legitimized. MLSZ accepted the appeal, and NAC received the 3 points (Speidl, 1914a). NAC aligned the following formation: Postarik, Könczey, Csobán, Robogó, Rózsavölgyi, Jónás, Brán, Hamburger, Kürschner, Strasser, Horváth (Dénes & Sándor, 2011).

According to magyarfutball.hu, NAC did not show up for the rematch due to the outbreak of World War I ("Vidéki bajnokság – Keleti kerület", n.d.). An article in the Sporthirlap newspaper mentions a completely different reason. The vice-president of the NAC club, Pásztor Bertalan, stated that he received the telegram sent by MLSZ announcing the day of the match only in the evening, although this telegram had arrived to Nagyvárad that morning. The justification was not accepted and the NAC was declared the defeated team. Ungvári AC got qualified for the trophy for best provincial team (Speidl, 1914b).

Although this final did not take place, the editors of the sports magazine "Sportvilág" considered the NAC team one of the best teams in the regional championship along with Tatabányai Sport Club, Győri Egyetértés Torna Osztály, Temesvári Kinizsi Sport Egyesület and Pozsonyi Torna Egyesület. The level at which these teams were playing was equal to the level of those in the second league of the Budapest Championship (Dénes, Sándor & Bába, 2013).

### **The international matches of Nagyvárad Atlétikai Club team**

The Bishop Auckland amateur team's visit to Nagyvárad on April the 13<sup>th</sup>, 1912 was good propaganda for football in this region (Kormányos, 2019).

It was the first football team from England to visit the city of Nagyvárad (Picture 7).

"Last night the silence in Bémer Tér (now Piața Ferdinand) was interrupted by a crowd gathered in front of the Pannonia Hotel (now the Queen Mary restaurant). The cars were lined up one after the other, and the young people wore multicolored badges. The cars had the Hungarian flag, the blue and white flag of the city of Nagyvárad. The cars had the and a foreign one, that of England. Despite the cold outside, about 1500 fans gathered up" (Sas, 1912b, p. 3)



**Picture 7.** The advert of the match (Sas, 1912a)

Saturday's match brought together the good people of Nagyvárad. The snowfall in the second half and the white equipment of the NAC players did not disturb the game. The parade of the islanders' team was watched by 2000 spectators at the end of which the English won with the score of 8-0 (Sas, 1912c).

NAC lined up the following team: Sisi (goalkeeper), Szücs, Szrenka (defenders), Milodanovics, Stotter, Weisz (midfielders), Niessner, Hanny, Kovács, Szkriván, Vécsey (forwards). For this match Niessner Aladár was borrowed from NSE (Sas, 1912b).

In the spring of 1913, the Austrian team Floridsdorfer Athletics Sports Club visited the city of Nagyvárad where they played two international matches in the company of the NAC and NSE teams. NAC won with the score of 2 - 0 (Sas, 1913).

### Headquarters, presidents and coaches of Nagyváradi Atlétikai Club team

The two local newspapers 'Nagyvárad' and 'Nagyváradi Napló' show that between 1910 and 1914, the members of the association met at cafés and discussed important matters of the association. During those five years they visited four different locations (Table 1).

**Table 1.** The location where important matters of the NAC association were discussed

Period	Name of the café	Current name of the location	Current address
1910 - 1911	<i>Emke</i> Kávéház	Restaurantul <i>Astoria</i>	Str. Teatrului nr. 1-2
1911 - 1913	<i>Szalon</i> kávéház	Cafeneau <i>Pellini Evolution</i>	Str. Primăriei nr. 2
1913	<i>Kürschner Club</i> Kávéház	Bazár bérház színház oldalán	Str Madách Imre
1913 - 1914	<i>Pannónia</i> Kávéház	Restaurantul <i>Queen Mary</i>	Str. Teatrului nr. 1-2

At the end of 1913, the football player Kürschner Izidor announced that he would close his café, due to the fact that it was not a prosperous business for him. He wanted to improve and take a coaching course in England and then work for a football team in Hungary (Röser, 1913).

