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THE CONTRIBUTION OF THE EFFECTIVENESS OF HIGH-LEVEL GOALKEEPERS HANDBALL TO THE FINAL TEAM RANKING IN A CHAMPIONSHIP

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ABSTRACT. The role and contribution of each player in a game increases when all the players of the same team are trying with all their might for the same purpose, the win. One of the main contributors of this effort is the efficiency of the player who struggling under the post (goalkeeper) in order to infringe as little as possible compared with the post of the opponent goalkeeper. The purpose of this study was to compare and examine whether the somatometric characteristics and the effectiveness of the goalkeepers (GK) high level, contribute and how to achieve a winning result. All GK who declared and competed in the Croatian European Championship in 2018 were tested and compared, categorized based on the percentage of efficiency each of them presented in the championship in live-game throws and 7-meter throws. Their individual effectiveness was also evaluated by the final ranking of their teams in the championship. Statistical analysis of the data was performed with SPSS 24.0 statistical package and more specifically Crosstabs (Independence Check) command. The analysis showed that GK are classified in the category of "high" GK, in terms of age are older than other players. In terms of efficiency, it seemed that the GK whose teams were ranked first in the championship showed lower rankings than those whose teams were ranked lower. This leads us to conclude that the effectiveness of the GK does not determine or guarantee the performance of a team but just contributes to the good performance of each player. On the contrary, the excellent defense function on the one hand restricts the activity of the offensives, on the other hand, it facilitates the GK in the process of repulse of the throws.

Key words: *Handball, Goalkeepers, analysis, effectiveness.*

Introduction

Handball is a team sport played by two teams of seven (7) players using their hands to throw a ball, and is distinguished for its hard physical contacts

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and tackles. The objective of both teams is to score in the opposing team's goal, which is defended by the goalkeeper (GK). Although the GK does not come into contact with the opposition during the game, they need to possess certain physical characteristics and technical skills that differ from their teammates (Hermassi et al., 2017; Por & Buligan, 2003; Romero Novoa, 2012; Srhoj, Marinovic, & Rogulj, 2002).

The efficacy of the GK significantly affects the team performance, by inspiring confidence that the team's goal is guarded well, as well as the final result of a game (Bárcenas & y Román, 1991). Furthermore, the GK can contribute in the effectiveness of a good team and the competitiveness of a mediocre team. When the goalkeepers' decisions and actions are successful the team gets motivated (Steffen et al., 2017), whereas, if this not the case, the team's performance is worsened (Fuertes, Penas, & Martinez L.C., 2010; Meletakos & Bayios, 2010). According to Czerwinski (1997) the effectiveness of the GK can affect the team's performance up to 50%.

With the help of statistical analysis based on notational analysis or video-analysis, athletes can improve the effectiveness of them in-game actions by feedback and 'spying' on the opposition. They can also correct their mistakes and improve their communication by boosting the motivation and the efficacy of their players and of the team as a whole (Taylor et al., 2004).

The same means assess the performance of the GK, determining their effectiveness through the comparison of the oppositions' shots on goal versus the goalkeeper's saves (Bilge, 2012). So far, the majority of the studies investigate the goalkeepers' anthropometric measurements (Justin, Vuleta, Pori, Kajtna, & Pori, 2013) or their natural fitness (Hansen et al., 2017; Rousanoglou, Noutsos, & Bayios, 2014), with the intend to showcase a goalkeeper's ideal physique, in order to increase their effectiveness during a game. They also study important individual factors that determine a goalkeeper's effectiveness, e.g. space, the shot type and distance, κατάληξη μπάλας στην εστία or the shot result. Recent bibliography shows that teams that dominated international events, e.g. the Olympic Games, and world or European tournaments, possess leading tall goalkeepers, whose effectiveness hovers at about 35% if not above that (Fieseler et al., 2017).

Given that the effectiveness of a goalkeeper's defensive actions in game are defined by their anthropometric measurements, it would be of some value to study this correlation in high-level games.

Method

The study sample consists of 21 GKs who took part in 6 to 8 games in the final round of the 13th European Men's Tournament in Croatia in 2018. The GKs that played in fewer games were not considered. The sample is divided in

four (4) groups, according to their effectiveness against the total number of shots to their goal during the games. The first group includes the GKs who achieved a successful defensive attempt percentage over 35% (Fieseler et al., 2017). The second group includes GKs with a percentage range of 34% to 30%. The third group ranges from 29% to 20% and the fourth group included GKs with a successful defensive attempt percentage up to 19%. Additionally, the field shots and the 7-meter shots were studied separately.

In the study sample, the anthropometric measurements (height, body weight and body mass) were taken into consideration and compared to the overall effectiveness of defensive attempts, as well as the field shots and 7-meter shots.

The source of the data that were used for the study was the official website of the tournament,
https://cro2018.ehf-euro.com/statistics/top-player/#PlayerFrame#hblTopPlayer#TopPlayerContent#HBEC18M_TOPPLAYER_HBM400000_json#Lists.8 and pertained to all the GKs of the tournament.

Statistical analysis

For the data analysis, the frequency of throws against each GK was calculated, in relation to the throw result. The statistics package SPSS 24.0 was used and, in particular, the Crosstabs command (contingency tables). For the determination of statistically significant differences between the shot percentage and the effectiveness, the non-parametric method of x^2 test ($p<0.05$) was used.

Results

Table 1 shows the number of the GKs who, according to their effectiveness, were admitted to one of the four groups. The statistical analysis demonstrated a significant difference only in the percentage between the second and first groups ($x^2= 5.991$, $p<0.02$), as well as the second and fourth groups ($x^2= 11.375$, $p<0,001$), which signifies that few of the GKs are admitted into the high effectivity group.

Among the eight GKs who showed an effectiveness >35%, there were two GKs who took part in just two games, namely Kastelic from Slovenia and Sterbik from Spain, who were effective at a percentage of 41% and 42% respectively, but they weren't included in the comparisons between the groups because of their limited participation (2 games).

Table 1. Categorization of the GKs, based on the effectiveness of their defensive attempts

Groups	Effectiveness	N	Valid Percent	Cum. Percent
1.	>35 %	8	21.1	100.0
2.	30-34 %	14	36.8*	78.9
3.	20-29 %	10	26.3	42.1
4.	0-19 %	6	15.8	15.8

(* 2vs1, (x^2= 5.991, p<0.02) και 2 vs 4, (x^2= 11.375, p<0.001)).

Figure 1 shows the frequency of the games that each team played in the tournament. The teams that played six or more games were 12 and the GKs that were registered were 21 (Fig.2). Four teams played 8 games (participation percentage 33%), two played in 7 games (participation percentage 17%) and six teams played in 6 games (participation percentage 50%). The statistical analysis of the data did not indicate any significant difference in terms of teams' participation in the tournament.

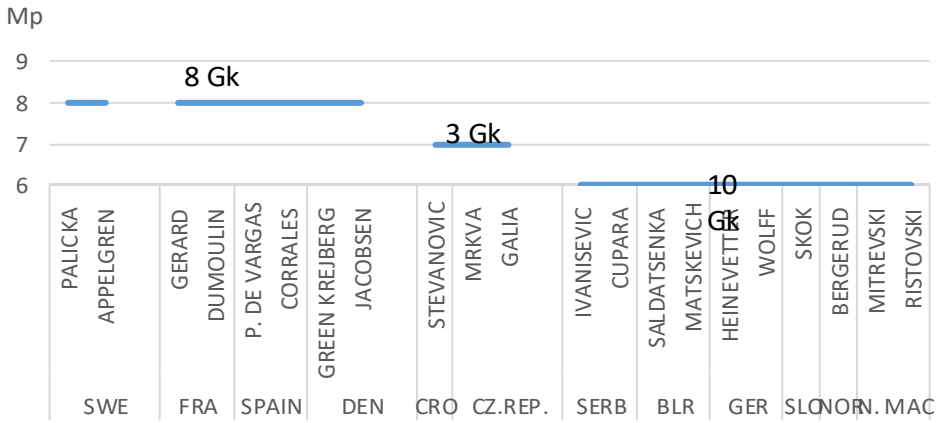

Fig. 1. Teams and GKs who were registered in more than 6 games.

Table 2 shows the average effectiveness of defensive attempts in relation to the body measurements of the GKs by group. Data analysis indicated a statistically significant difference only in the effectiveness between the averages of each group's defensive attempts (1st vs 4th (x^2=23.235, p<0.0001) and similarly, 2nd vs 4th (x^2=17.902 and p<0.0001) and 3th vs 4th (x^2=9.478, p<0.01)) and not in body measurements, age, height, and BMI between the groups.

Table 2. Averages of goalkeepers' effectiveness and body measurements among groups

Groups		M.O Eff/ness (%)	Years old	Height	Weight	BMI
1	**1**	37,1 *	30,1	192,5	97,4	27,5
2	**2**	32,7 #	29,1	195	99,3	25,8
3	**3**	24,7	30,9	195,1	97,1	25,5
4	**4**	8,5	27,5	195,5	102,7	26,9
	Mean of total G/K	**27,6**	**29,7**	**193,9**	**97,8**	**26,0**

(1 vs 4 (x^2= 23,235, p<0.0001) and 2 vs 4 (x^2= 17,902, p<0.0001) and 3 vs 4 (x^2=9.478, p<0.01).

Figure 4 shows the sum of the received shots by the GKs in 6-8 games (n=3620). Data analysis indicates that GKs from the 1st group received 1044 shots (28.8%), GKs from the 2nd received 1596 shots (44.1%), GKs from the 3rd received 766 shots (21.2%) and GKs from the 4th group received 214 shots (5.9%), (fig.4). These results demonstrate that the 2nd group received more shots than group 1 (x^2= 5.052, p<0.03), 3 (x^2= 11.923, p<0.001) and 4 (x^2= 38.913, p<0.0001). Furthermore, the 3rd group received significantly more shots than the 4th group (x^2=9.991, p<0.002) and the 1st group received significantly more shots than the 4th group (x^2=18.285, p<0.0001).

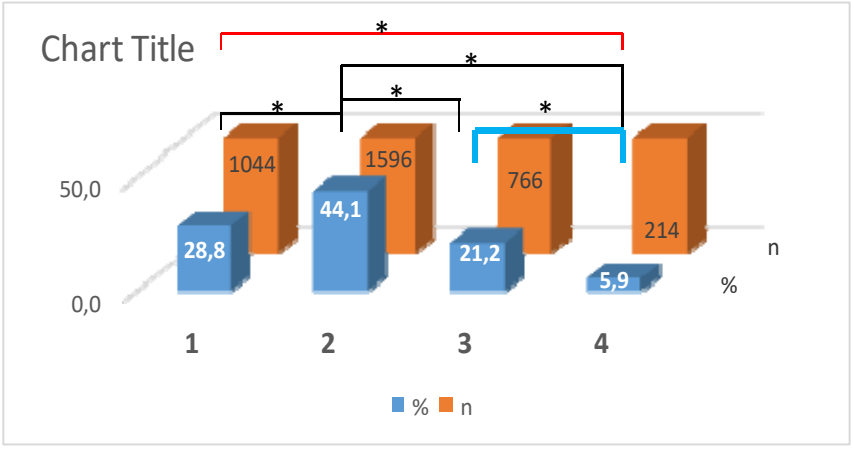

Figure 1. Total number of shots and percentages of shots by group of effectiveness of the goalkeepers

(* 2nd vs 1st (x^2= 5.052, p<0.03), 2nd vs 3th, (x^2=11.923, p<0.001), 2nd vs 4 (x^2= 38.913, p<0.0001), 3 vs 4, (x^2=9.991, p<0.002), 1 vs 4, (x^2=18.285, p<0.0001)).

A review of the total effectiveness between the groups of effectiveness of the goalkeepers, data analysis did not indicate significant differences in the 1st group (Fig. 2) or the 2nd group (Fig. 3).

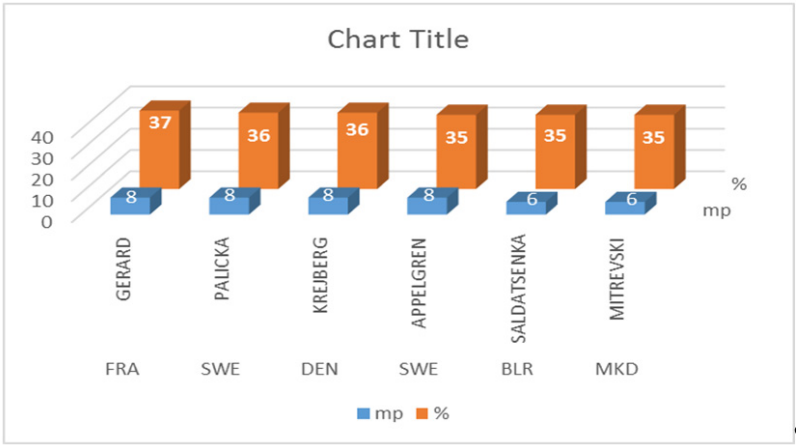

Figure 2. Effectiveness of 1st GK group

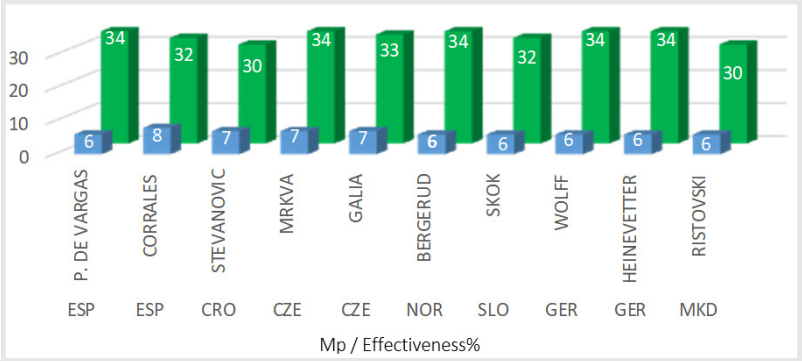

Figure 3. Effectiveness of 2nd GK group

An assessment of each goalkeeper's effectiveness in field shots and 7-meter shots, the statistical analysis showed differentiation of each goalkeeper's effectiveness, depending on shot type in the 1st and 2nd groups. In the 1st group, half of the goalkeepers (n=3) showed significant difference in effectiveness in field shots and 7-meter shots (x^2= 9.713, $p<0.002$, x^2= 7.867, $p<0.01$ and x^2= 5.254, $p<0.03$, respectively) and the rest (n=3) showed similar effectiveness between these two shot types (Fig. 4).

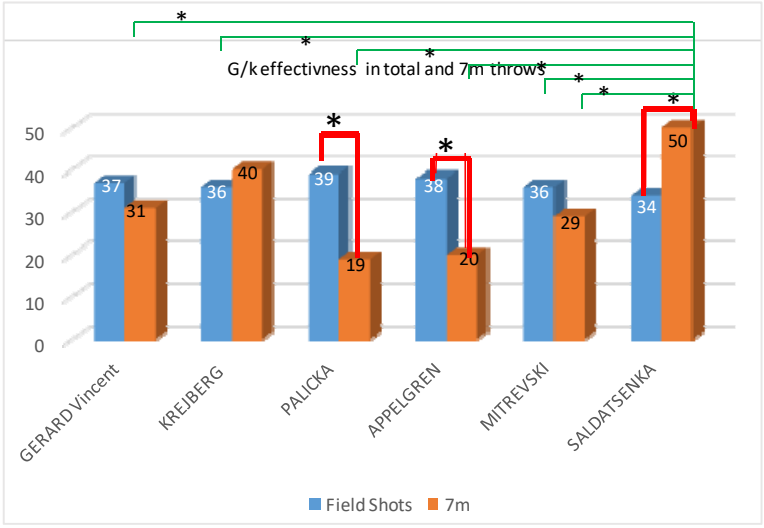

Figure 4. Percentages of effectiveness of each GK, against field shots and 7-meter shots.
Palicka, Appelgren, Saldatsenka, all field shots vs 7m.
(x^2 = 9.713, p<0.002, x^2= 7.867, p<0.01 and x^2= 5.254, p<0.03, respectively).
* Saldatsenka vs all in 7m., (x^2= 7,490, p< 0.0001).

Statistical analysis of the 2nd group indicated that most of the GKs (n=7) showed significant difference in effectiveness against field shots (x^2=3.977, p<0.05, x^2=5.222, p<0.03, x^2=5.913, p<0.02, x^2=6.650, p<0.01 and x^2=7.434, p<0.01, respectively). Analysis also showed that some GKs (n=4) were not effective at all against 7-meter shots, because they were substituted before the shot (Fig. 5).

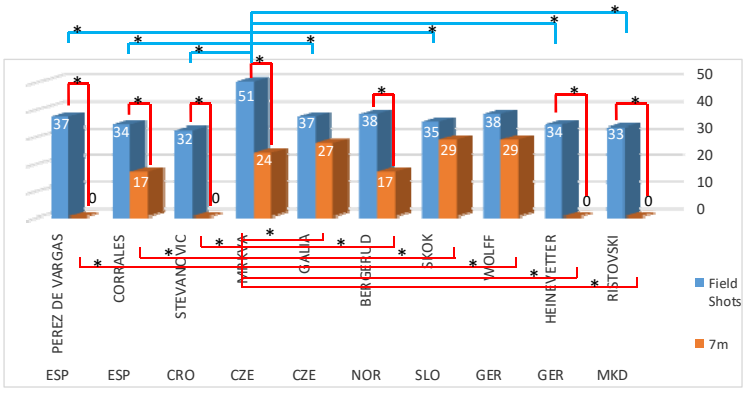

Figure 5. A Comparison of the goalkeepers' effectiveness against field shots vs 7-meter shots.

Discussion

According to the researchers (Espina-Agulló, Pérez-Turpin, Jiménez-Olmedo, Penichet-Tomás, & Pueo, 2016; Fuertes et al., 2010; Maroto-Izquierdo, García-López, & De Paz, 2017; Steffen et al., 2017; Meletakos & Bayios, 2010), the goalkeeper position has a key role in a team, with regard to its general performance, as well as in the final result of a game. In the 13th European Men's Handball Championship that took place in Croatia in 2018, the participating teams were 16, according to data from the EHF. However, the number of the goalkeepers that are registered in each team differs, which leads to a variable number of goalkeepers. In the 13th E.Ch., there were 38 goalkeeper registrations (Fig. 1). It was observed that some teams (n=6) registered 3 goalkeepers, whereas other teams (n=10) registered 2. In this study, the GKs' anthropometric measurements were analyzed and examined, pertaining to their effectiveness and the final placing of their teams.

The number of games in which the 38 GKs participated was relatively proportionate to their team's progression in the tournament. The statistical analysis showed that 14 GKs played in 8 games, 4 played in 7 games, 3 played in 6 and 5 games, 1 played in 4 games, 2 played in 3 games and 11 GKs played in 2 games.

A goalkeeper's performance (Hansen et al., 2017; Hasan, Rahaman, Cable, & Reilly, 2007; Murphy, Button, Chaouachi, & Behm, 2014*)* is related to their anthropometric measurements and their natural fitness, which affect their effectiveness and, therefore, play a crucial role in the choice of athletes, their effectiveness and their success in a sport discipline (Ziv & Lidor, 2009). Data processing indicated that the average GK who participated in the 13th European Men's Handball Championship measured 193.9cm in height and are characterized as "tall" goalkeepers (Justin et al., 2013). Almost all researchers mention that anthropometric measurements play a significant role in the performance of the players.

In regards to the age of the goalkeepers, the general average was 29.7 years, whereas the average of the goalkeepers that were categorized in the 1st group (successful defensive attempts >35%) was 30.1 years and the average of the 3rd group was 30.9 years. Game experience offsets the deteriorating physical skills of older players, explaining the high level of their effectiveness (Hamid, Hamid, Babak, Mahdi, & Ian, 2013; Justin et al., 2013; Karcher & Buchheit, 2014; Michalsik, Madsen, & Aagaard, 2015).

The average weight was 97.8kg and the average BMI was 26.0 kg/m^2 (Table 2). There are similar results in the study of Hamid et al. (2013), which mentions that in the 2013 World Men's Handball Championship the average GK

height was 191.59cm, the weight 95.7kg and the BMI 25.59 kg/m^2. Massuca et al. (2015) studied the body measurements of 24 handball goalkeepers who played in the Portuguese Championship and mentions an average height of 183.7cm, weight 86.8kg and BMI 25.7 kg/m^2, which diverge from the average of high-level GKs.οποίος αναφέρει ότι στο παγκόσμιο πρωτάθλημα ανδρών το 2013 ο μ.ο. ύψους στους Τ/Φ ήταν 191.59 cm, βάρους 95.7kg. και, BMI 25.59 kg/m^2. Michalsik et al. (2015), studying players from the Danish Premier Handball League, mentions an average GK age of 30.2 years, height 191.8cm, weight 94.2kg and BMI 25.5 kg/m^2, which correlates with the data that characterize high-level handball goalkeepers.

The current data analysis showed no differences in regards to the averages of the anthropometric measurements and ages of the goalkeepers, in comparison to observations of other similar studies.

An assessment of the categorization of the goalkeepers according to their effectiveness indicated significant differences between groups. More specifically, the 1st group showed significant difference in shots received compared to the 2nd, which cannot be accounted for, since the 1st GK group participated in more games than the second. The difference between the 1st and 2nd groups compared to the 3rd and 4th groups can be summarized to the fact that the 3rd and 4th groups participated in fewer games against teams of equal or lesser ability (Hongyou, Miguel A., & Lago-Peñas, 2015).

A review of the goalkeepers that belong to the 1st group (highest effectiveness) shows the absence of the GKs of Spain (Perez De Vargas, 35% and Corrales, 32%), the team which was the champion of the 2018 E.Ch in Croatia. On the other hand, Saldatsenka, the goalkeeper of Belarus who participated in 6 games, received the most shots for a percentage of effectiveness of 35% even as his team finished 10th, which was higher than the GKs of Spain (1st) and equal to Applegren of Sweden (2nd), who also had a percentage of effectiveness of 35% and the second most shots received.

This fact leads to the conclusion that a goalkeeper's effectiveness contributes to a team's progression as much as the other players' performance but it does not determine or secure it. Contrarily, good defense limits the offensive activity of the opposition and reduces the offensive threat, leading to less defensive attempts from the GK, helping them save shots, since the shots are made under pressure.

According to the study of Balint (2013), defense in modern handball is the cornerstone of teams that want to dominate major tournaments. What this means is that defense is established through continuous and systematic work by all the players, which can lead to a particularly taxing, physically and mentally,

training system. Communication and cooperation between the defense and the goalkeeper is widely recognized as being the factor that, along with technical-tactical and mental training, as well as good natural fitness, can determine the team's performance, particularly in difficult games. Technical-tactical and mental training is the deciding factor that forges a commanding and high-level defensive player in handball (Balint, 2013).

Furthermore, a very important characteristic of handball is that defense primarily aims to stop attackers from reaching the goal and to reduce the threat for the goalkeeper. The rapid concentration of defense in the various offensive formations and the adaptation of them, has the effect of increasing its immediate effectiveness, which most likely affects the final result of a game (Yiannakos, 2016).

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EVALUATION OF ELITE JU-JITSU ATHLETES' PHYSICAL FITNESS USING THE JMG TEST

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ABSTRACT. The JMG test has been widely used since 1982 and has been included in performance testing in many national federations, especially judo's. The study was conducted using the JMG (Jose Manual Garcia) test, to evaluate the physical fitness of ju-jitsu international federation's elite ju-jitsu athletes, during a five days training camp (precompetitive period). The athlete performs three exercises for 1 minute each (a total of 3 minutes) and the goal is to measure ju-jitsu's functional capacities. Eighteen (No=18) athletes, aged from 16 to 22 years, 12 males and 6 females, were tested. Their fitness was assessed, according to the test, from poor to excellent. The test's results show that JMG test can be used by athletes of Fighting System (ju-jitsu international federation) which is articulated in a three-minute combat.

Key words: *ju-jitsu fighting, specific fitness test, JMG test*

Introduction

Ju-Jitsu is a discipline that has high-level requirements (Ambroży, Nowak, Mucha, Chwała, Piwowarski, & Sieber, 2014). Fighting in sport ju-jitsu is a combination of actions typical for karate and judo (Sterkowicz-Przybycień, Ambroży, Jasiński, & Kędra, 2014). Ju-jitsu fighting (JJF) can be described as a high-intensity martial art and modern competition sport, in which the aim is to defeat the opponent using punches, kicks, takedowns, throws and ground techniques (Staller, 2013a). JJF is one of three official competition systems of the Ju-Jitsu International Federation, and as such an official competitive sport at the World Games, which is organized and governed by the IWGA, under the patronage of the international Olympic Committee (Ju-Jitsu International Federation, 2011).

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JJF is the most comprehensive discipline in ju-jitsu (Staller, 2013b), since the competitors have to engage in distance combat (Part 1), in throwing and takedowns (Part 2), and in ground-fighting (Part 3). The system is divided into several categories according to sex, age and weight. A fight consists of three parts, total 3-minute round and has to be fought in every part. Three referees reward successfully applied techniques with "ippon" (2 or 3 points) or "waza-ari" (1 point). In order to win, an athlete has to have more points than his opponent after the regular fighting time. Another option to win is by "full ippon", which means to have an "ippon" in every part. Penalties are divided into "light forbidden acts" ("shido": 1 penalty point) and "forbidden acts" ("chui": 2 penalty points). The addition of two forbidden acts results in losing the fight by "hansoku-make" (Ju-Jitsu International Federation, 2011).

The possibility to win with particular opponents is conditioned by the level of physical preparation, which is visible during attacks and counter-attacks during the fight. High changeability of a situation in the course of a competition requires as many muscular fibers as possible to be engaged in training (Ambrozy, et al., 2014). Many times, such confrontation takes place in tournaments where subsequent fights are organized after only a short break.

Great changeability of actions in the course of fight makes it necessary to develop not only speed and strength (of shoulders, legs, back, stomach and forearms), but also stamina (Ambrozy, et al., 2014). There are several tests which one can do with very little or no equipment or assistance in judo. Among these tests JMG test is the most popularly used as the fitness assessment test (García, 1999). A fitness test should be such, which can be administered with very few resources and in a very simple way (Yadav, 2015).

The JMG test is an evaluation technique specifically designed for those sports where force, resistance and speed is an important element of the sport (García, 1999; Rodríguez, Saborit, & Díez, 2008). The test is based on the capacity to produce a mixture of aerobic and anaerobic energy and to correlate of obtaining energy with force resistance at speed while performing the three exercises that make up the test lasting three minutes (one minute for each exercise). This test has been used since 1982 and has been included in the testing of performance in many National Federations especially Judo. The results coincide favorably with various laboratory controls and remain true with the specific performance of judokas in competitions of the highest category.

JMG Test comprised of three exercises viz. tunnel, sit ups and jumping from one side to the other of a 30 centimeter (cm) high bench, as explained under (García, 1999):

Tunnel: The helper stands with legs apart, trunk bent forward with the back at the height of subjects. The subject jumps on the helper, goes over through the back and comes back the way between helper's legs. This complete movement is one repetition (Note: for the test to be valid subject must complete at least 16 repetitions in one minute).

Sit ups (abdominals): Lying face up with the legs separated shoulder width apart and slightly flexed at the knee, with the hands behind the head. The subject without wasting time between the first and second exercises, start doing sit ups touching the elbow to the opposite knee. After touching the elbow to the opposite knee, both elbows must touch the ground (mate) while going back.

Jumping from one side to the other of a 30 cm bench: The subject jumps from one side to the other. The feet must leave and touch the ground at the same time but it is not essential for the feet to be together. Every time the floor touching is counted as one repetition.

At the command of 'now' the subject starts the tunnel exercise for one minute, at the end of one minute without any gap/ interval with command 'change' the subject starts the sit ups for one minute and immediately after second exercise without any gap/interval starts to execute the third exercise i.e. jumping from one side to the other of a bench. At the end of the test subject is stopped and recordings of immediate heart rate as P1, after one-minute recovery heart rate as P2 were recorded with the help of Polar Heart Rate Monitor.

The following data is necessary to establish the ratio JMG:

P1= Heart rate at the moment of termination of the test.

P2=Recovery heart rate after one minute of termination of the test.

N°rpt= Total number of complete repetitions executed (the total of the three exercises).

Kg = Weight of the subject in kilograms.

Age = Age of the subject in years.

The following equations are used when obtaining the ratio JMG:

A= [(P1 + P2) / 2]-[n°rpt + kg / 2]

B= [K- (P1 - P2)]-[n°rpt + kg / 2]

Thus resulting in the Ratio JMG = (A + B) / 2

Where, K= (220-age). In different studies carried on elite sportsmen, there was a tendency for this factor to be the number 200.

Table 1. Degree of aptitude (results of the ratio JMG)

Excellent	Very good	Good	Quite good	Fair	Not very good	Bad	Very bad
>-50	-40	-30	-10	0	+10	+30	>+50

The results of the ratio JMG give a clear idea of the functional state of the competitor from the point of view of the above-mentioned facts. Negative results of the ratio JMG (for example -30) indicate a good aptitude of force resistance at speed while obtaining aerobic - anaerobic energy. On the contrary, positive

results (for example +30) give us an indication of poor aptitude. This test is usually accompanied by a valuation of the fatigue level of the subject showing itself, at the end of the test on the Borg Scale of Perceived Exertion (Borg's category ratio/CR-10 scale) and level estimations that takes into account your fitness level (Borg, 1990). Ratio scaling methods are used to measure perceived exertion; functions for various workloads are obtained which can be compared with physiological responses, such as heart rate and blood lactate concentration.

Material and Methods

Sample. In the beginning of a five days training camp (pre-competitive period), eighteen (N=18) senior, 12 male and 6 female ju-jitsu athletes, who represented their countries for national and international championships, were selected to perform the JMG test.

Procedure. Age and body weight of subjects were recorded and once they became familiar with the procedure, they performed the three-minute JMG test. A polar 400M was used to record the heart rate immediately after completion of the test and one minute after the end of it.

Statistical Analysis. SPSS statistical package was used for data analysis. The collected data were subjected to mean and standard deviation computation and an independent t-test was used to compare men and women mean difference.

Results

The mean values of total number of repetitions (men 146.75 ±19.95 and women 117.67±20.22), of heart rate immediately after completion of test (PI) (men 187.67±6.08 and women 187.33±7.15), of heart rate after one minute of termination of test (P2) (men 152.08±5.81 and women 150.33±6.19) and Index for JMG test (men -13.73±20.20 and women 21.17±23.95). (table 2). Lesser mean values of JMG test, better condition. (Table 2)

Table 2. Descriptive Statistics of variables of JMG Test

Variables	Male (N=12)		Female (N=6)	
	Mean	S.D.	Mean	S.D.
Age	18.75	2.45	17.67	2.16
Weight	69.50	14.22	56.50	7.40
Total no. of reps (01+02+03)	146.75	19.95	117.67	20.22
PI of JMG Test	187.67	6.08	187.33	7.15
P2 of JMG Test	152.08	5.81	150.33	6.19
Index for JMG	-13.73	20.20	21.17	23.95

JMG Test= Jose Manual Garcia Test
P1= Heart rate immediately after completion of test
P2= Heart rate after one minute of termination of test

From the test results the men 1 (8.3%) was in excellent fitness, 1 (8.3%) in good, 7 (58.3%) in quite good, 2 (16.7%) in fair and 1 (8.3%) in not very good. Of the women, 1 (8.3%) was in quite good fitness, 2 (33%) in fair, 1 (16.7%) in not very good and 2 (33.3%) in bad. An independent t-test analysis showed that men was in better condition than women, t=-3.254 and p<0.05 (Graph 1).

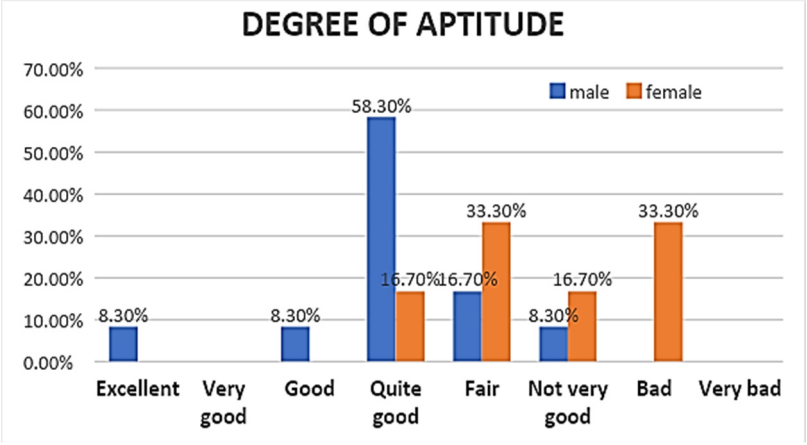

Fig. 1. Degree of aptitude

Discussion

The methodology of the sport training was always guided for the performance. In these terms, the physical evaluation becomes indispensable in the identification of the athlete's condition, as well as it supplies subsidies to the trainer for the prescription, planning and appropriate periodization of the sporting training (Ambroży, et al., 2014; Harris, Foulds, & Latella, 2019).

In this way, with the present study has for objective to analyze the ju-jitsu athletes' evaluation by means of a specific test composed of three exercises (non-specific actions): the JMG test (Rodríguez, Saborit, & Díez, 2008). The JMG test is widely used to evaluate especially judo athletes (Carvalho, 2000), and this work we wanted to recommend it for other similar combat sports such as ju-jitsu fighting. The results showed that it can be used as effectively as in judo (Yadav, 2015). The simple way of doing it allows us to use it at the beginning, during and at the end of the preparatory period, to evaluate the physical fitness in force, speed and endurance (aerobic and anaerobic condition) of athletes (Carvalho, 2000) in relation to the training program (e.g. circuit or functional circuit training).

Conclusions

JMG test was validated to specifically estimate for sporting purposes. Therefore, the JMG can be used to evaluate the aerobic and anaerobic conditioning of judo and ju jitsu practitioners and for prescribing adequate intensity training. The use of this test and classifications can be relevant for goal setting in terms of physical development either aiming at peaking for a specific competition. The responses to different types of periodization can also be monitored through the application of this test.

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THE EFFECTS OF ADDITIONAL PHYSICAL ACTIVITY PROGRAMMES ON MOTOR AND HEALTH RELATED COMPONENTS IN CASE OF STUDENTS IN 6TH GRADE

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ABSTRACT. Introduction. According to a Eurydice report, in EU member states there are differences regarding the number of physical education classes held throughout a school year. Considering the number of EU physical education and health classes, in 2016, out of the total of 28 member states, Hungary occupied the 1st place and Romania the 21st place. **Aims of the Research.** This research aims to analyze the effects that additional physical activity programmes have on motor and health related components of students in 6th grade. **Subjects and Methods.** The research was performed on a sample group of 55 subjects, students in 6th grade, from two schools from Oradea, the additional programme using exercises and games with themes from handball, basketball, rugby-tag and badminton. We used two test batteries (EUROFIT and NETFIT) by which we measured the motor and health related components of physical fitness of the subjects involved in the research. The data was statistically analyzed using the SPSS software, version 20.0. In order to test the normality of the distribution of the data we used the Kolmogorov-Smirnov and Shapiro-Wilk tests, and to compare the mean values we used parametric and non-parametric tests, depending on the distribution: paired sample t-test or Wilcoxon signed-rank test. We also calculated the effect size (Cohen's d or eta-squared) with a confidence interval of 95%. Using the ANOVA analysis of variance, we calculated the variation between the scores and the mean values of the groups involved in the research. **Results**. Regarding the motor parameters with a normal distribution, the paired sample t-test shows that in case of experimental group A (EGA), after 7 months of additional physical activity, significant differences were recorded for 6 out of the 9 assessed parameters (plate tapping (PT), standing broad jump (SBJ), handgrip test (HT), sit-ups (STU), endurance shuttle run (ESR), paced push-ups (PPU)), while in case of experimental group B (EGB), the differences were recorded for 7 parameters (PT, SBJ, HT, sit-and-reach (SAR), shuttle run (SR), ESR, PPU, and in case of the control group (CG), for 5 parameters PT, SBJ, HT, ESR and trunk extension (TE). **Conclusions.** In EGA, in case of the nine assessment tests, the number of students located within the

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health zone increased by 5, in EGB this number increased by 13, and in the CG, by 3 subjects. We can establish that from this point of view the most efficient programme was the one applied to EGB.

Keywords: *motor components, health related components, physical fitness, adipose tissue, 6th grade.*

REZUMAT. ***Efectul unui program suplimentar de activităţi fizice asupra componentelor motrice şi de sănătate ale elevilor din clasa a VI-a.*** **Introducere.** Potrivit unui raport Eurydice, în statele membre ale UE sunt diferenţe privind numărul lecţiilor de educaţie fizică practicate într-un an şcolar. În anul 2016, din totalul de 28 de state membre Ungaria a ocupat locul I iar România locul 21 privind numărul lecţiilor de educaţie fizică şi de sănătate UE. **Scopul cercetării.** Scopul acestei cercetări l-a constituit analiza efectului unui program suplimentar de activităţi fizice asupra componentelor motrice şi de sănătate ale elevilor de clasa a VI-a. **Subiecţi şi metode.** Cercetarea a avut loc pe un eşantion de 55 de subiecţi, elevi de clasa a VI-a la două şcoli orădene, programul suplimentar utilizând exerciţii şi jocuri cu teme din handbal, baschet, rugby-tag şi badminton. Au fost folosite două baterii de teste (EUROFIT şi NETFIT) cu ajutorul cărora au fost măsurate componentele motrice şi cele de sănătate ale fitnessului fizic al subiecţilor. Datele au fost analizate statistic cu ajutorul programului SPSS, varianta 20.0. În vederea testării normalităţii distribuţiei datelor s-a utilizat testele Kolmogorv-Smirnov şi Shapiro-Wilk, iar pentru compararea mediilor s-au folosit teste parametrice sau nonparametrice, în funcţie de distribuţie: t-testul pentru eşantioane pereche sau testul Wilcoxon al rangurilor pereche. De asemenea, s-a calculat mărimea efectului (d a lui Cohen sau eta^2), cu un interval de încredere de 95%. Cu ajutorul analizei de varianţă ANOVA s-a calculat variaţia dintre scoruri şi pe cea dintre mediile grupelor incluse în cercetare. **Rezultate**. Referitor la parametrii motrici cu distribuţie normală, testul-t pentru eşantioane pereche ne arată că la GEA, după 7 luni de activităţi fizice suplimentare au fost înregistrate diferenţe semnificative la 6 din cei 9 parametri evaluaţi (AP, SL, DM, RTA, CNR şi FR), la GEB la 7 parametrii (AP, SL, DM, FT, CNA, CNR şi FR), iar la GC la 5 parametrii (AP, SL, DM, CNR şi ET). **Concluzii.** La GEA la cele nouă teste evaluate a crescut numărul de subiecţi din zona de sănătate cu 5, la GEB cu 13, iar la GC cu 3 subiecţi. Putem afirma că din acest punct de vedere cel mai eficient program a fost cel aplicat subiecţilor din GEB.

Cuvinte cheie: *componente motrice, componente de sănătate, fitnessul fizic, ţesut adipos, clasa a VI-a.*

Introduction

Hallal, Andersen, Bull, Guthol, Haskell, Ekelund, & Group, (2012) found that a quarter of the population of the European Union member states was not sufficiently active from physical point of view, and an OECD report (2012) specified that only one in five children was regularly performing physical exercises of moderate or high intensity level.

In 2010, in Romania, 73.2% of the boys and 88.1% of the girls with ages between 11-17, were not achieving the physical activity levels recommended by WHO. In Hungary, insufficient physical activity levels were encountered in 74.4% of the cases among boys and 86.5% among girls (WHO, 2015).