Between 1910 and 1914, the first NAC football team had five coaches and three presidents (Table 2 and 3).

**Table 2.** The coaches of the NAC football team between 1910-1919

Season	1910 - 1911	1911 - 1912	1912 - 1913	1913 - 1914	1914 - 1919
Surname and Name	Mikló Béla*	Szabó Andor	Stotter Aladár*	Kürschner Isidor*	ifj. Horváth Ferenc

Note: \* = coach-player; Stotter Aladár between 1912 - 1913 was assisted by Grell János (assistant coach)

**Table 3.** The presidents of NAC sports association between 1910-1919

Season	1910 – 1911	1911 – 1913	1913 – 1919
Surname and Name	dr. Jónás Emil	dr. Dénes Sándor	dr. Adorján Emil

Note: Pásztor Bertalan chief secretary between 1912 – 1914 and vice president between 1914 – 1919 coordinated the NAC football team in an exemplary manner

### Players in Hungary's and Romania's national teams

Hirsch Elemér, the player of the NAC team between 1912 and 1913, attended the Olympics in Paris in 1924, was selected five times for the Romanian national team (1922 - 1924) and coached the tricolors between 1947 and 1948. He was one of players of the first match played by the Romanian national team on June the 8<sup>th</sup>, 1922 (“Hirsch Elemér”, n.d.).

Kürschner (Szűcs) Izidor Dori, the player of the NAC team between 1912 and 1914, was called to the Hungarian national team five times between 1907 and 1911. Kürschner Izidor was the only one from the team who had a long coaching career. He trained for 22 years in Hungary, Germany, Switzerland and Brazil. As assistant selector of the Swiss national team he won the silver medal at the Olympic Games in Paris (1924) (“Kürschner Izidor”, n.d.).

The coach - player of the NSE team, Niessner Aladár, was the first player from Nagyvárad co-opted into the Hungarian national football team (five appearances: 1903 - 1907) (Demjén, 1989). He has also been lended to the NAC team several times.

Nyúl Ferenc was the player of the NAC team in 1913 for a short period because MLSZ did not approve his final transfer because within six months he had also played for a football team from Debrecen, and according to the regulations in force at that time he could not be transferred. He was nine times champion of the national football division with MTK and was selected four times for the Hungarian national team (1916 - 1920) (“Nyúl Ferenc”, n.d.).

### Conclusion

The management and members of the NAC association came largely from the Jewish community of the city of Nagyvárad and had a modern vision regarding the development of local football. Unfortunately, the storm of time removed it from the battlefield, but its memory remained with us. The legend was passed on from father to son. The performance of the NAC was possible due to the sportsmanship and sacrifice of the Jews of Nagyvárad (Schön, 1981).

NAC managed to popularize football among the locals, so that, before the outbreak of World War I, it became the favorite sport of the inhabitants. According to Fehér (1913), “more than a year has passed, and the inhabitants of Nagyvárád, in addition to the traditional langaméta and duplex, play football, athletics and swimming. We could not imagine that the game of football can attract so many supporters and spectators in such a short time. Every Sunday, there was a massive public presence at the NAC team’s matches” (p. 68). After its establishment, the association also had departments for fencing, gymnastics, boxing, athletics, skating, free wrestling, swimming and tennis.

In the first 4 years, the NAC team got to play against the best teams in the regional championship, the players' technique was perfected, their own style of play was developed, the team spirit strengthened, and the footballers imposed respect for the following decades. Not financial reasons, but the sincere love for the game of football was the reason for which they've improved their playing level. At the same time, the fans lined up behind their favorite team and there was no bad weather that could keep them away from their favorite matches.