Certain researches revealed that during adolescence there are factors which may be associated with physical activity levels in a positive manner: personal efficiency in breaking one's own barriers (Trost, Pate, Saunders, Ward, Dowda, & Felton, 1997), perception regarding physical activity and sports (Sallis, Prochaska & Taylor, 2000), positive attitude towards physical education classes (US Department of Health and Human Services, 1996).

According to Kent, quoted by Epuran (2013, p. 139) "physical education is any planned programme of motor activities which helps individuals develop and control their own bodies (...) is a process by which adjustments and acquisitions are gained as a result of the physical activities".

Ceaușescu (2002, p. 112) quotes Godin who in his paper *Raising Children in the Age of School*, recommends:"more physical exercise between the ages of 12 – 15 and less intellectual activity: if we don't do it, students do it on their own, unsystematically and sometimes falling into excess (...) from the ages of 9 – 10, the way children play becomes more structured and more abstract, the groups of playing children now have an order".

Regarding the quality of physical education the United Nations Educational, Scientific and Cultural Organization (2015) presents the orientations which the decisive factors must have, proposing that the actual time of performing physical education and sports classes in schools to be at least 120 – 180 minutes / week, not including the time spent in locker rooms or the time needed to get to the designated areas.

According to a Eurydice report, there are differences between the EU member states regarding the number of physical education classes performed throughout a school year. The average is around 50 – 80 classes/year or 1.5 - 2.5 classes/week (Toussaint & Rocha, 2015). In 2016, considering the number of physical education and health classes, out of the total of 28 EU member states, Hungary was number 1 and Romania was on the 21st place. Physical education

and health class means "sports, physical activity to improve health by traditional games, gymnastics, swimming, athletics, dance or other activities which develop physical and social competences (skills, coordination, psychomotor development and cooperation) and an active and healthy lifestyle" (CCE, 2016, p. 8).

In the 2015-2016 school year, in Romania the curriculum for 5th – 8th grades stipulated physical education and sports as a distinct curricular area, with two classes per week in the common schedule for 5th-7th grades and one class for children in the 8th grade. According to the Educational Framework Plan N. 3590 from April the 5th, 2016, starting with the 2020-2021 school year the number of physical education classes will increase to two classes/week for children in 8th grade as well.

In order to increase the time spent practicing physical activities and health levels among school children in Hungary, according to Law no. 97, Paragraph 6, in the 2012-2013 school year, 5 physical education classes per week were implemented into the programme for children in 1st, 5th and 9th grade. The number of physical education classes increased every year for the rest of the grades as well, thus by the 2015-2016 school year all students in Hungary had 5 physical education classes every week, a frequency similar to subjects like mathematics and mother tongue.

In 2013, the Cooper Institute from U.S.A. signed a partnership agreement with the Hungarian School Sport Federation regarding the implementation of a national test battery for assessing the physical fitness of students. The *National Student Fitness* Test (NETFIT) test battery was created based on the model of FITNESSGRAM. The aerobic fitness, skeletal muscle fitness and flexibility are measured by 7 motor tests and based on age and gender; the results of the subjects are categorized in two or three action zones (health zone, zone that needs progress, and zone that needs continuous progress - high risk of developing diseases).

According to the study performed by Lukács & Hanţiu (2017) on a sample group of 934 students (474 from Bihor County, 460 from Hajdú-Bihar county), which used the EUROFIT and NETFIT test batteries for assessing the subjects, there is a direct relation between the levels of somatic and motor characteristics of a student and the number of physical education and sports classes from the common schedule of the curriculum. The students who attended four or five classes a week (the ones from Hajdu-Bihar county, Hungary) had higher average values of motor component levels, and the number of those located within the health zone was higher compared to the students from Bihor county who attend only one or two classes a week.

Aims of the Research

Our study aims to find out the somatic and motor responses to additional physical activity in case of a sample group of students in the 6th grade from Oradea, by implementing additional physical activities within two optional sports programmes, with two classes per week, for a period of 7 months.

Hypotheses of the Research

This study starts off with the following hypotheses:

- Supplementing the number of hours of physical activity for students in 6th grade by an intervention programme which uses exercises within optional sports programmes, results in the increase of motor and health related component values of physical fitness;
- The additional physical activity programme will result in an increased number of students in the health zone;
- By supplementing the weekly physical activity, the percentage of adipose tissue will decrease for subjects participating to the study.
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Subjects and Methods

The research was performed as part of the doctoral degree studies, between October 2015 – May 2016 on a sample group of 55 students from three classes in 6th grade (36 girls and 19 boys), divided into three groups: two experimental groups and one control group. The 1st experimental group included 18 subjects (5 boys and 13 girls), the 2nd experimental group was made up of 17 subjects (8 girls and 9 boys), and the control group had 20 subjects (15 girls and 5 boys).

Two test batteries were used (EUROFIT and NETFIT) with which we measured the motor components and the health related physical fitness of the subjects. The EUROFIT test battery is made up of nine motor tests: sit-and-reach (SAR), Flamingo balance test (FB), bent arm hang (BAH), standing broad jump (SBJ), sit-ups (STU), handgrip (HT), plate tapping (PT), 10 x 5 meter shuttle run (SR) and endurance shuttle run (ESR). The NETFIT test battery assesses the aerobic fitness, skeletal muscle fitness and flexibility, being made up of seven motor tests: endurance shuttle run, paced sit-ups (PSU), trunk extension (TE), paced push-ups (PPU), handgrip, standing broad jump, flexibility test (FLT). Three tests are similar for both test batteries.

The data was statistically analyzed using the SPSS software, version 20.0. In order to test the normality of the distribution of the data we used the Kolmogorv-Smirnov and Shapiro-Wilk tests, and to compare the mean values we used parametric and non-parametric tests, depending on the distribution: paired sample t-test or Wilcoxon signed-rank test. We also calculated the effect size (Cohen's d or eta-squared) with a confidence interval of 95%. Using the ANOVA analysis of variance, we calculated the variation between the scores and the mean values of the groups involved in the research.

Performing this study required going through the following steps:

- choosing the sample group (control group / two experimental groups) and the place where the study was going to take place;
- choosing the methods and means of research;
- planning the activities depending on the schedule of the class in question;
- recording the results obtained at the pre-tests and post-tests;
- statistical analysis of the obtained results;
- drawing up conclusions based on the results;
- using the results in conferences / seminars / round tables.

At the beginning of the experiment, all students presented medical certificates. The children took part in the research based on their own free consent. During the experiment, the quantity of the performed work was designed for both experimental groups according to our own planning, the work chart being as it follows:

Experimental group A (EGA)	Pretesting	Additional programme	Posttesting
Experimental group B (EGB)	Pretesting	Additional programme	Posttesting
Control group (CG)	Pretesting	Without additional programme	Posttesting

The initial testing was performed between October the 23rd – 25th, 2015, and the final testing between May the 23rd – 27th, 2016, the monitored indicators being measured each time by the same person, using the same equipment.

The activities within the research were performed within two weekly optional sports programmes with durations of 60 minutes each. The activities of experimental group A included specific exercises, dynamic games and bilateral games from two well-known sports (handball and basketball), and the activities of experimental group B, included exercises taken from two other sports (rugby-tag and badminton).

The organizing part, the warm up and the exercises / dynamic games took up approximately 50% of the duration of the class, and the rest consisted of bilateral games specific to the sports mentioned above.

The optional sports programmes had the following structure:

1. Warm up (12-15 minutes)
2. Fundamental part (45-50 minutes)
3. Closing part (3-5 minutes)

The sports games used during the experiment were chosen based on the following criteria: the content of the physical education programme of the school, the technical-material base of the school and the popularity of the sports within the educational institution.

The alternative sports games used during the experiment were chosen based on certain criteria similar to the ones used for choosing the sports.

Some of the exercises and games with themes taken from basketball were described by Roman (2000), others by Ciorbă (2006), and some were created based on our own experience. Every session, besides the above enumerated exercises / games, we also organized bilateral games with / without a theme.

According to Roman (2008), in order to learn a game through playing there are more versions of exercises from handball that can be used. Besides the exercises recommended by the author, the following versions were used: 1:1 (with small goals), 2:2 or 3:3 (to exercise counter attack and phases I and II of defense), 4:4 (exercising by going from defense to attack) or games with equal number of players of 5:5 or 6:6 all over the playing field.

Some of the exercises and games of badminton that were used, were described by Stănescu (2010), and others were used and taken over from badminton classes. There were also organized simple / double games between girls / boys or mixed ones with / without themes.

Some of the rugby-tag exercises and games that we used were described by Mitrea (2013), and others were used within other rugby-tag classes. Besides the enumerated exercises / games we organized games with / without themes.

Results

Following the analysis of the obtained results, we found that 65.45% of the total sample group were girls and 34.55% were boys, the average age of the girls being 12.23 (±0.60) years, and the average age of the boys 12.05 (±0.61) years.

Using the Kolmogorov-Smirnov test (Table 1) we checked the normality of the distribution of the anthropometric and motor data obtained by applying the two test batteries, and the results for the following variables were below

the threshold of 95%: body mass, BMI, flamingo balance test, bent arm hang, shuttle run 10x5 and paced push-ups. For these variables, the data does not have a normal distribution, so the next tests are going to be nonparametric tests.

By comparing the mean values of the anthropometric variables with normal distribution – height and adipose tissue – we found that there are no differences between the subjects of the three groups (Table 2).

In addition, there were no differences between the mean values of weight and BMI variables (χ^2 = ,398, df = 2, p = ,819 for BMI, respectively $\chi 2$ = 1,322, df = 2, p = ,516 for weight).

Seeing the data from tables 3 and 4, which contain the analysis of variance of the scores registered at the initial testing of the motor parameters, as well as the multiple comparisons – Bonferroni test – of the results registered in case of the three groups involved in this study, we found that although in case of some variables significant differences were registered, the effect size (Eta^2) is small, fact which allows us to state that the three groups were approximately equal (homogenous) at the beginning of the study.

Table 1. Testing the normality of the distribution of the anthropometric and motor data at the initial testing (N=55)

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistically	df	Sig.	Statistically	df	Sig.
Height	,073	55	,200*	,987	55	,793
Body mass	,177	55	,000	,908	55	,000
BMI	,191	55	,000	,874	55	,000
Adipose tissue	,082	55	,200*	,968	55	,143
FB1	,120	55	,046	,947	55	,017
PT	,073	55	,200*	,958	55	,051
SBJ	,075	55	,200*	,973	55	,259
HT	,063	55	,200*	,984	55	,655
STU	,127	55	,027	,972	55	,221
PSU	,078	55	,200*	,978	55	,426
BAH	,238	55	,000	,790	55	,000
SR	,174	55	,000	,894	55	,000
SAR	,126	55	,029	,963	55	,087
FLT	,086	55	,200*	,972	55	,231
ESR	,102	55	,200*	,966	55	,121
TE	,099	55	,200*	,981	55	,552
PPU	,107	55	,174	,931	55	,004

Note: a. Lilliefors Significance Correction, *, This is a lower bound of the true significance, Flamingo balance test (FB), Sit-and-reach (SAR), Shuttle run 10x5 m (SR), Standing broad jump (SBJ), Handgrip test (HT), Plate tapping (PT), Sit-ups (STU), Bent arm hang (BAH), Endurance shuttle run (ESR), Paced sit-ups (PSU), Trunk extension (TE), Paced push-ups (PPU), Flexibility test (FLT), Handgrip test (NETFIT),

Table 2. ANOVA analysis at the initial testing for the anthropometric data with normal distribution (height and adipose tissue)

ANOVA								Multiple Comparisons – Bonferroni test				
Dependent Variables		Sum of Squares	df	M S	F	Sig.	Eta²	(I) Group	(J) Group	Mean dif. (I-J)	Std. Error	Sig.
Height	Between Groups	207,907	2	103,95	2,470	,094	0,087	EGA	EGB	3.832	2.194	.260
	Within Groups	2188,138	52	42,08					CG	-.639	2.108	1.000
	Total	2396,045	54					EGB	CG	-4.471	2.140	.125
AT	Between Groups	256,895	2	128,45	1,589	,214	0,058	EGA	EGB	1.54477	3.040	1.000
	Within Groups	4202,602	52	80,82					CG	-3.55611	2.921	.687
	Total	4459,496	54					EGB	CG	-5.10088	2.966	.274

Note: AT = Adipose tissue, SS = sum of squares, df = degree of freedom, MS = mean square, F = Anova ratio

Table 3. Initial testing – Comparing the means in case of motor parameters without normal distribution –Kruskal Wallis Test (N=55)

	Dependent variable [a,b]									
	FB	Eta squared η^2	STU	Eta squared η^2	BAH	Eta squared η^2	ESR	Eta squared η^2	SAR	Eta squared η^2
χ^2	3,105	.075	2,641	.046	2,949	.076	1,221	.009	1,993	.035
Df	2		2		2		2		2	
Asymp. Sig.	,212		,267		,229		,543		,369	

Note: a. Kruskal Wallis Test, b. Grouping Variable: Group

At the end of the intervention programme, we performed the same measurements as the ones we did at the initial testing, the obtained data being compared with the ones registered at the beginning of the research using the adequate tests depending on the type of distribution. According to Table 5, in case of the experimental groups (EGA and EGB), for the variables without normal distribution, the Wilcoxon test indicates that there were significant differences registered for body mass, body mass index, PSU test and endurance shuttle run test, and in case of the flamingo balance test and sit-ups, these differences were not significant. In case of the control group (CG), significant differences were registered for body mass and BMI, a natural change considering that the subjects were in their period of growth and development.

Table 4. ANOVA analysis of the motor results at the initial testing for motor parameters with normal distribution (N=55)

ANOVA								Multiple Comparisons - Bonferroni				
		Sum of Squares	df	Mean Square	F	Sig.	Eta²	(I) Group	(J) Group	Means Dif. (I-J)	Std. Error	Sig.
PT	Between Groups	18,842	2	9,421	5,440	0,007	0,17	EGA	EGB	0,88781	0,44506	0,154
	Within Groups	90,051	52	1,732					CG	-0,53778	0,42755	0,642
	Total	108,893	54					EGB	CG	-1,42559*	0,43412	0,006
SBJ	Between Groups	516,489	2	258,245	0,501	0,609	0,02	EGA	EGB	148,693	767,503	1,000
	Within Groups	26.780,420	52	515,008					CG	-552,778	737,306	1,000
	Total	27.296,909	54					EGB	CG	-701,471	748,632	1,000
HT	Between Groups	24,491	2	12,246	0,64	0,531	0,02	EGA	EGB	-152,549	147,950	0,922
	Within Groups	995,151	52	19,138					CG	-131,167	142,129	1,000
	Total	1.019,642	54					EGB	CG	0,21382	144,313	1,000
FLT	Between Groups	183,196	2	91,598	1,992	0,147	0,07	EGA	EGB	313,072	229,317	0,534
	Within Groups	2.390,731	52	45,976					CG	-124,722	220,295	1,000
	Total	2.573,927	54					EGB	CG	-437,794	223,679	0,167
SR	Between Groups	3.020,075	2	1.510,037	15,130	0,000	0,37	EGA	EGB	-582,353	337,864	0,272
	Within Groups	5.189,671	52	99,801					CG	11,80000*	324,570	0,002
	Total	8.209,745	54					EGB	CG	17,62353*	329,556	0,000
TE	Between Groups	147,326	2	73,663	3,328	0,044	0,11	EGA	EGB	0,96405	159,122	1,000
	Within Groups	1.151,110	52	22,137					CG	-283,889	152,861	0,207
	Total	1.298,436	54					EGB	CG	-380,294	155,209	0,053
PPU	Between Groups	337,551	2	168,775	3,594	0,035	0,12	EGA	EGB	-6,00327*	231,767	0,037
	Within Groups	2.442,086	52	46,963					CG	-424,444	222,648	0,186
	Total	2.779,636	54					EGB	CG	175,882	226,069	1,000

Note: SS = sum of squares, df = degree of freedom, MS = mean square, F = Anova ratio

Table 5. Comparing the means of paired variables without normal distribution (N=55)

		Statistical Test [a,b]					
Group		G2 - G1	BMI2 - BMI1	FB2 - FB1	PSU2 - PSU1	PT2 - PT1	ESR2 - ESR1
EGA	Z	-3,578[c]	-2,334[c]	-1,889[c]	-2,162[c]	-1,808[c]	-2,635[d]
	Sig. (2-tailed)	.000	.020	.059	.031	.071	.008
EGB	Z	-3,622[c]	-3,528[c]	-,105[d]	-3,581[c]	-,450[c]	-2,769[d]
	Sig. (2-tailed)	.000	.000	.916	.000	.653	.006
CG	Z	-3,922[c]	-3,922[c]	-1,446[d]	-,112[c]	-,056[d]	-1,045[c]
	Sig. (2-tailed)	.000	.000	.148	.910	.955	.296

Note: a. Group, b. Wilcoxon Signed Ranks Test, c. Based on negative ranks, d. Based on positive ranks.

Regarding the motor parameters with normal distribution, the paired sample t-test shows that in case of EGA, after 7 months of additional physical activity, significant differences were registered for 6 out of the total of 9 assessed parameters (PT, SBJ, HT, STU, ESR and PPU), in case of EGB, for 7 parameters (PT, SBJ, HT, SAR, SR, ESR and PPU), and in case of the CG these differences were registered for 5 parameters (PT, SBJ, HT, ESR and TE).

Table 6. Paired sample t-test for motor parameters with normal distribution based on the groups (N=55)

Pair	EGA (N=18)				EGB (N=17)				CG (N=20)			
	t	df	Sig. (2-tailed)	d	t	Df	Sig. (2-tailed)	D	t	df	Sig. (2-tailed)	d
PT1 - PT2	4,251	17	,001	1.00	4,707	16	,000	1.142	4,750	19	,000	1.06
SBJ1 - SBJ2	-5,915	17	,000	-1.39	-4,919	16	,000	-1.193	-2,810	19	,011	-0.63
HT1 - HT2	-5,176	17	,000	-1.22	-6,001	16	,000	-1.455	-8,723	19	,000	-1.95
STU1 - STU2	-3,005	17	,008	-0.71	-1,554	16	,140	-0.377	,800	19	,433	0.18
SAR1 - SAR2	-1,325	17	,203	-0.31	-5,951	16	,000	-1.443	,413	19	,684	0.09
SR1 - SR2	1,146	17	,268	0.27	-2,893	16	,011	-0.702	,773	19	,449	0.17
ESR1 - ESR2	-4,823	17	,000	-1.14	-4,500	16	,000	-1.091	-3,918	19	,001	-0.88
TE1 - TE2	-1,110	17	,282	-0.26	-1,353	16	,195	-0.328	3,959	19	,001	0.89
PPU1 - PPU2	-2,787	17	,013	-0.66	-2,964	16	,009	-0.719	1,226	19	,235	0.27

Discussions

The statistical analysis of the obtained data, performed for the subjects involved in the study after completing the additional physical activity programme, shows that for certain motor parameters significant differences were registered in case of all the groups involved in the study, including the subjects of the control group, but in case of the subjects of the experimental groups the number of motor parameters with significant differences, is higher. Thus, for EGA significant increase was registered for 8 parameters, for EGB for 9 parameters, and for the CG only for 5 parameters.

It's worth mentioning that in case of the subjects of the CG, 4 out of the 5 parameters that registered significant increase, registered significant increase in case of the subjects of the experimental groups as well, thus we can say that these differences of the measured values may be caused by other things than the influence of the additional physical activity programme.

Regarding the number of subjects located within the health zone after supplementing the physical activity classes, we find that the results are different for each group depending on the tested variable (Table 7). Thus, in case of EGA for the two assessed tests the number of subjects within the health zone increased by 5, in case of EGB by 13, and in case of the CG by 3 subjects. We can establish that from this point of view the most efficient programme was the one applied to EGB.