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**Published article “Brigitta Szilágyi, Alexandra Makai, Péter Tardi, Viktória Kovácsné Bobály, Ágnes Simon-Ugron, Melinda Járomi, Back School Program: Development of Back Care Knowledge and Spine Disease Prevention and Trunk State Among 6-7 Year-Old-Children, STUDIA UNIVERSITATIS BABES-BOLYAI EDUCATIO ARTIS GYMNASTICAE, LXVI, 3, 2021, pp. 77 – 92”.**

**The sections below already contain the corrected text and numbers.**

**ABSTRACT. Introduction:** The prevalence of posture deformities and muscle weakness among primary school children is high (50-65%). **Objective:** To assess and improve the back care knowledge and spine disease prevention, the strength of the trunk muscles, the flexibility of the lower limb muscles, the posture, and the lumbar motor control ability of primary school children by a 1-school year back school program. **Methods:** 102 (mean age: 6.549±0.500 years) children were examined at the baseline, and 48 (23 boys, 25 girls) were chosen for the program. Back care knowledge was examined by validated questionnaire, trunk muscle strength, and muscle flexibility by Lehmann tests, posture by New York Posture Rating Chart, and lumbar motor control by Sitting Forward Lean Test. **Results:** The complete back care knowledge (3.269±3.341, 16.269±2.426 points; p<0.001), trunk flexor (3.615±7.910, 56.885±113.748 sec; p<0.001), trunk extensor (8.962±5.963, 77.000±139.801 sec; p<0.001) static muscle strength, lower limb flexibility (p<0.001), habitual posture (53.846±10.130, 81.154±9.829 points; p<0.001), posture deemed correct 40.962±16.311, 91.346±6.566 points; p<0.001) and lumbar motor control (8.269±5.474, 0.154±0.368 mm; p<0.001) significantly improved in the intervention group for the end of the program. **Conclusions:** The back school program improves the back care knowledge and the trunk state among 6-7 years old children.

## **Data collection**

### *Health Questionnaire on Back Care Knowledge and Spine Disease Prevention for 6-10 Years Old Children*

The questionnaire was filled out by the children before and after the back school program. We used a self-developed and validated questionnaire (Szilágyi, 2021). The questions have been read aloud for them and were illustrated by drawings, pictures, and figures. Four questions addressed the anatomical and biomechanical properties of the spine, three questions were about spine utilization and ergonomics.

**Scoring:**

There are questions, with more correct answers, for every correct answer a point can be given, thus who can find all the correct answers a total of 7 points can be given for question 1, 2 points for question 2, 2 points for question 3, 3 points for question 4, 2 points for question 5, 1 point for question 6, and 1 point for question 7. For the wrong answer, 0 point was given. A maximum of 18 points can be obtained in the questionnaire and a minimum of 0 point. For the anatomical and biomechanical questions (1,2,5,7) 12 points, for spine use and ergonomical questions (3,4,6) 6 points could be awarded. Between 100-80%, the knowledge is appropriate, between 79-60% it needs to be developed, and between 59-0%, it is inappropriate.

**Results****Results at the baseline measurement (n=102)**

The mean point of the total score targeted to the back care knowledge was  $2.333 \pm 2.136$  points, which we can say was categorized inadequate with a  $12.963 \pm 11.865\%$ . The mean point of the anatomical, biomechanical knowledge was  $1.127 \pm 1.559$  points, and the mean point of the spine use, ergonomic knowledge was  $1.206 \pm 1.205$  points.

**Back Care Knowledge and Spine Disease Prevention (Table 2)**

**Table 2.** *The results of back care knowledge and spine disease prevention in the intervention and control groups*

		Intervention group (n=26)		Control group (n=22)		Differences between the intervention and control groups
		Mean $\pm$ SD (point)	p-value	Mean $\pm$ SD (point)	p-value	p-value
Total score	pre	3.269 $\pm 3.341$	<0.001	2.227 $\pm 1.378$	0.134	0.217
	post	16.269 $\pm 2.426$		3.000 $\pm 1.773$		<0.001
Anatomical, biomechanical	pre	2.423 $\pm 2.101$	<0.001	0.955 $\pm 0.950$	0.308	<0.001
	post	11.000 $\pm 1.265$		1.409 $\pm 1.593$		<0.001
Spine use, ergonomics	pre	0.846 $\pm 1.515$	<0.001	1.273 $\pm 1.241$	0.331	0.064
	post	5.269 $\pm 1.343$		1.591 $\pm 1.297$		<0.001

pre: baseline, before the program; post: after the program; SD: standard deviation