Table 7. Classification of subjects into action zones at the initial and final testing

Variable	EGA (N = 18)						EGB (N =17)						CG (N = 20)					
	HZ			NP+NCP			HZ			NP+ NCP			HZ			NP+NCP		
	IT	FT	Dif.	IT	FT	Dif.	IT	FT	Dif.	IT	FT	Dif.	IT	FT	Dif.	IT	FT	Dif.
BMI	15	13	-2	3	5	2	13	11	-2	4	6	2	14	10	-4	6	10	4
AT	11	11	0	7	7	0	11	12	1	6	5	-1	10	9	-1	10	11	1
SBJ	13	16	3	5	2	3	12	13	1	5	4	-1	16	16	0	4	4	0
HT	15	16	1	3	2	-1	15	17	2	2	0	-2	17	17	0	3	3	0
PSU	16	16	0	2	2	0	8	14	6	9	3	-7	16	15	-1	4	5	1
FLT	5	3	-2	13	15	2	2	3	1	15	14	-2	2	3	1	18	17	-1
ESR	17	18	1	1	0	-1	15	17	2	2	0	-2	8	14	6	12	6	-5
TE	9	11	2	9	7	-2	12	12	0	5	5	0	10	14	4	10	6	-4
PPU	10	12	2	8	6	-2	12	14	2	5	3	-2	12	10	-2	8	10	2
Total			+5			+1			+13			-15			+3			-5

Conclusion

The performed study allows us to formulate the following conclusions:

a) Supplementing the number of physical activity classes for students in 6th grade by activities organized in schools within optional sports programmes using exercises and dynamic games with technical elements from handball, basketball, rugby-tag and badminton, resulted in the increase of the motor components and health related physical fitness, the hypothesis being therefore accepted.

b) Based on the paired sample t-test applied for EGA, the mean values obtained at 9 out of the total of 13 motor tests (FB, PT, SBJ, HT, STU, PSU, SR, ESR and PPU) presented significant differences ($p < 0.05$). In case of EGB, the mean values of 9 of the initial tests (IT) and final tests (FT) out of the total of 13 motor tests (PT, SBJ, HT, PSU, SR, SAR, FLT, ESR, PPU, BAH), had a significant difference ($p < 0.05$).

c) Supplementing the number of physical activity classes in case of EGA resulted in the increase of the number of students located within the health zone. Practicing sports games proposed within the optional sports programmes in schools contributed to the improvement of the components of health related physical fitness; at 5 motor tests the number of those located within the HZ at the IT increased, and at one test (PSU) there were no differences compared to the initial testing.

d) In case of EGB practicing sports games within the optional sports programmes improved the components of health related physical fitness for 6 motor tests, the number of those located within the HZ at the FT increased compared to the IT (ESR – by one student, TE – by three students, PPU – by three students, HT – by three students, SBJ – by one student, FLT – by one student). The hypothesis was accepted.

Conflicts of interests

The authors declare that there is no conflict of interest.

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DIDACTIC EXPERIENCE IN MY CLASSES WITH STUDENTS OF PRIMARY AND PRE-SCHOOL EDUCATION PEDAGOGY

VĂIDĂHĂZAN REMUS[1]

ABSTRACT. The difference between a successful course and a useless one could only be a problem of perception, a problem related to the experience created for the person who comes in front of us, eager to learn new things. Effective learning may not often occur despite effective teaching. Neurons may be unprepared for the new connections needed to integrate new information into cognitive patterns if the learning situation does not produce a pleasing experience for the "user of the teaching process". The present research was built out of my personal desire to measure as much as possible the attractiveness of my courses in a discipline that I teach in two different places. I aimed to measure the degree of pragmatism and the degree of hedonism in my courses but also to compare the attractiveness of my discipline with the education system that students experienced in high school. Last but not least, I aimed to identify if there are differences in approach in my course between students with maximum attendance and students who attended only the minimum required number of courses. The results of my research showed that the attractiveness of my courses is high, with few differences between the two groups, and the differences between the students who attended the maximum courses and those who attended the required minimum are more difficult to be identified than I anticipated.

Key words: *user experience, pedagogy, teaching, attractiveness, school.*

REZUMAT. ***Experienţa didactică la cursurile proprii cu studenţii de la Pedagogia Învăţământului Primar şi Preşcolar.*** Diferenţa dintre un curs reuşit şi unul nefolositor ar putea fi doar o problema de percepţie, o problemă legată de experienţa creată pentru persoana care vine în faţa noastră, dornică să înveţe lucruri noi. Învăţarea eficientă poate să nu aibă loc, de multe ori, în pofida unei predări eficiente. Neuronii pot să nu fie pregătiţi pentru noile conexiuni necesare integrării noii informaţii în schemele cognitive existente dacă situaţia de învăţare nu produce o experienţă plăcută „utilizatorului procesului de predare". Cercetarea de faţă s-a născut din dorinţa personală de a măsura cât mai bine gradul de atractivitate al cursurilor mele la o disciplină

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pe care o predau în două locuri diferite. Am urmărit măsurarea gradului de pragmatism și de hedonism la cursurile mele dar și compararea atractivității disciplinei mele cu sistemul de învățământ pe care l-au experimentat studenții în liceu. Nu în ultimul rând, am urmărit să identific dacă există diferențe de abordare a cursului meu între studenții cu maxim de prezențe și studenții care au participat doar la numărul minim obligatoriu. Rezultatele cercetării mele au arătat că gradul de atractivitate al cursurilor mele este unul ridicat, cu unele diferențe între cele două grupe (localități), iar diferențele între studenții care au participat la numărul maxim de cursuri și cei care au participat la numărul minim sunt mai greu de identificat decât am anticipat.

Cuvinte cheie: *experiență didactică, pedagogie, predare, atractivitate, școală.*

Introduction

Teaching is one of the pedagogical concepts discussed and researched for centuries. Each year, the sphere of old pedagogy changes, taking over components that, until recently, belonged to the new pedagogy. The new pedagogy takes on new approaches, evaluating more and more the components and the relationships between them. All these synergies are motivated by a common goal, of all the actors involved: the maximum efficiency of the teaching process in order to optimally prepare the student of today to become the adult of tomorrow. For this, the student "must learn" everything that is transmitted to him through the teaching process.

Sadly, effective learning often does not happen, despite effective teaching. Teaching is a process that can be carried out perfectly and yet, at the student level, no learning will be triggered. Neuroscience research increasingly accentuates the idea that learning does not take place when the learner does not feel comfortable, when the learning situation does not produce a pleasant experience to "user of the teaching process". According to Burns (2012), when the learning situation is pleasant, dopamine and acetylcholine are released, which will prepare the neurons for new connections and support the integration of new information into existing cognitive schemes. According to this researcher, inhibitory neuromodulators that block the formation mechanism of new connections can also be released in the brain, if the learning situation is unpleasant (Burns, 2012).

I like to say that I am part of this group of teachers who believe that educators need to learn to focus much better on the child's learning experience. I believe that this approach, which is increasingly adopted in today's education

- student-centered education, should start from the experience that children have during our teaching class. Everyone who feels comfortable in this educational process will involve better and longer. If we are interested in effective teaching, then we should be interested if the student enjoys our teaching, if the student continues to think about what happened in the classroom even after the teaching is over, if the student continues to work at home on the problems proposed in class without someone forcing him, or her. Burns (2012) argues that all of these aspects are related to the chemical imprint of the brain.

A solid foundation for effective teaching means planning the best learning experience the educated person can have when we want him, or her, to take a keen interest in the content of the course and to solve our teaching tasks, whether assigned individually or in teams. I, also, believe that we can get the best learning experience only if we have feedback from the learners, and this feedback should be the source of the continuous changes that we bring to the teaching process when preparing our courses. Dewey said, "If we teach today, as we taught yesterday, we rob students of tomorrow" (Hebert, 2018, citing John Dewey).

Objectives

The objectives of my research were:

1. Measuring the attractiveness level of my courses, carried out with Primary and Pre-school Education Pedagogy students, in two different localities: Cluj-Napoca and Târgu-Mureș.
2. Measuring the level of pragmatism of my teaching process (perspicuity, efficiency, dependability).
3. Measuring the level of hedonism of my teaching process (stimulation and novelty).
4. Comparing the attractiveness of my didactic process with the didactic process that students experienced in high school.
5. Comparison of the didactic experience of the students with maximum attendances with the didactic experience of the students with minimum attendances (the minimum number is the mandatory one for the final examination).

Material and methods

The research took place in May 2019, at the end of the 2nd semester of year 3, with the students of the Primary and Pre-school Education Pedagogy of the Faculty of Psychology and Educational Sciences, Babeș-Bolyai University

Cluj-Napoca. The students were divided into two groups: the Cluj-Napoca (CJ) group with 46 respondents and the Târgu-Mureș (MS) group with 24 respondents.

The evaluated discipline had the same didactic content, prepared according to official curriculum, combined with didactic games with the help of technology and without the help of technology (Văidăhăzan, 2018) and with dynamic games specific to the discipline curriculum.

Data collection tool used was "User Experience Questionnaire", version 7 (February 8, 2019), developed by Hinderks, Schrepp & Thomaschewski (UEQ Team, 2018). Data analysis and processing was done with the accessories that the UEQ Team offers on their website.

The UEQ contains 6 scales with 26 items: Attractiveness, Perspicuity, Efficiency, Dependability, Stimulation, and Novelty. Attractiveness is split into 2 categories: Pragmatic (Perspicuity, Efficiency, and Dependability) & Hedonic (Stimulation, and Novelty). After the raw data centralization stage, the answers that had inconsistencies were eliminated.

The following table presents the 6 scales with corresponding items for each scale.

Table 1. Items for each scale of UEQ

Scale	**Items**	
Attractiveness	annoying	enjoyable
	good	bad
	unlikable	pleasing
	unpleasant	pleasant
	attractive	unattractive
	friendly	unfriendly
Perspicuity	not understandable	understandable
	easy to learn	difficult to learn
	complicated	easy
	clear	confusing
Efficiency	fast	slow
	inefficient	efficient
	impractical	practical
	organized	cluttered
Dependability	unpredictable	predictable
	obstructive	supportive
	secure	not secure

Scale	Items	
	meets expectations	does not meet expectations
Stimulation	valuable	inferior
	boring	exciting
	not interesting	interesting
	motivating	demotivating
Novelty	creative	dull
	inventive	conventional
	usual	leading edge
	conservative	innovative

The questionnaire was first used to measure the learning experience of students in the didactic process in high school. The second application of the questionnaire aimed to record the student learning experience in the didactic process of my courses.

The items are scaled from -3 to +3. Thus, -3 represents the most negative answer, 0 a neutral answer, and +3 the most positive answer.

Results

The didactic experience of students from CJ group at my didactic process is presented in Chart 1.

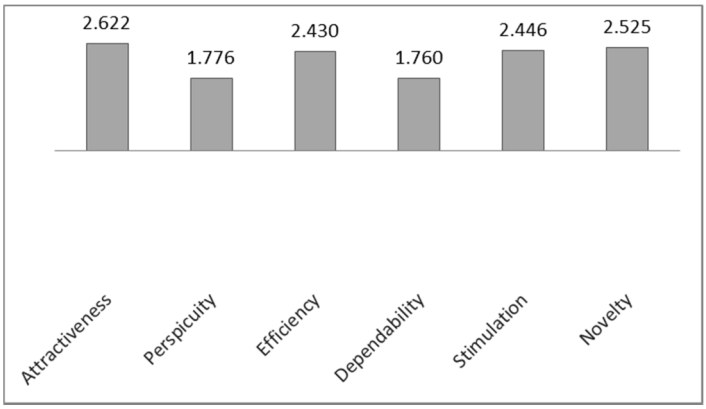

Chart 1. The didactic experience of CJ students in the didactic process of my courses

The didactic experience of students from MS group at my didactic process is presented in Chart 2.

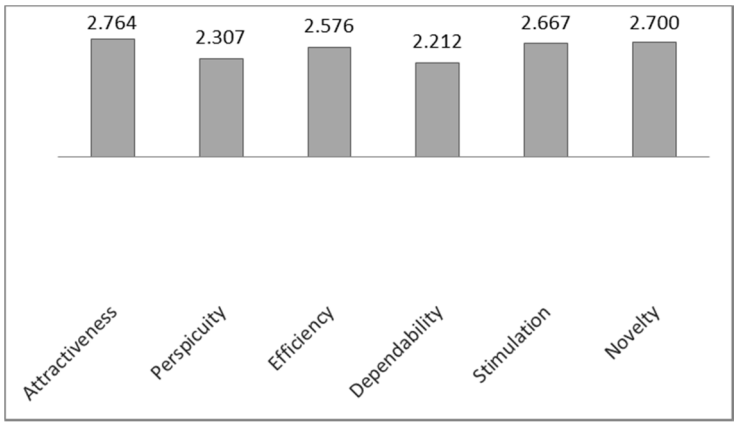

Chart 2. The didactic experience of MS students in the didactic process of my courses

The didactic experience of students from CJ group at the didactic process carried out in high school is presented in the Chart 3.

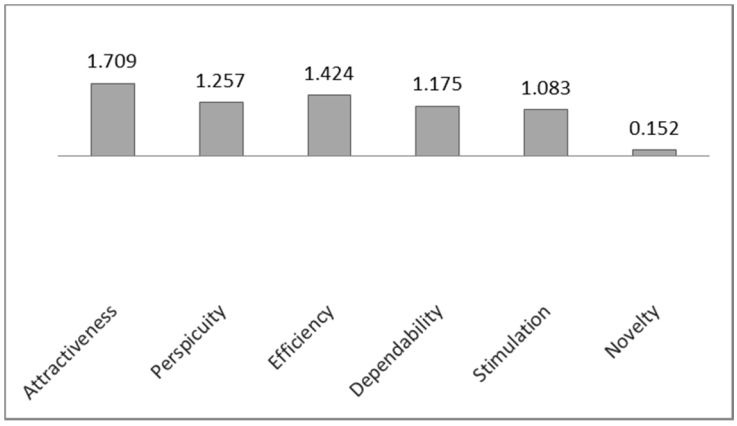

Chart 3. The didactic experience of CJ students in the didactic process in high school

The didactic experience of students from MS group at the didactic process carried out in high school is presented in the Chart 4.

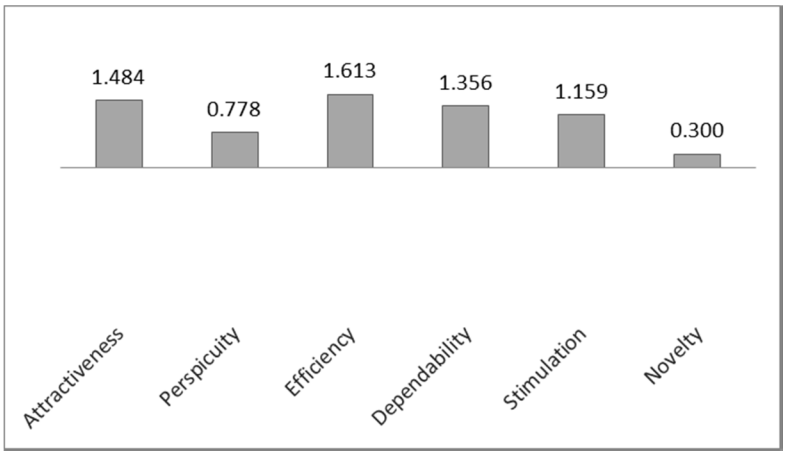

Chart 4. The didactic experience of MS students in the didactic process in high school

Chart 5 presents a comparison of the didactic experience for all my students (CJ & MS) between the didactic process in high school and the didactic process in my courses.

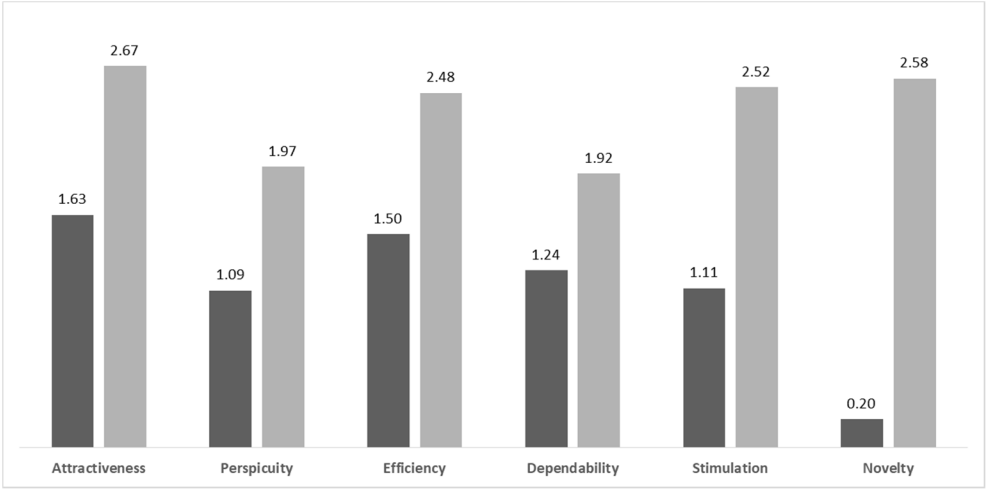

Chart 5. The didactic experience of all students (CJ & MS) in the didactic process in high school compared with the didactic process of my classes

Two sample T-Test (Alpha-Level 0.01) is presented in Table 2.

Table 2. Two sample T-Test (Alpha-Level 0.01) for didactic experience in high school compared with the didactic process of my classes

Attractiveness	0.0000	Significant Difference
Perspicuity	0.0000	Significant Difference
Efficiency	0.0000	Significant Difference
Dependability	0.0002	Significant Difference
Stimulation	0.0000	Significant Difference
Novelty	0.0000	Significant Difference

The didactic experience of the CJ students in the didactic process of my courses, a comparison between those with the maximum number of attendance and those with the minimum number of attendance, is presented in the Chart 6.

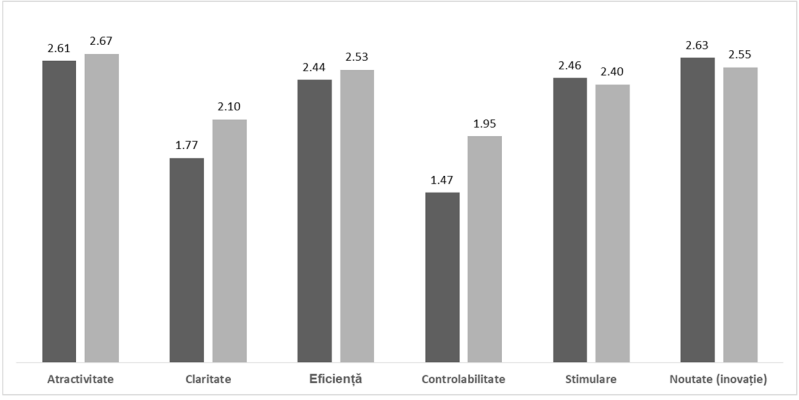

Chart 6. The didactic experience of CJ students in the didactic process of my classes (maximum number of attendance and minimum number of attendance).

Two sample T-Test (Alpha-Level 0.05) is presented in Table 3.

Table 3. Two sample T-Test (Alpha-Level 0.05) for CJ didactic experience of my classes (maximum number of attendance and minimum number of attendance)

Attractiveness	0.6663	No Significant Difference
Perspicuity	0.2256	No Significant Difference
Efficiency	0.5175	No Significant Difference
Dependability	0.1964	No Significant Difference
Stimulation	0.7625	No Significant Difference
Novelty	0.5573	No Significant Difference

The didactic experience of the MS students in the didactic process of my courses, a comparison between those with the maximum number of attendance and those with the minimum number of attendance, is presented in the Chart 7.

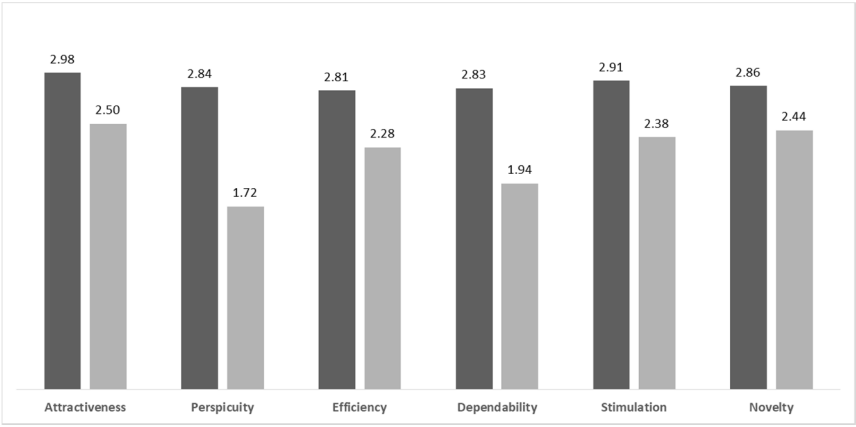

Chart 7. The didactic experience of MS students in the didactic process of my courses (maximum number of attendance and minimum number of attendance).

Two sample T-Test (Alpha-Level 0.05) is presented in Table 4.

Table 4. Two sample T-Test (Alpha-Level 0.05) for MS didactic experience of my courses (maximum number of attendance and minimum number of attendance)

Attractiveness	0.0235	Significant Difference
Perspicuity	0.0081	Significant Difference
Efficiency	0.0480	Significant Difference
Dependability	0.0117	Significant Difference
Stimulation	0.0316	Significant Difference
Novelty	0.0537	No Significant Difference

Discussions

The overall attractiveness of my courses had a score of 2.67, calculated for all respondents, presenting a better appreciation from the MS group (2.764) compared to the CJ group (2.622). The difference between the two groups in terms of the overall attractiveness of the courses is very small, even though the meetings with the CJ group took place every two weeks, and the meetings with the MS group took place 4 times (in a modulated regime).

Regarding the other 5 scales used (Perspicuity, Efficiency, Dependability, Stimulation, Novelty) the biggest difference between the two groups was registered in Perspicuity and Dependability, for both in favour of the MS group. It is possible that the approach in a modulated regime (8 hours of teaching, continuously) will increase the clarity of the content of the course, as well as the controllability for students regarding the purpose pursued by my personal methods of teaching.

The level of pragmatism was higher in the MS group on all 3 specific scales (Perspicuity, Efficiency, Dependability), with the two major differences in clarity and controllability, as presented above. The difference between the two groups is, however, small in terms of perceived efficiency (0.146), which may mean that the teaching methods used and the way of how the meetings took place have had the same success rate. However, the success rate was a very good one, a fact confirmed by the score of 2.48 calculated for all participants.

Regarding the level of perceived hedonism, it was also higher in the MS group, with a slightly larger difference on the stimulation scale (0.221) compared to the novelty one (0.175). Overall, for all registered respondents, the level of hedonism achieved had very good results on both measurement scales: Stimulation (2.52) and Novelty (2.58).

Compared to the high school education system, my teaching system obtained statistically significantly different results, having a general attractiveness of 2.67 as compared to 1.63, for high school education system. The biggest difference was recorded on the Novelty scale, where the high school education system was rated with 0.20, and my course scored 2.58. This big difference could also be explained by the fact that in high school the education system does not have such a high degree of specialization on the needs of the student, as the faculty education system has.

Analysing the experience of the students who attended almost all classes with the experience of the students who attended only the minimum number required, no significant differences were recorded in the CJ group. In the MS group, however, there were significant differences on all scales, except the Novelty. The students from the MS group who participated to all my courses considered the didactic content to be more attractive, clearer, more efficient, more controllable, and more stimulating than the students who attended only the minimum number of courses.

Conclusions

1. The activity of my courses was considered very attractive by both groups of students (CJ + MS).

2. The activity in modulated regime can improve the clarity of the course and the level of control perceived by the students about the didactic content.

3. The level of pragmatism of my didactic process was appreciated by both groups of students.

4. I consider, as a result of the scores obtained at the level of hedonism, that the learning situations created were very pleasant during the meetings with my students.

5. The learning situations experienced by the students in my didactic activities were much more pleasant than those experienced in the high school education system.

6. Increasing the number of attendance at teaching activities enhances the possibility that they will be considered more valuable when the activities take place in a modulated regime (8 hours for each meeting).

This research was born because of my recent hobby, Gamification, and my desire to relate more and more to the learning experience of our learners. This research provided me useful information for redefining my future teaching activities, but I have no claims that this research is part of the reference system of Romanian education. Please approach this research as "being what it is". However, I want to continue this kind of research and I want to read many other findings of this kind, applied by more and more teachers because we need a new approach in designing the didactic activities that will minimize the lack of involvement of our children in the teaching process.

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INFLUENCE OF COMPLEMENTARY SPORT TRAINING DURING THE TRANSITION PERIOD OVER THE REACTION TIME AND COORDINATION FOR FEMALE BASKETBALL PLAYERS

GHERŢOIU DAN MIHAI[1,*], MOCA COSMIN MIHAI[1]

ABSTRACT. ***Introduction.*** Basketball is a dynamic team sport that involves a pattern of intermittent dynamic and skilled movement activities that are governed by the reaction time and coordination level of the player. ***Objectives.*** The aim of this paper was to determine if the use of complementary sport training (tennis) during the transition period influences the reaction time and the coordination coefficient of young female basketball players, measured using the MGM-15 jumping carpet. ***Materials and Methods.*** The participants in this study were female basketball players (N = 14), aged from 11 to 12 years that underwent two measurements: the jumping reaction time test and the coordination coefficient test (EVC) using the MGM-15 carpet before and after a transition period. ***Results.*** There was a significant difference between the initial and final measurement for both the reaction time and EVC variable. ***Conclusion.*** The reaction time and the coordination coefficient were decreased by the transitional period of complementary sport training.

Keywords: *basketball, reaction time, coordination, transitional period, tennis training*

REZUMAT. ***Influenţa unui sport complementar în perioada de tranziţie asupra timpului de reacţie şi al coordonării la jucătoarele de baschet.*** Introducere. Baschetul este un sport de echipă care implică un model de mişcări dinamice intermitente care sunt guvernate de timpul de reacţie şi nivelul de coordonare al jucătorilor. ***Obiective***. Scopul acestei lucrări a fost de a determina dacă folosirea unui sport complementar (tenis) in perioada de tranziţie influenţează timpul de reacţie şi coeficientul de coordonare a unor jucătoare tinere de baschet folosind covorul de sărituri MGM-15**.** ***Materiale şi metode***. Participantele în studiu au fost jucătoare de baschet (N=14) cu vârste cuprinse intre 11 şi 12 ani la care au fost măsurate timpul de reacţie în săritură şi testul

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coeficientului de coordonare (EVC) folosind covorul de sărituri MGM-15 înainte şi după perioada de tranziţie. ***Rezultate.*** A existat o diferenţă semnificativă între măsurătorile iniţiale şi cele finale atât pentru timpul de reacţie cât şi pentru variabila EVC. ***Concluzie.*** Timpul de reacţie şi coeficientul de reacţie au scăzut prin folosirea în perioada de tranziţie a unui sport complementar.

Cuvinte cheie: *baschet, timp de reacţie, coordonare, perioadă de tranziţie, antrenament tenis*

Introduction

The worldwide popularity of basketball is unquestionable, especially among the young. Basketball is a dynamic team sport that involves a pattern of intermittent dynamic and skilled movement activities. There are complex demands that require a combination of individual skills, team plays, tactics, and motivational aspects. During a basketball game, we can see variety of movements such as running, dribbling, shuffling, and jumping. These movements are directional, multidirectional, intense and short lasting and most importantly, they are all governed by the reaction time and coordination level of the player (Wong et al., 2012).

Basketball is an anaerobic and high intensity exercise. Because of the high intensity and anaerobic property of basketball, one has to perform the players' best performance within the short period of the game. These performances include shooting action, jump shooting and defense. Shooting is the basic way to get score in basketball and for this reason, it is the most frequently used technical action. The jump shot is distinguished as the most important of all the shooting actions (Atan and Akyol, 2014).

In the field of team sports training, it is important to establish the reference reaction time profile for a better control of the training efficiency. Although it is commonly accepted that team sports training needs a multifaceted approach to understand all of the performance factors affecting competition, it is also well known that the enhancement of reaction time levels is relevant to obtain a better result (Tamer, 2000).

Sprinting performance, strength, and muscular power are thought to be important for successful participation in basketball (Koç et al., 2006). Anthropometrically, basketball players have shown a notable average height in several studies (Colakoglu et al., 1993) even when conducted with players from different nationalities. Most notably, the reaction and coordination performance are crucial in basketball, with critical elements in the game such as quick change

of direction, acceleration, deceleration and jumping ability. However, physical characteristics are not homogeneous for all the positions of the game. Characteristics of junior basketball players differ slightly, in the above-mentioned parameters, from those playing in high-performance situations (Menevşe, 2011).

Reaction times depend on motor nerve conduction velocity and are commonly divided between auditory reaction times (ART) and visual reaction times (VRT). It has been demonstrated that ART are less important than VRT, since it is essentially a visual game (Spierer et al., 2011; Ruschel et al., 2011).

Objectives

The aim of this paper was to determine if the use of complementary sport training (tennis) during the transition period influences the reaction time and the coordination coefficient of young female basketball players, measured using the MGM-15 jumping carpet.

Methods

Subjects

The participants in this study were female basketball players (N = 14), aged from 11 to 12 years that underwent two measurements: the jumping reaction time test and the coordination coefficient test (EVC) using the MGM-15 carpet.

The subjects were part of a basketball team that was during a summer transitioning period where they underwent a series of tennis trainings as a complementary sport. The transition period was 5 weeks, composed of 4 trainings of 90 minutes per week.

Methods and the Steps of the Research

We used the MGM-15 Jumping Carpet for test. The test consists of 15 jumps repeated 3 times: once for the left leg, once for the right one and last time on both legs. The legs must not be bent during the execution of the jumps. The software from the MGM-15 Jumping Carpet offered out, among others, two measurements for each subject named: reaction time and EVC (energetic variance coefficient). The reaction time is measured in milliseconds, while the coefficient is just a quantifiable number. The initial and final measurements were used for the statistical analysis.

Results

After the tests, the data collected was centralized in Table 1.

Table 1. Collected data for each subject regarding the average reaction time and average EVC for the initial measurement

Initial measurement		
Subject	Reaction_Time	EVC
1	0.325	6
2	0.458	11
3	0.39	8
4	0.452	11
5	0.332	6
6	0.377	7
7	0.489	14
8	0.462	13
9	0.401	8
10	0.385	7
11	0.49	11
12	0.442	10
13	0.311	4
14	0.372	5

Table 2. Collected data for each subject regarding the average reaction time and average EVC for the final measurement

Final measurement		
Subject	Reaction_Time	EVC
1	0.313	5
2	0.436	9
3	0.374	7
4	0.43	9
5	0.32	4
6	0.363	6
7	0.461	11
8	0.436	10
9	0.385	7
10	0.371	7
11	0.468	9
12	0.422	10
13	0.303	4
14	0.362	5

Table 3. Descriptive statistics for the initial and final measurement of the reaction time and EVC coefficient

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Reaction_Ini	.4061	14	.06011	.01607
	Reaction_Fin	.3889	14	.05443	.01455
Pair 2	EVC_Ini	8.6429	14	3.05355	.81610
	EVC_Fin	7.3571	14	2.34052	.62553

Table 4. Correlation between the initial and final measurements of the reaction time and EVC

		N	Correlation	Sig.
Pair 1	Reaction_Ini & Reaction_Fin	14	.999	.000
Pair 2	EVC_Ini & EVC_Fin	14	.956	.000

Table 5. Paired sample t test for the two pairs of measurements (initial and final) for the two tested variables: EVC and reaction time

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Reaction_Ini - Reaction_Fin	.0172	.006	.001	.013	.0208	10.590	13	.000
Pair 2	EVC_Ini - EVC_Fin	1.285	1.069	.285	.66847	1.902	4.500	13	.001

A paired-samples t-test was conducted (Table 5) to compare the reaction time before and after the transition period. There was a significant statistical difference in the scores between the initial (M=0.406, SD=0.06) and final (M=0.389, SD=0.054) conditions; t(13)=10.59, p = 0.000. This means that the transitional training period had an influence over the reaction time of the subjects as recorded by the MGM-15 Jumping Carpet.

A paired-samples t-test was conducted (Table 5) to compare the EVC before and after the transition period. There was a significant statistical difference in the scores between the initial (M=8.64, SD=3.05) and final

(M=7.35, SD=2.34) conditions; t(13)=4.5, p = 0.001. This means that the transitional training period had an influence over the EVC of the subjects as recorded by the MGM-15 Jumping Carpet.

Conclusion

Our study has shown that there was a positive decrease of the two measured variables. Both the reaction time and the EVC have shown a decrease that was significant from a statistical standpoint. This means that the transitional period of trainings consisting of exercises from a complementary sport (tennis) did have a positive influence over the reaction times and EVC variable.

Further studies should compare a transitional period with and without the complementary sport trainings.

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PHYSICAL ACTIVITY LEVELS, MOTOR PERFORMANCE AND RELATED FACTORS IN ADOLESCENCE. THE UNIVERSITY OF FOGGIA REGIONAL OBSERVATORY IN ITALY

COLELLA DARIO [1], BELLANTONIO SERGIO [*]

ABSTRACT. Physical activities promotion in developmental age is a public health priority and numerous studies highlight the benefits of various structured and unstructured activities for the prevention of non-communicable diseases and health promotion. Curricular physical education in secondary school offers several and different opportunities to practice physical activities that help promoting learning competences, complying with international guidelines on physical activity and acquiring correct lifestyles. Increasing levels of daily physical activity as well as the development of motor skills are a specific curricular area necessary to structure the conditions for motor learning and the premises for the continuation of sports and physical activities in extracurricular hours. Unfortunately, environmental and socio-cultural characteristics in Italy contribute to increase sedentary habits, limit opportunities to practice unstructured physical activities and lead to a reduction in motor performance. The aim of the following paper is to present the project of the University of Foggia in Italy aimed at systematic monitoring the adolescents' levels of physical activity and motor development. The Regional Observatory at the University of Foggia wants to assess motor skills related to health, analyze correlations with body weight and gender differences, compare the results of prevention interventions carried out in school and structure the premises for regional health promotion projects.

Keywords: *Adolescence, Health Promotion, Health Prevention, Motor Abilities, Physical Education*

Introduction

Promoting physical activities for children and young people is a priority for public health and school. Daily structured and unstructured motor activities – according to WHO guidelines (2010, 2016) helps to foster the individual

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educational process through a balanced cognitive, motor, social and developmental process. The systematic assessment of children's physical activity levels and physical efficiency is of particular importance, because it allows the acquiring of cross-cutting and longitudinal information on the evolution of motor skills and abilities necessary to personalize educational actions.

Acquired data – both quantitative and qualitative – can be used to carry out systematic monitoring of adolescent's motor development and "surveillance" studies necessary to implement evaluation of multi-component interventions, promoting the awareness of student's health condition. Surveillance studies are the first level for intervention studies because they are the basic research for methodological-didactic experiments. The following three-year research project (2019-2021), approved by the Administration of the Puglia Region (south Italy), concerns the implementation of the Regional Observatory on monitoring of physical efficiency related to adolescent's health. The three-year research project will involve secondary schools and it will be coordinated by the University of Foggia (Italy) - Degree Course in *Science and Techniques of Preventive & Adaptive Motor Activities* and the *University Laboratory of Motor Activities Didactics.*

Sedentary habits are a risk factor for human health at all ages. Physical inactivity is a global pandemic and is one of the leading causes of non-communicable diseases (Lee *et al*., 2012). The increase in daily physical activity and the decrease in sedentary behaviors require concrete educational actions to have a positive impact on the promotion of health during the developmental age (Carson *et al*., 2016; Poitras *et al*., 2016). Blair (2009) warns that regular physical activity is an inescapable preventive factor because it contributes to a reduction in the risk of chronic diseases such as heart disease, type II diabetes, certain types of cancer, etc.

Guthold *et al.* (2020) in a recent study based on a sample of 1.6 million subjects from 146 countries, found that more than 80% of 11 to 17-year-old adolescents do not follow WHO recommendations to perform at least one hour of physical activity per day. Globally, girls are more inactive than boys are, with 85% compared to 78% of boys. The authors analyzed data collected through schools. The assessment included all types of physical activity: time spent in active games, recreational and sports activities, household chores, walking, cycling or other types of active transport, as well as physical education hours. Girls are more inactive than boys are: as many as 85% move less than an hour a day compared to 78% of boys.

The European HBSC (Health Behaviour in School-aged Children) study and 2014 data for Italy (Cavallo *et al*., 2016) show that the percentage of boys who say they do not engage in physical activity increases from 4.2% in 11-year-olds to 7.4% in 13-year-olds, to reach 12.1% in 15-year-olds. The frequency of

those achieving the recommended value of one hour of daily physical activity (seven days a week) is 13.7% at the age of eleven, 9.6% at 13 years and 8.3% at 15 years, respectively. Males are on average more active than females, in all age groups: 17% vs 10% in 11-year-olds, 13% vs. 6% at 13 years old and 11% of males vs. 6% in females in 15-year-olds. Low levels of physical activity contribute to reduce the preventive and protective effects of motor activities and are among the main causes of the decline in motor skills, which indirectly express the degree of efficiency of systems, organs, apparatuses of the organism.

In this regard, a study by Uddin *et al.* (2019) warns that the precursors of non-communicable diseases often manifest themselves during childhood and adolescence with little knowledge about the coexistence of the related lifestyle risk factors. For this purpose, the prevalence and grouping of six main risk factors for non-communicable diseases in adolescents around the world were assessed. Data from the School Student Health Survey, collected between 2007 and 2016, were analyzed in 304,779 adolescents aged 11 to 17 (52.2% female) from 89 countries. Overall, 82.4% of adolescents had two risk factors, while 34.9% had 3. Teenagers between the ages of 16 and 17, compared to those aged 11 to 13, were more likely to report 3 risk factors.

Many children and adolescents around the world do not comply with the WHO guidelines on physical activity and sedentary behavior. Schools are the ideal setting to intervene, although despite the numerous interventions made in this context, the positive results that can be appreciated on a large scale are still limited (Cassar *et al*., 2019). Unfortunately, the sedentary habits of young people and a poorly systematic participation in motor activities and sports limit the effects of mediation for the development of the cognitive, emotional-affective and social factors of individuals (Stodden *et al*., 2008). In addition, the decline in habitual physical activity levels also leads to a consequent decline in motor performance and related factors in different ages, with particular reference to muscle strength and endurance (Tomkinson *et al.*, 2012). Low levels of physical activity and physical efficiency in adolescence have been shown to be associated with low levels of physical activity and physical efficiency in adulthood, preconditions for sedentary living (Huotari *et al*., 2011).

Recent scientific evidence, in fact, warns that the sedentary habits of young people are among the main causes of the decline in motor skills, predisposing the organism to several non-communicable pathologies as the preventive and protective effects of daily motor activities are progressively reduced. Lifestyle changes, including the reduction of opportunities to engage in motor activities in formal and informal settings (school, equipped parks, sports clubs, etc.), lead to a progressive increase in health problems, the most obvious being overweight and childhood obesity (Hills *et al.*, 2014). Periodic

collection of data in schools, motor development and behavioral risk factors through evidence-based data and self-reporting should be encouraged to facilitate sustainable global surveillance.

Motor Activities, Physical Education and Health Promotion at School

The contribution of motor activities and physical education to the growth, development and promotion of children and young people's health is confirmed by various studies that highlight the need to develop integrated and joint interventions in different educational contexts (school, health, sport). For each institution it is a priority to study the cause-and-effect relationships among different factors: socio-environmental determinants of daily physical activity, reduction in children's physical activity levels, increased overweight and obesity in developmental age, cognitive, emotional and social development (Hills *et al*., 2007; Trost *et al*., 2014).

Childhood and adolescence are significant periods for individuals, in which they can intervene effectively with educational actions aimed at promoting health through motor activities and sport. Particularly in developmental age, physical activity positively influences the various factors characterizing metabolic syndrome and it is associated with numerous health and physical efficiency benefits (Brambilla *et al.*, 2011).

The European Commission (2015) warns that physical education in school is a significant opportunity to raise awareness of the importance of HEPA (Health-Enhancing Physical Activity) and to implement health prevention and promotion programs through physical and sporting activities. Urgent cross-sector strategic interventions in the field of HEPA promotion are necessary and urgent. Therefore, evaluable actions are needed to promote HEPA policies through the development of a cross-cutting policy approach involving different institutional sectors, including sport, the Ministry of Health, education, environment and transport, in order to design, implement and monitor levels of physical activity at different ages. Physical education during adolescence, supported by correct methodologies, offers many and varied opportunities to practice structured physical activity, promote the development of motor, coordination and conditional skills. The significant contribution of motor experiences to the development of the organic, affective, social and cognitive area and their relationships is crucial to promote education for the health of young people through physically active lifestyles (Bailey, 2006; Le Masurier & Corbin, 2006).

This process is the result of the educational and mediation intention among the teacher, the pupil, the various motor tasks and organizational arrangements, as well as the context in which motor experiences are realized. Numerous recent studies, in fact, show that many of these benefits will not necessarily be the result of participation in activities but the effects could be mediated by the nature of the interactions among pupils and their teachers, parents and adults of reference at school, in family and in socio-cultural context (Lonsdale *et al*., 2013). In particular, physical activity offers significant benefits on school performance, cognitive function and classroom behavior (Watson *et al*., 2017; Singh *et al*., 2019), involving the individual in its entirety. The control of the outcomes of curricular and extracurricular interventions is inescapable to study the effects of the educational process, analyze relationships with related factors, make comparisons at different periods of school cycle, share the results among the different educational agencies.

The Development of Health-Related Motor Skills

Motor development during the developmental age depends and is influenced by organic growth, as well as maturation and interaction with the environment in which the individuals grew (Malina, 2003). Others may regress to less mature stages before moving on to a more advanced stage, others can show seemingly continuous progress (Malina, 2003; Gallahue, Ozmun, & Goodway, 2011). Motor experiences take place in various contexts including home, school, spaces equipped to play in the neighborhood. Sports facilities and all this contributes to the development of motor skills through the learning of skills gradually more specific and which are the essential basis for the promotion of health in different aspects (Lubans *et al*., 2010; Barnett *et al*., 2016).

Recently, Faigenbaum, Rebullido, & Mcdonald (2018), highlights that most of children and adolescents in the world do not reach the 60-minute threshold of moderate to intense daily physical activity, resulting in reduced levels of physical efficiency. This is coupled with a progressive reduction in motor repertoire of motor skills and the resulting levels of individual coordination development. Today's children are weaker, slower and heavier than their peers in the past, with an increasing tendency to develop physical, psychosocial and cognitive health problems, especially in school age. The recommendations proposed by international institutions (WHO, 2018) provide guidance for the practice of habitual physical activities - both of quantitative and qualitative type – differentiated also according to the age group considered and taking into account various types of physical activity.

In general, the World Health Organization recommends 150 minutes per week of moderate-intensity activity for adults and 60 minutes per day of moderate-to vigorous intensity activity for the developmental age (WHO, 2018). Despite the global recommendations, therefore, the decline in levels of physical activity in recent years does not seem to stop. In this regard, Faigenbaum, Rebullido, & Mcdonald (2018) propose an interpretation of this phenomenon from a threefold perspective. We speak of the Triad of Physical Inactivity in childhood, in which three distinct but closely related factors are identified: exercise deficit disorders, pediatric dynapenia and motor literacy (physical illiteracy).

The first component of the triad of physical inactivity is the *Deficit Disorders of Exercise*: this is a condition characterized by reduced levels of MVPA (Moderate-to Vigorous Physical Activity), which do not comply with the global health recommendations. Young people who do not reach the minimum recommended levels of physical activity can be considered in a pre-morbid condition, such as to be treated with the same methods that would be the same as a hyperthetic individual or adolescent smoker, in order to prevent possible pathological progress. In this context, targeted programmes would be needed to improve the lack of physical activity, maintain a certain level of participation in activities and promote a proper lifestyle, regardless of the weight state in which young people find themselves, as interventions aimed only at obese individuals eliminate a large proportion of them. Even those who have a BMI (Body Mass Index) in the norm, associated with poor levels of physical activity, must be "supervised" and therefore participate in such programs.

The second component of the triad of physical inactivity, is the *Pediatric Dynapenia*, understood as the condition characterized by low levels of strength and muscle power, resulting in functional limitations not related to neurological or muscle diseases. The ability to force in its various expressions, in fact, is necessary to perform some simple activities such as jumping, climbing, kicking, and young people who have low levels of strength are more likely to remain inactive to avoid failures and are also exposed to increased risks of accidents even lean later ages. It is therefore necessary to urge these individuals to join motor activity programmes aimed at improving the performance of muscle strength and power, so they can achieve optimal levels, as well as their peers.
The third component of the triad is *Physical Illiteracy*, understood as a lack of motivation, confidence, perceived self-efficacy, reduced repertoire of motor skills and executive variants, knowledge and self-awareness to evaluate and engage responsibly in motor activities (Faigenbaum, Rebullido, & Mcdonald, 2018).

This triad creates a dangerous circular process: those with low levels of MVPA will be less inclined to participate in motor activities, even free/ deconstructed, and this results in a lower fitness to practice physical or sport activities that involve achieving a state of joy/fun, associated with movement (joy of movement). Therefore, the concept of physical illiteracy must be considered as a whole: it includes cognitive, affective, social, and organic-metabolic factors, characterizing learning processes.

Several studies highlight the importance of promoting physical efficiency in adolescents, particularly for the effects on BMI and related effects on cardiorespiratory efficiency levels (Ortega *et al*., 2008), on relationship between physical activity and overweight, between fitness and overweight (Rauner *et al*., 2013), and between motor skills levels and body weight (Cattuzzo *et al*., 2014).

With regard to the relationship between motor skills and BMI, Gontarev & Ruzdija (2014) showed on a sample of 2228 adolescents that those with a higher than normal BMI have a lower percentage of muscle mass and achieve lower results in muscle strength assessment tests, speed and coordination and low aerobic capacity, compared to their peers. Groups with a high BMI achieved similar results to the normal weight group only in terms of flexibility and greater in static force. An interesting study (Smith *et al*., 2016) aimed at studying adolescent healthy behaviors (group ATLAS-Active Teen Leaders Avoiding Screen-time), measuring physical activity and motor skills and assessing the reciprocal effects of mediation, showed that improving resistance outcomes can be an effective strategy to achieve a positive impact on body composition and strength in different expressions.

The ASSO Multi-Component Project (Jemni, Viana, & Tabacchi, 2016) is being carried out in Italy involving more than 800 adolescents and using technologies to evaluate different factors (lifestyle, eating habits, smoking, alcohol consumption), shows that 78% of adolescents are sedentary. 22% of adolescents are active because they play sports at competitive or uncompetitive levels; the most worrying factor is the cardiorespiratory resistance of the sample with no difference between the under-16s and the over-16s.

With reference to the assessment of health indicators, Lang *et al*. (2018), warns that systematic control of cardiorespiratory efficiency (resistance in its expressions) allows to reactively assess and study the links between physical activity and health related to the child and youth population. Monitoring of cardiorespiratory efficiency promotes monitoring of health of children and young people in each country: the data can be used in scientific research, physical education and clinical. Last but not least, the development of guidelines could support future efforts to interpret monitoring data at national and international level (Santander *et al*., 2019).

The studies presented in this paper demonstrate the relationships between motor performance and levels of physical activity, and the importance of systematically controlling physical efficiency and factors related to the health of young people, with reference to different variables as age, gender, BMI, socio-cultural condition, extracurricular sports practice. Interdisciplinary didactics actions – diversified according to the needs of individuals – aimed at the promotion of health and prevention of various pathologies, and they require an inter-institutional and cross-cutting approach. Interventions should involve practitioners from different sectors (health, education, sport) to encourage pupils and parents the necessary understanding of the main meanings underlying the movement. In particular, any proposed action "for the school" and "in the school" must include the measurement and evaluation of motor skills and related factors to analyze temporal variations and the impact of interventions on behavioral change.

The *University of Foggia Motor Skills Monitoring and Health Promotion Regional Observatory*

According to several studies, the assessment of adolescents' physical efficiency takes on particular importance because it allows the acquiring of information – transversal and longitudinal – on evolution and development of motor skills. Surveillance studies are the first level for intervention studies, basic research for methodological-didactic experiments. The *University of Foggia Regional Observatory for Monitoring Adolescent Motor Development* involves several educational institutions and arises from the need to annually acquire quantifiable data on the development of motor skills related to health and levels of physical activity during developmental age. These data provide direct information on the evolution of children's motor skills in Apulia Region and indirectly the effectiveness of interventions in schools, as well as the quality of physical education in secondary schools. Furthermore, the data promote the self-assessment of motor performance and health conditions by pupils, a prerequisite of education in daily motor activities. The data can be shared among national, regional and local institutions that cooperate in the design and implementation of health promotion interventions in the school.

Why a Regional Observatory?

1.1 Aims

(*a*) establish a territorial database on motor development and levels of physical activity accessible to different professionals and helping institutions to achieve national benchmark regulatory values; (*b*) compare levels of physical activity and motor development of pupils at different ages (cross sectional and

longitudinal study); (*c*) facilitate the communication of data obtained among different sectors (school, university, health, sports, local administrators), in order to design integrated educational actions according to evidence-based data; (*d*) motivate teachers and pupils to control the teaching process; (*e*) promote pupils' self-assessment of physical activity levels, motor performance and the dangers related to sedentary lifestyle; (*f*) analyze changes in lifestyles at various periods of developmental age and promote the spread of healthy habits; (*g*) guide the sport practice of young people; (*h*) promote the use of testing in school assessment; (*i*) identify the relationships among motor practice, eating habits, school performance and related psychological and social factors.

1.2 Participants

The participants of the University of Foggia Regional Observatory are middle and high school students from Apulia Region who are affiliated with the University of Foggia and who agree to participate in the study. Additional involved participants are the parents of the pupils and the teachers of the participating schools. The establishment of this observatory is a reference for the design of motor activities in the field of health education in the school, a "container" of information to draw on to study the main emerging issues and formulate solution hypotheses, by the school and other educational agencies. Monitoring levels of physical activity and motor development in adolescence – through objective and self-reporting measures – can help to improve the quality of physical education by returning useful and necessary information to plan teaching, identify pupils' needs, vary teaching methodologies, and prepare measures to contrast sedentary habits. Territorial benchmarks can also be developed to identify inter-individual differences, national and international comparisons. In addition, up-to-date information on psychological and socio-cultural factors related to physical education and guidance necessary to change activities and environments can also be given.

1.3 Timeline

The activities of the University of Foggia Regional Observatory will develop over a three-year period according to the following timeline:

First Year: (*a*) identification of the sample of adolescents residing in Apulia Region, neurotypical, special needs, and disadvantaged social classes; (*b*) analysis of the scientific literature to choose objective assessment protocols and self-reports according to the international literature; (*c*) first anthropometric, motor, postural and related assessment; (*d*) website structure for data collection and documentation; (*e*) presentation of the study of parents, teachers and school leaders.

Second Year: (*a*) communication to parents and teachers of schools affected by the preliminary results; (*b*) methodological and curricular interventions according to experimental teaching and organizational models; (*e*) second anthropometric, motor, postural and related factors assessment.

Third Year: (*a*) continuation and development of experimental methodological-didactics interventions; (*b*) third anthropometric, motor, postural and related factors assessment; (*c*) dissemination of results to parents and teachers of the schools involved.

During the three-year period, the website will be managed to ensure the documentation of the detected and processed data. The study provides: (*a*) cross-and-longitudinal analyses on the socio-cultural determinants of physical activity; (*b*) assessment and monitoring of adolescents' physical activity and motor development levels (11-13 years/14-18 years), in relation to individual and socio-cultural variables (T_0, T_1, T_2). The research will also analyze (*c*) the effects of experimental curricular experimental methodological and organizational interventions, aimed at learning motor skills, promoting daily physical activity, developing factors of motor performance (resistance, strength, joint mobility, speed, motor coordination), some psychological constructs (physical self-efficacy, enjoyment and motivations) and analysis of correlations with school results.

1.4 University of Foggia Regional Observatory Strengths and Weaknesses

The following strengths are identified: (*a*) three-year duration to perform longitudinal analysis and studies through object methods and self-reporting; (*b*) schools spread across the Apulia Region; (*c*) developing reference standards to identify international and national inter-individual differences; (*d*) surveillance of those at risk of obesity; (*e*) promotes pupils' awareness of their own state of health; (*f*) analyzing data to improve the quality of physical education at school.

The following weaknesses are identified: (*a*) physical activity levels are measured by self-reporting; (*b*) availability of financial resources for the duration of the project; (*c*) systematic communication with institutional stakeholders (health, sports, local government); (*d*) lack of interdisciplinary relationships in educational design; (*e*) lack of informed consent for some parents to detect data.

Methodological Conclusions and Educational Implications

Motor assessment in secondary school enables data on methodological quality of physical education, levels of physical activity and motor development of pupils. The collection of quantitative and qualitative data in the school should

be aimed at improving the quality of teaching. Frequently physical education teachers annually detect numerous data on the motor development of pupils that are not properly or fully used to improve the teaching process, that is, the data are not transformed into information useful to educational action. Regarding scientific research, the quantity and quality of studies of physical activity during developmental age and sedentary behaviours have rapidly increased in recent years, but research directions are often pursued in an uncoordinated manner among scholars. There has been a wide-ranging comparison so far to identify the characteristics of quality curricular interventions aimed at physical education for health promotion.

To reach an international consensus on the priorities of physical activity and motor development research for adolescent health, two independent groups of scholars (Delphi procedure) were compared to define a list of research priorities for the next ten years (Gillis *et al*., 2013). Among the top three research priorities (out of 29) for the next 10 years were identified:

a) to develop effective and sustainable interventions to increase the physical activity of long-term pupils
b) to implement policies to promote environmental change and their influence on physical activity levels and reduction of sedentary behaviours
c) to foster longitudinal studies on the effects of physical activity on sedentary habits and health promotion

Several areas of action emerge: school, family, sports, urban furniture (park presence, bike lanes, equipped play spaces, sports facilities) among the fundamental determinants of deconstructed and structured motor practice. Particularly at school, the process of learning motor skills, as well as the development of motor skills, are conditioned by reduced opportunities for motor practice that predispose young people to overweight and obesity and limit the motor repertoire of each pupil.

Custom methodological intervention is a priority to propose activities adapted to the motor skills of children with greater BMI in the parameters of executive difficulty, duration and intensity, in order to help to increase the quantitative and qualitative levels of physical activity, promoting success and motivation to continue physical activity outside of school. Among the essential and indispensable skills of physical education teachers, we can found the analysis of the motor tasks and the customization of intervention in the motor and sports field of youth supported and guided by appropriate teaching styles and didactics strategies.

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FACTORS INFLUENCING BASKETBALL SHOOTING

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ABSTRACT. In this study, we tried to summarize the evolution of shooting in basketball, emphasizing all factors that have a special and direct influence on the player's shot. Through the decades, the basketball evolved continuously reaching another level of performance, being more and more refined by the coaches and by the new circumstances. Modern basketball implies different types of shooting the ball, all of them improved by the necessity of trying to score in any circumstances and avoiding a better and better defense. The game of basketball offers many possibilities to score because is a sportive discipline with a large repertory that can be increased every day by adding new technics and abilities to place the ball inside the basket. The shooting ability is influenced by many factors and between them; the most important are the constant training in order to reach performance and the psychosocial factors. The momentarily athletic performance of the player will be given by such factors like training level, fatigue, recovery after effort, motivation, concentration, but the sportive value of a player is a constant that remains almost the same during the entire career. The value varies only a little, while the athletic performance of the player can reach different levels, depending also on the factors described above. One of the most important assets for a basketball player is the coordination of the body and mind, defined as the minimum effort made in order to obtain the easiest and almost perfect shot to the basket.

Keywords: *basketball game, type of shooting, basketball evolution, athletic form*

REZUMAT. ***Factori care influenţează aruncarea la coş în jocul de baschet.*** În această lucrare am încercat să trecem în revistă evoluţia aruncării în baschet, punând accentul pe toţi factorii care au avut o influenţă directă şi specială asupra jucătorului. De-a lungul ultimilor zeci de ani, baschetul a evoluat în mod continuu ajungând la un alt nivel de performanţă, fiind tot mai mult şi mai mult rafinat de către antrenori din cauza noilor circumstanţe de joc. Jocul de baschet modern implică diferite tipuri de aruncare, toate fiind îmbunătăţite permanent din necesitatea evidentă de a evita o tot mai bună apărare. Cel mai important aspect este că baschetul oferă multe posibilităţi de a înscrie pentru că este o

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disciplină sportiva cu un repertoriu foarte mare, care poate fi îmbunătăţit în fiecare zi prin adăugarea de noi tehnici si abilităţi. Abilităţile de aruncare sunt influenţate de mulţi factori, printre aceştia, cei mai de seamă fiind antrenamentul constant pentru a atinge performanţa şi factorii psiho-sociali. Pregătirea de moment a unui jucător va fi data de către anumiţi factori precum ar fi: nivelul antrenamentului, oboseala, recuperarea după efort, motivaţia, concentrarea, dar valoarea sportiva a jucătorului este un lucru constant care se menţine de-a lungul întregii cariere. Valoarea ei variază foarte puţin, în vreme ce forma sportiva poate atinge diferite nivele, în funcţie si de factorii enumeraţi mai sus. Cel mai important lucru pentru un jucător este coordonarea dintre corp şi minte, definită foarte succint ca fiind efortul minim realizat de către aceasta pentru a obţine cea mai uşoară şi aproape de perfecţiune aruncare la coş posibilă.

Cuvinte cheie: *jocul de baschet, tipuri de aruncare, evoluţia jocului de baschet, forma sportive*

Introduction

Similar games involving a basket and a ball have existed in human history since ancient times, but only in the metaphorical way can we speak of them as being the predecessors of the basketball game.

In South American tribes, in ancient civilizations, Maya, Aztec etc. there were such games, but they were a bit different from what we understand today through basketball. Such primitive sports competitions, as described below, only show that the idea of combining a ball and a basket has appeared in various geo-cultural areas throughout human history:

> "The first games were played by teams of 50 players and with two fruit baskets placed on the ground, the ball being played only by rolling. Due to collisions occurring near the baskets, it was necessary to lift the basket from the ground in order not to be touched. Then, because there was the disadvantage of climbing the ladder, after each basket, to retrieve the ball and put it back in the game, players cut the bottom of the basket and thus the "new" basketball basket was born" (Antoniale, 2002, p. 14).

The modern basketball game was invented in 1891 by American professor James Naismith, who tried to diversify his students' sports hours at Springfield, Massachusetts College. Initially there were no precise rules, but over the time the overall criteria of the basketball game began to be defined, which are updated each year by FIBA.

Development of the basketball game and improvement of shooting

With the evolution of basketball as an increasingly complex sport, there was also the improvement of the throw to the basket, appearing new and more refined ways to register. Modern basketball is a sport that involves different methods of throwing the basketball. The objective of the game is to score more points than the opposing team by throwing the ball through a circle.

This goal can be achieved through various throwing processes, which have been refined over time and are continually refined by the emergence of new elements that can be introduced to prevent opposing defenses from anticipating and blocking the throw. The continuous evolution of this sport discipline and the refinement of the processes are due in principle and due to the fact, that "basketball is one of the sports games with the richest background of technical-tactical procedures, which stimulates the continuous development of both the content of the game and the enhancement of the game." (Antoniale, 2002, p. 15).

Sorin Iulius Bărbuică (2012, p. 7) classifies shootings in basketball into two main categories:

a) On the spot - and here we have a very important distinction regarding gender differentiation:

For female players:

- With two hands from the chest
- With one hand from the shoulder
- Jump shot

For male players:

- With one hand and from the shoulder
- Jump shot

b) From motion

- From above
- Offered, or lay-up in American terminology
- In hook and semi-hook

Throwing to the basket must be practiced countless times at every training because it is fundamental to the offense. In order to be as close as possible to the real conditions of the game, thus offering an adequate and quality training, the throw must meet some conditions such as:

- To be practiced together with a teammate / passer to highlight the optimal moment for the preparation of the shoot and with another player who will play the opponent, simulating the best defense in the match. Therefore, in order to practice the throw of one of the members of the team, it takes 2 more players to participate as passer and opponent.

- Ideally, each throw should be tracked by the shooter, who will go to recover his own shot, thus developing other skills needed on the offensive.
- Before the actual execution of the throw (not to mention open shots, when the shooter remains completely free on the semicircle or at half distance for a fraction of a second), the player must perform a throw or pass slot or a short dribbling with change of direction in order to be able to mislead the opposing defense.

Factors influencing the shooting in basketball

Throwing to the basket and improving it is not only about sports skills or ball training by repeating some procedures but is also affected by other elements that we will list below. The psychosocial factors that can affect the shootings are:

- Lack of concentration
- Excessive nervousness
- Precipitation
- Hyper motivation
- Indifference / apathy
- Alteration of lucidity

In contrast to these factors are the qualities of exceptional athletes who are educated over time:

- Self-control
- Constant concentration throughout the game
- Motivation
- Clearness in choosing the type of execution at key moments

An almost exhaustive classification of the difficulties that can affect the player's athletic form (implicitly, his throw to the basket) is made by Roxana Enoiu (2008, pp. 85-86), who identifies the following very relevant indications of the loss of this performance:

- Underactive
- Hyperactive
- Tension tendencies
- Mental confusion
- Lack of self-confidence
- Depression
- Negativity

- Defeatism
- Panic
- Agitation
- Giving up effort
- Decreased stress tolerance
- Insecurity in decision and action
- Non-motivation, etc.

A basketball coach should be able to differentiate very well between the athlete's current form and his actual value as a player. Fitness can vary greatly depending on several factors that determines it, and the most common are: fatigue, physical training, sufficient rest, recovery of the athlete after exercise, nutrition, etc. The sports value is more constant than the athletic form at a certain moment of the player:

> "The athletic form is a temporary state that a player possesses while his (player's) value represents a level that, once acquired, does not pose the problem but to be maintained. In a state of form, a player shows maximum efficiency" (Enoiu, 2008, p. 86).

Throwing to the basket and implicitly the percentage with which the player scores can be affected by his sporting form at the moment, while his value determines some limits between which the percentage oscillations can manifest. If we take the extreme case of players who have never had a good percentage in free throw lineups like the legendary Shaquille O'Neal we can see that he throws much better when he is in shape (can reach 60%), but will never have a higher value than a player with fabulous percentages in free throws, like Steph Curry (even though he is temporarily in poor shape).

Coordination between mind and body

When shooting the basketball from action, but not only this type of throwing we need coordination, which is learned from very young ages. Therefore, coaches of baby basketball, the minibasketball and the junior basketball teams try to form in the young players the principles of good coordination and mechanics of the throw because this will remain imprinted during the whole career of the basketball player.

> "The meaning of the term coordination is synonymous with that of skill, ability, precision, accuracy, finesse, grace, balance, all of which represent an individual's ability to learn and quickly combine new movements, to make harmonious and efficient movements in a given time, with little energy consumption" (Cătănescu, 2009, p. 112).

Espenshade and Eckert have provided the most synthetic definition of coordination that can be expressed in the following sentence:

> "An individual has a good coordination when moving easily and the sequence and timing of his actions are well controlled" (Cătănescu, 2009, p. 113).

There are several factors that greatly influence the coordination in basketball shooting, and of these, the most important are the following:

- The athlete's IQ
- The tactile finesse
- Precision of the senses
- Motricity

Conclusions

Shooting in basketball requires the simultaneity of several factors in order to approach perfection. It is primarily about mastering a good throwing technique, but also constant training to reach a high percentage. To achieve this, considerable practice must be done to optimize the psychosocial factors that are important in the key moments of the match.

The summation of all these elements must lead to a perfect coordination of the player in order to prepare and execute basketball shooting even in the most difficult situations of the game. It is about adapting the player to the context, who will recognize the situation and act accordingly very quickly and with the necessary self-control, choosing the best possible option at that time to throw the ball in the basket.

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FOREST ADVENTURE PARKS OF ROMANIA: NEW POSSIBILITIES TO DEVELOP THE HUMAN PHYSICAL CAPACITY

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ABSTRACT. One of the primary goals of physical education is to improve the human physical capacity. The physical capacity is a dynamic potential of a person, which is composed by the level of motor abilities and motor skills acquired during life. School-based physical education plays an important role in the development of motor capacity, but it is by far not enough to achieve the goal of physical education. **Purpose**: The purpose of this study is to map the adventure parks of Romania and to examine (by reviewing the literature) the effect of climbing on the motor capacity of the participants. We would like to examine the most common obstacles in adventure parks and determine what physical abilities are needed to complete them. **Case Presentation**: In Romania, the first forest adventure park was built in 2006 and by now, their number has reached thirty. Their main characteristic is that the climbers, by relying on their own physical and mental abilities, try to cross obstacles of various difficulty, height and length. **Conclusions**: Moving activities provided by forest adventure parks have become easily available to more and more people. Climbing in adventure parks (and climbing in general) can be an excellent alternative to improving motor capacity, as it uses and develops the body in a versatile way.

Keywords: *adventure park; climbing; physical benefits; motor skill, rope courses.*

REZUMAT. ***Parcurile de aventură din România: noi posibilități pentru creșterea capacității motrice a omului.*** Unul dintre obiectivele primare ale educației fizice este dezvoltarea capacității motrice. Capacitatea motrică este un potențial dinamic, compus din nivelul de dezvoltare al calităților motrice și deprinderilor motrice. Educația fizică școlară are un rol important în dezvoltarea capacității motrice a elevilor, dar nu este suficientă pentru atingerea obiectivelor educației fizice. **Scop**: Scopul acestui studiu este prezentarea parcurilor de aventură din România și de a descrie (prin studiul literaturii de specialitate) efectul cățărării asupra capacității motrice. Am dori să descriem cele mai comune

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obstacole din parcurile de aventură și să determinăm acele calități și deprinderi motrice care se implică în cățărare. **Rezultate**: În România, primul parc de aventură forestier a fost construit în 2006 și până acum numărul lor a ajuns la treizeci. Principala lor caracteristică este că cățărătorii, bazându-se pe propriile abilități fizice și mentale, încearcă să traverseze obstacole de diferite dificultăți, înălțimi și lungimi. **Concluzii**: Activitățile motrice oferite de parcurile de aventură forestiere au devenit accesibile pentru tot mai mulți oameni. Cățărarea pe traseele cu obstacole (și cățărarea în general) poate fi o alternativă excelentă pentru îmbunătățirea capacității motrice.

Cuvinte cheie: *parc de aventură; cățărare; beneficii fizice; deprindere motrică.*

Introduction

In the public schools of Romania, there are two physical education (PE) classes per week at elementary and middle school level, and just one class of PE per week in secondary schools. School-based physical education plays an important role in the development of motor capacity, but it is by far not enough to achieve the goal of physical education. In addition to the few hours of physical education, in many cases even the material and didactic conditions are very weak and underdeveloped. One of the primary goals of physical education is to improve the human motor capacity (Mitra & Mogos, 1980). Motor capacity is defined as the dynamic potential of a human that is formed by the level and quantity of motor skills and motor abilities acquired during life. Dynamic potential as it expands through the learning of unknown skills or narrowing by forgetting skills (Cârstea, 1999).

It is also an important role of the school physical education to prepare the individual for independent out-of-school physical activities. If we succeed to create a lust in the individual for the physical activity, we are halfway to achieve an important role.

Regular physical activity is required to maintain the optimum fitness level of the human body. However, in order to develop the motor capacity on various way, we should not stop at a kind of activity, it is best to have a diverse training program, which is changed or adapted. Regular physical activity (also the non-regular physical activity (O'Keefe, 2012)) has a wide range of beneficial effects on the human body, which has been proven by thousands of studies (Janssen & LeBlanc, 2010), but there are still some new and surprising facts in the new studies.

Climbing is a motor activity that occurs through the joint work of the lower and upper limbs on vertical or steep surfaces. It is a complex form of movement that we start learning when we are 2-3 years old (Hébert, 1912). Climbing is usually done on a solid, stable surface, which can be a rock wall, a tree, a climbing wall or on a very mobile rope. In contrast, in a forest adventure park, we encounter a particular form of climbing, obstacle climbing. In many cases, obstacle climbing occurs on unstable surfaces, which are not always vertical surfaces, they are hanging objects and this position makes climbing more difficult. Occasionally, the climber may be in a support, hanging, lying or even kneeling position. Due to the diversity of climbing, it affects the human body in many ways and we can benefit from its favorable effects.

Objectives

The aim of this literature review study is to map the adventure parks of Romania and to describe the effect of climbing on the motor capacity of the participants. We would like to examine the most common obstacles in adventure parks and determine what physical abilities are needed to complete them. In addition, we would also examine what kind of motor skills are necessary during obstacle climbing.

Forest Adventure parks and rope courses

Forest Adventure Park began to spread relatively recently (from the mid-twentieth century) as a recreational activity for society (Wagstaff). There are currently several names that refer to the same or similar activities: rope courses, rope challenge courses, aerial obstacle courses, challenge courses, aerial adventure park, Tree-Top Adventure course. The simple ground obstacle courses can be considered the ancestor of the adventure parks, which have been used for a long time in training soldiers. It seems, that Georges Hebert was that person who recognized the importance of the obstacles and obstacle courses, and made efforts to include them in the PE activity (Hébert, 1912). He included such obstacles which requires walking, running, jumping (up, down, over), hanging, climbing (rope, pole, tree, wall), balancing, brachiating, carrying, throwing exercises.

The Outward Bound movement in Aberdovey, Wales (Parker, as cited in Attarian, 2001), built the first obstacle course for educational and recreational purposes. Originating in the United Kingdom, this movement has prospered in

the United States since 1962 (Attarian, 2001; Neill, 2004). Initially (for nearly 30 years), builders built their courses and obstacles according to their own insights and ideas. From the 90s onwards, it is only possible to build and operate courses under supervision and regulation in accordance with strict regulations. This made the courses much safer; by the way, these can be operated only by trained staff and their condition is checked periodically (Attarian, 2001).

In the forest adventure parks, we can find a diverse obstacle course type, which uses the motor abilities of the climbers in a versatile way. One of the main characteristics of the courses is that they are stretched the trunks or branches of the living trees. Another characteristic is that the climber is constantly in safe, because of the safety equipment he wears. In the majority of parks, this safety equipment is composed by a helmet, a harness and a pair of gloves. The harness and the helmet are must-have accessories, but the gloves are just recommended.

In Romania, the first forest adventure park was built in 2006 (Grigore, 2006). In the past 13 years, their number has reached thirty. Their main characteristic is that the climbers, by relying on their own abilities (physical and mental), try to pass-over obstacles of various difficulty, height and length. Most of the Romanian adventure parks have been built near major cities, but we can still find county seats that are missing these parks. The map in Figure 1 shows the currently operating adventure parks divided by counties.

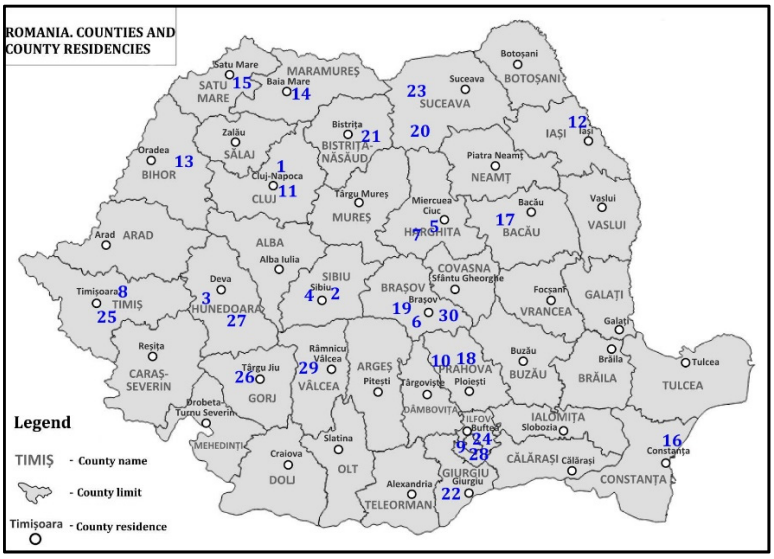

Figure 1. Location of Romania's forest adventure parks by county
Adrenalin Park, Casele Micești, Cluj

1. Arka Park, Păltiniș, Sibiu
2. Arsenal Parc, Orăștie, Hunedoara
3. Aventura Parc Drăguș, Sibiu
4. Balu Park, Hargita Băi, Harghita
5. Cheile Grădiștei, Brașov
6. Club Aventura, Salina Praid, Harghita
7. Domeniul Herneacova, Herneacova, Timiș
8. Edenland Park, Balotesti, Ilfov,
9. Escapade Adventure Park, Sinaia, Prahova
10. Geko Park, Sălicea, Cluj
11. Hamak, Bârnova, Iași
12. Happy Land Adventure Park, Stâna de Vale, Bihor
13. Jungle Park, Baia Mare, Maramures
14. Jungle Park, Satu Mare, Satu Mare
15. Paradis Land, Neptun-Mangalia, Constanța
16. Parc Aventura Magura, Bacău
17. Parc aventura Cumpătu, Sinaia, Prahova
18. Parc Aventura, Brasov
19. Parc Escalada, Gura Humorului, Suceava
20. Parcul de Aventură Cocoș, Bistrița, Bistrița-Năsăud
21. Parcul de aventură Comana, Giurgiu
22. Parcul de aventură Fălticeni, Suceava
23. Parcul de aventură Herăstrău, Bucuresti
24. Parcul de Aventură Nădrag, Nădrag, Timiș
25. Parcul de aventură Rânca, Novaci-Romîni, Gorj
26. Parcul Gurasada, Gothatea, Hunedoara
27. Phoenix Extrem Park, București
28. Vatra Parc, Nicolae Bălcescu, Vâlcea
29. Wolf Park Adventure, Zărnești, Brașov

If we take the regional division of the country as the basis, most adventure parks (12) are found in Transylvania. Muntenia follows this region with six adventure parks; three of them are in or near the country capital, Bucharest. There are 2-2 adventure parks in Banat, Moldova, Maramures, Bukovina and Oltenia, and 1-1 adventure parks in the Crisana and Dobrogea regions. It is worth to mention, that the Club Aventura Park is located in a transformed salt mine.

Climbing as the most used motor skill in forest adventure parks

Climbing takes place through the joint work of the lower and upper limbs. It is a complex form of movement that is learned at an early age (Cârstea, 2000). According to Hébert (1912, p.58) "Climbing consists in raising or moving the body using the arms or the arms and legs from a suspension or a holding position. It is one of the most useful practical exercises: climbing is important in many different situations from reaching a high place to passing an elevated obstacle to fleeing from danger vertically."

Why do children climb? According to Frost, Brown, Thornton and Sutterby (in Frost, 2013, p.8) "children climb for fun, enjoyment, challenge, the sense of danger, and to access the top for success and observation. They climb to explore, gain new perspectives, access play options, play chase, engage in make-believe play, respond to parent and peer challenges and encouragement, and to compete with peers".

We can say that climbing (we are now referring to obstacle climbing) is a complex motor activity, because during the time we want to get up or forward on the obstacle, we have to control accurately the movement of our limbs, keep focusing, keep our balance, make good decisions, sometimes to overcome our fears, to trust in our abilities, to convince ourselves to try again after a fail, etc.

Although the biomechanics of climbing types are largely the same, but depending on the surface or the (protective) equipment we use, we can name more than 20 kinds of climbs: bouldering, buildering, canyoneering, chalk and ice climbing, free climbing, indoor climbing, ladder climbing, lumberjack, mountaineering, pole climbing, traditional climbing, tree climbing, tower climbing (Wikipedia, 2019). These types of climbing influence the musculoskeletal and functional systems in different ways.

The level of motor capacity may increase from several sides due to the (obstacle) climb. At first, we would like to describe the motor abilities that are used in this activity:

- The dynamic force of the arm, leg, and muscles of the trunk.
- The activity takes place for a relatively long time (90-180 minutes), therefore, the endurance strength of the body parts can be improved.
- Occasionally, with great effort, quick movements (jumps, brachiating, pull-ups) must be carried out so the explosive strength of some body parts is also improved.
- The obstacles are almost always mobile, so the dynamic balance of the climber is continuously used.
- The parts of the obstacles are also moving, making it difficult to catch them. As a result, the spatial orientation of the climber and the eye-limb coordination also develops.
- Occasionally, you need to catch obstacles with fast movement, so the limb or movement speeds also developed.
- By climbing, we can increase the mobility of the shoulder and hip joints.
- Because we use sensitive opening-type carabineers, fine motor skills are also developed.

Obstacle climbing on obstacle courses helps the participants to learn or to prefect some motor skills such as:

- climbing (on: rope, tree, rope net, obstacle, climbing wall)
- crawling (on: abdomen, back, side)
- brachiating (on: ladder, rope)
- jumping and walking types.

Figure 2. Girl on a low obstacle doing a cross split

Benefits of (obstacle) climbing
Physical Benefits

Forest aerial ropes courses are generally considered to be fun and adventurous. Visitors are more likely to visit them for relaxation than for the health benefits of climbing activity (Deane, 2018). Because we encounter hundreds of thousands of different obstacles in an adventure park, they will use the skeletal muscles and joints of our body in different ways and intensities.

During climbing, although the upper as well as the lower limb are involved in the movement, the upper limb and trunk muscles are used more. Obstacles must be caught, pulled, held. We must keep our own weight partly or wholly in hanging or support position. The most used muscles in obstacle course climbing are biceps brachii, brachialis, triceps brachii, pectoralis major, latissimus dorsi, serratus anterior, rectus abdominis, etc. We have mentioned these muscles and body parts, but we can be sure that "but you will also use many of your body's often overlooked muscles while completing a high ropes course" (Skywalker, 2018).

Perhaps, one of the most used motor ability while climbing on obstacle courses is the balance, especially its dynamic type. The dynamic balance is our ability, which is responsible for not falling during motion and movement. The other type of balance is the static balance, which is responsible for keeping the postures without movement (Panjan & Sarabon, 2012). Both have an important role to play in everyday life, because they are alternately responsible for maintaining body balance. Obstacle climbing takes place on ropes stretched between trees or on hanging obstacles, which always move during the climb, providing a truly unstable base.

Figure 3. Climber on a mobile obstacle, which requires force

Effects on cardiovascular system

Obstacle climbing have a significant impact on the cardiovascular system, because during this activity the effort is from medium to high intensity (Watts, et al., 1999). Heart rate increases significantly during climbing, on the one hand due to the muscle work, on the other hand due to the risk factors (height of the course, unstable obstacles, fatigue). Usually, the courses are 3 to 12 meters above ground level, but you can also read about tracks at 25 meters (for example in pine Forest, in Sinaia). The heart rate is also partly dependent on how fast the climber wants to finish an obstacle or course. If someone's goal is to perform as quickly as possible, it is normal to have much higher heart rate values.

Watts et al. were the first to investigate the physiological effects of obstacle climbing on a 20-person group. They built a five-part obstacle course, 20 feet (about 6 meters) above the ground. The length of the obstacles was 30 feet each (about 10 meters). The group needed an average of 11.18 ± 2.88 minutes to finish the obstacles. The average heart rate was 142 ± 16, and the energy demand per minute was 5.12 ± 0.91 (kcal*min-1). During the effort, the oxygen demand was also measured, and its average value was 13.9 ± 2.3 (ml * kg-1 min-1). The Metabolic Equivalent of Task also has been calculated. Its average was 4, which is a medium intensity activity, however, on some obstacles a 6-7 score has reached, which is a vigorous intensity activity.

Frost (2013, p.9) states, "climbing playground equipment, trees fences, and other objects promotes strength, confidence, vestibular stimulation, perceptual-motor skills, creativity and neuromuscular development".

The various exercises involved in rock climbing can aid in the prevention of chronic illnesses, such as heart disease, high blood pressure, high blood cholesterol and diabetes (Nunan, Mahtani, Roberts, & Heneghan, 2013). The Centers for Disease Control and Prevention said rock climbing was a vigorous and intense physical activity and because of its health benefits in reducing stress, cardiovascular activity and building muscle, rock climbing can decrease the risk for various chronic illnesses (Rockreef, 2017).

Psychological benefits

Many people, who has not yet tried to climb, are afraid of starting the climbing and doubting in their own abilities. Because in the adventure parks have different levels of difficulty, climbers with weaker abilities also can succeed, thus experiencing the joy of overcoming the obstacle and the growth of self-confidence. Skywalker (2018) says that obstacle climbing is a "fantastic boost of self-esteem." They can gain self-confidence, self-esteem, self-knowledge and self-image, which can be taken with them in their daily life and can be utilized at work and in social situations. Willig asked rock climbers and concluded that the climbers "experience a state of being similar to individuals who meditate" (as cited in Steinberg, 2011, p.74). Steinberg studied novice and experienced rock climbers in his 2011 study and found "that mindfulness and psychological well-being are correlated with the activity of rock climbing (p.75)."

Climbers must overcome their various fears. There are those who are afraid of the height, in this case the safety equipment is of great help, which allows the wearer to climb to any height without any risk. This equipment can provide security for the fearful wearer. Fear of failure can be overcome by the fact that the climber can move forward on the courses starting with the simplest obstacles, gaining a sense of success, so the climber can start boldly harder courses.

Benefits of climbing for toddlers

By 18 months, a normally developed toddler could climb a chair, and by two years old, he may be able to climb on to furniture to look out of a window. These types of physical challenges can help the toddlers to grow in body and mind. Climbing develops their coordination, besides muscle and bone strength (BabyCenter, 2013).

According to Wentworth (2018), there are many benefits for young children from climbing, which they put together in five points:

(a) Through climbing toddlers develop their dexterity, which can be transferred into the classroom and used when they will learn to hold a pen or a pencil while handwriting.

(b) By practice, toddlers will learn to face their fears regarding climbing, harder obstacles and altitude. A climbing confidence will be achieved by taking on new climbing challenges in the subsequent days.

(c) Their upper body strength will improve with regular activities.

(d) Also, their problem-solving skills will develop, because a critical thinking mode should be used in climbing, decisions with consequences are made.

(e) There is a risk in climbing activities, because climbing is risky. Beginners frequently fall a few times before reaching their goal. Children can injury themselves, can fracture their bones. The good news is, that they can become experts by practice, and a child with experience can "manage and assess risk which is an important life skill to learn from young age" (Wentworth, 2018).

If sufficient playtime is provided "for children to develop their natural intuition for protecting themselves in increasingly risky play" (Frost, 2013, p. 11). They can learn to protect themselves during fall like an athlete who practicing wrestling, gymnastics or parkour.

Climbing a wall, a tree or an obstacle requires focus and concentration. If children want to progress, they need to pay attention for every single part of their climbing activity. After the initiation phase, they work together one with others, and "they are responsible for someone else's life" (HighSports, 2016).

The various exercises involved in rock climbing can aid in the prevention of chronic illnesses, such as heart disease, high blood pressure, high blood cholesterol and diabetes (Nunan, Mahtani, Roberts, & Heneghan, 2013). The Centers for Disease Control and Prevention said rock climbing was a vigorous and intense physical activity and because of its health benefits in reducing stress, cardiovascular activity and building muscle, rock climbing can decrease the risk for various chronic illnesses (Rockreef, 2017).

Conclusions

As we have seen, about 30 adventure parks have been built and are operated in Romania in the past 13 years. A significant part of these parks was established near metropolitan agglomerations. Their disposition is not uniform, most of them are located in Transylvania and especially in the vicinity of big cities like Cluj-Napoca, Braşov, Sibiu.

Climbing can greatly contribute to improve motor capacity, because obstacle climbing develops up to 7-8 subspecies of motor abilities (especially strength, endurance and joint mobility) during a two-hour climbing session. The most practiced motor skills are the different types of climbing, but in some situations, the climber needs to crawl, to brachiate or to jump from obstacles.

In the past 2-3 decades, adventure parks and climbing activities have attracted the attention of researchers, leading to studies, which assessed the physical, psychological and social effects of obstacle climbing.

Climbing can produce beneficial functional effects on human body. We believe that the caused beneficial mental effects are at least as important as the physical ones. They can help us overcome our fears, give us self-confidence, give us a sense of success, stress relieving, help improve your self-awareness, and help to build a proper self-image.

Climbing can begin at a very young age (2-3 years) and can be practiced until old age. By now, there are many varieties of climbing and a great advantage is that everybody can find the right difficulty for themselves.

Conflict of interest

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THE PROMINENCE OF THE PEAKS FROM RODNEI MOUNTAINS (ROMANIA) WITH RELEVANCE FOR MOUNTAINEERING. METHODOLOGICAL AND PRACTICAL ASPECTS

BÎCA IOAN[1]

ABSTRACT. In recent years, mountain leisure activities in Romania recorded spectacular growth, due to several factors, such as: technical progress in the field of mountain equipment, increased leisure and circulation of information on the internet or in the media. If in the past, mountain tourism activities belonging, to a certain extent, of niche tourism, today they fall into mass tourism and one of the criteria that attract the mountaineers to mountain areas is altitude and prominence of the peaks. The higher the altitude, the more attractive and competitive the respectively peak. The prominence is a parameter that refers to the gap between top and base of the peak, marked by neighboring saddles called key-saddles or key-col. According UIAA, minimal prominence for a mountain/hill structure to be considered peak with relevance for sports activities is 30 m (a rope length). Between altitude and prominence of the peak is not necessarily a relation, therefore, often, more important is the last one, who actually, identifying the peak. Therefore, in this study it approached Rodnei Mountains area, which was manually calculated the prominence of the peaks from main ridge, in order to underline the importance of this sector for various leisure activities.

Key words: *mountain tourism, mountain leisure, mountaineering, key-saddle, base level, independent peak, parent peak, orometric dominance*

REZUMAT. ***Proeminența vârfurilor din Munții Rodnei, cu relevanță pentru muntenărie. Aspecte metodologice și practice.*** În ultimii ani, agrementul montan din România a înregistrat creșteri spectaculoase datorită mai multor factori, cum ar fi: progresul tehnic din domeniul echipamentului montan, creșterea veniturilor, creșterea timpului liber și circulația informației pe internet sau în mass media. Dacă în trecut, activitățile turistice montane aparțineau,

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într-o anumită măsură, turismului de nișă, astăzi acestea se încadrează în turismul de masă, iar unul dintre criteriile care atrag muntenarii spre arealele montane este altitudinea şi proeminenţa vârfurilor. Cu cât este mai mare altitudinea, cu atât este mai atractiv şi mai competitiv vârful respectiv. Proeminenţa este un parametru care se referă la diferenţa de nivel dintre creştetul vârfului şi baza sa, marcată de înşeuările limitrofe, numite înşeuări-cheie. Conform UIAA, proeminenţa minimă, pentru ca o structură montană să fie considerată vârf cu relevanţă pentru activităţi sportive este 30 m (o lungime de coardă). Între altitudinea şi proeminenţa vârfului nu este, neapărat, o legătură, de aceea, de multe ori, este mai importantă aceasta din urmă, care individualizează, de fapt, vârful. Prin urmare, în studiul de faţă s-a abordat arealul Munţilor Rodnei, pentru care s-a calculat manual proeminenţa vârfurilor de pe culmea principală, cu scopul de a sublinia importanţa acestui sector pentru diferitele activităţi agrementale.

Cuvinte cheie: *turism montan, agrement montan, înşeuare-cheie, nivel de bază, vârf independent, vârf părinte, dominanţă orometrică*

Introduction

In recent years, mountain tourism and leisure of Romania boomed due to several factors, such as:

-technical progress registered in the field of mountain equipment (shoes, clothes, accessories) and easy access to the equipment through classic stores (Decathlon, Nootka Alpin Expe, Mormota Land, Atta, Himalayas, Maia Outdoors, Maramont Edelweiss Outdoor Shop Montrek, etc.) and their online versions;

-founding of several mountain travel agencies, such as: Altitude Expedition Team, Extreme Travel, Experts Summits, Extreme Expedition etc.

-access to information via Internet (social networks, blogs, vlogs, articles, advertisements, videos);

-free movement of tourists within the European area;

-easy access to mountainous areas (roads, transport);

-increasing leisure.

Therefore, mountaineering, previously considered niche tourism, became a mass phenomenon, which tends to move in the recreational area in the sports performance by moving the center of interest for climbing high peaks of the Carpathians (over 2,000 m). These peaks are characterized by certain parameters, such as: elevation (altitude above sea level), the shape (sharp, rounded, angled, pyramid) and the prominence.

The prominence is the difference in height between the top and base of the peak, expressed through a low area, adjacent, called key-saddle or key cool. This parameter, called height/autonomous altitude, correlates with the relative altitude and resulting in deep erosion exerted by external agents.

Concerns about establishing minimum prominence began in the UK, while trying to identify geomorphological structures according to the "mountain" in England, Wales and Ireland.

Thus, in 1891, Sir Hugh Munro considered that a mountain have a height of at least 900 m (914 m), and a prominence of at least 55 m and is sufficiently isolated from other mountains. In 1920, John Rooke Corbett incorporate in mountains list the geomorphologic units with altitude of 762 -914 m, and 150 m minimum prominence.

In 1935, Percy Donald believes that mountain units are between 610-833 m and minimum prominence is 30.5 m. John and Anne Nuttall in the guide "The Mountains of England and Wales" (1989, 1990) believes that the prominence must go 15 meters and height of the mountains from 610 m. In 1992, Fiona Graham published a list where mountain peaks are between 610-762 m, with the prominence of at least 150 m, and Alan Dawson, in "The Relative Hills of Britain" (1992), prepare the Marilyns list, considering the prominence as at least 150 m on all sides of the mountain.

Richard Goedeke (1991) decides to use to define the minimum prominence of a peak, with relevance for mountaineering, a classical length of a climbing rope, 30 m. In 1994 the UIAA take this condition and sets the minimum value of the prominence for a peak to be considered independent, 30 m (length of a climbing rope).

In 1995, Michael Dewey publishes "Mountain Tables: Tables of the mountain and hill summits of England and Wales", which the mountains units are between 500-610 m, and the minimum prominence of at least 30 m. In 1997, Alan Dawson publishes the Hewitt list, which includes mountain peaks between 610-1085 m and minimum prominence is 30 m.

In the US, the minimum value of the prominence, for a geomorphological structure to be considered independent peak, is 91 m, and the prominence of 600 m defines peaks with important status.

Independent peaks or parent peaks are the peaks with high prominence and the peaks of their vicinity is considered sub-peaks (fig. 1). Another parameter that is used for mountain climbing hierarchy is orometrical dominance, defined as the difference between the mountain elevation and the prominence (P / Alt * 100). This indicates the percentage dominance of a mountain peak within a mountain system.

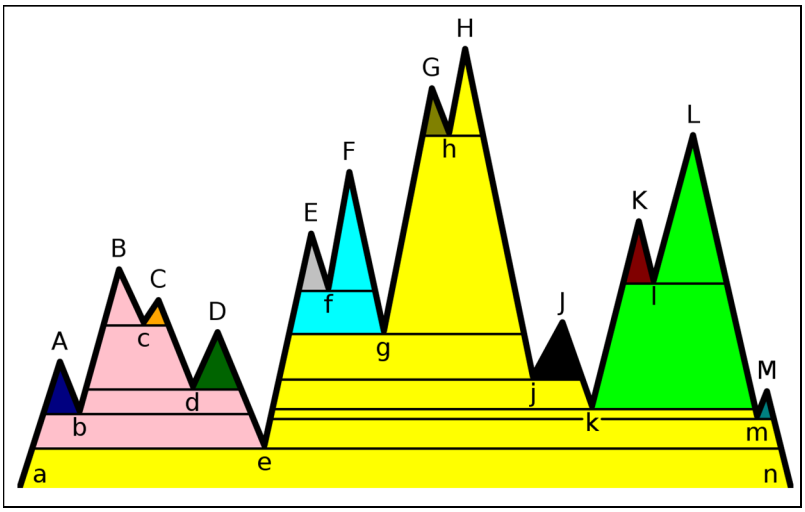

Fig. 1. The prominence principle. H=parent peak; B, F, G, J, L, M=sub-peaks of Rank I; A, C, D, E, K=sub-peaks of Rank II-III. a-n=key saddles
(Source: https://en.wikipedia.org/wiki/Topographic_prominence)

Besides technical importance, orometric prominence have a psychological relevance on performance, because the peaks with great prominence are valuable competitive. Therefore, to reconsider the status of peaks and there are new challenges to their climbing, such an example being Bloomers Challenge UK, comprising peaks with minimum prominence of 500 m.

Given these considerations, the present study aims to determine the prominence of the representative peaks of the main ridge of Rodnei Mountains, in order to highlight their value and competitiveness for tourism.

Study area

Rodnei Mountains are located in the northern group of the Eastern Carpathians, between Dragoș Vodă fault in the north, Prislop, Bistrița Aurie Valley, Rotunda Valley and Rotunda Pass to northeast, Someșul Mare Valley on the east and southeast, Rodnei fault to south, Sălăuța Valley, Șetref Pass and Carelor Valley to the west (fig. 2). The analyzed peaks are located on the main ridge, which runs sinuous between Șetref Pass (826 m) and Rotunda Pass (1277 m), showing a branching northward along the lines Rebra-Buhaescu Mare-Pietrosul Mare (fig. 3).

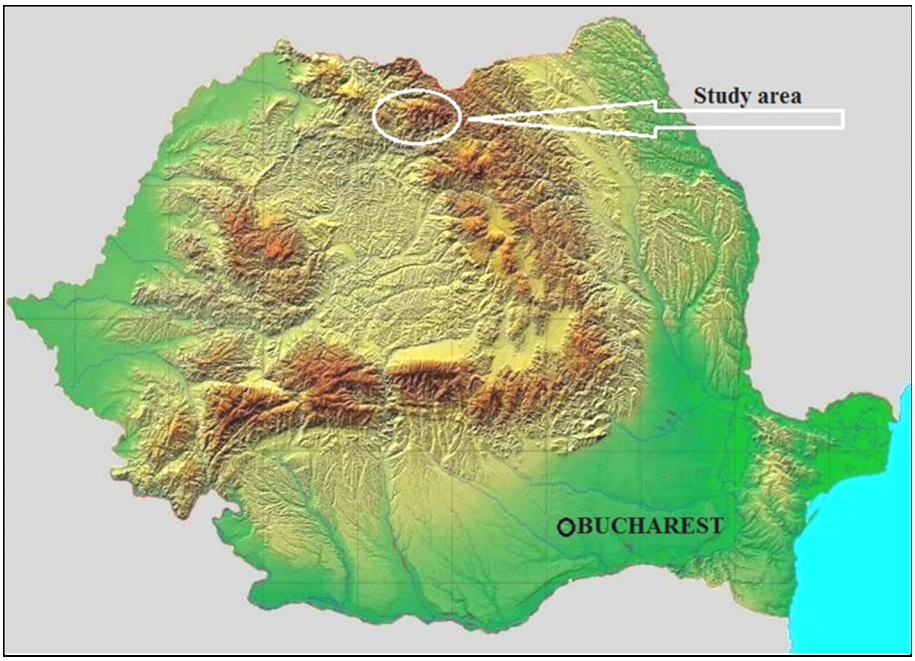

Fig. 2. The geographical position of Rodnei Mountains in Carpathians Chain

Fig. 3. The main ridge of Rodnei Mountains
(Source: mapmyhike.com, with changes)

From the geological and geo-morphological point of view, these peaks are shaped by erosion, are composed of hard rock (metamorphic rocks), resulting from the process of carving the upper (1800-2200 m), medium (1600-1800 m), and lower leveling surfaces (1100-1300 m) of Rodnei Mountains (Sîrcu, 1978; Geography of Romania, vol. I, 1983).

Materials and methods

To achieve this study we used several materials such as:

-online topographic map 1:25 000 scale, provided by the Department of Military Topography, on which we calculated manually the prominence of the main peaks;

-geological map scale 1: 200 000 (1968);

-Rodnei Mountains tourist map 1:55000 scale (2014);

-the photos taken in during the field trip;

-studies about the landforms of Carpathians and Rodnei Mountains (Sîrcu, 1978; Geography of Romania, 1983, 1987; Trif, 2014);

-studies about topographic prominence of peaks relevant to mountaineering and mountain sports (climbing, rock climbing, hiking, extreme skiing, ski touring) (Munro, 1891; Donald, 1935; Nuttall, Nuttall, 1989, 1990; Goedeke, 1991; Dawson, 1992; Graham, Fiona, Torbet, 1992; Höhne, 1993; Dewey, 1995; Dawson, 1997; Munro, Bearhop, 1997; Grimm, Mattmüller, 2004; Goedeke, 2006);

-works about the calculation of orometric prominence and dominance (Helman, 2005; Schmidt, 2018; Stubbemann et al., 2019);

-different web pages related to prominence, such as:

-http://www.peaklist.org/lists.html;

-https://explorersweb.com/2018/02/23/prominence-or-dominance-what-makes-a-mountain;

-https://www.8000ers.com/cms/en/dominance-mainmenu-178.html;

-https://routes.tips/blog/on_terminology_elevation_vs_altitude_vs_prominence;

-http://www.cohp.org/prominence/publication_2005_illustrations/Chapter_2/index.html;

-http://www.cohp.org/prominence;

-https://peakvisor.com/panorama.html?lat;

There were chosen the peaks of the main ridge of Rodnei Mountains (table 1), which, based on topographic maps, were manually calculated the prominence. Methodological steps were as follows:

a) drawing a geomorphological profile on the main ridge, by using the topographic surface of the site mapmyhike.com, outlining the sequence of peaks and saddles (fig. 4);

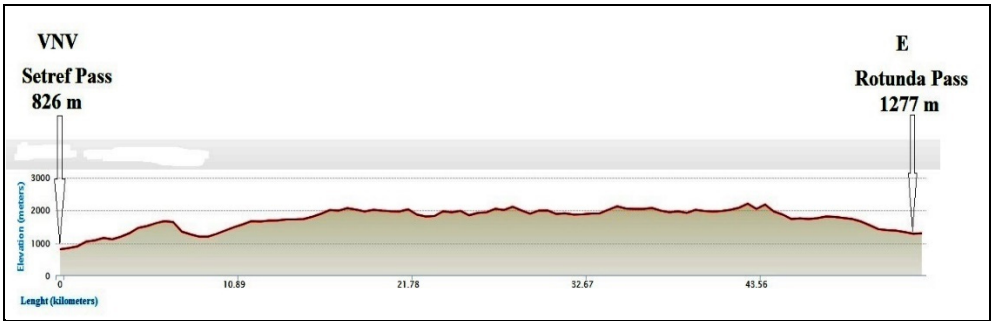

Fig. 4. The Geomorphological profile of the main ridge of Rodnei Mountains (Source: mapmyhike.com with changes)

b) schematic drawing of two sections, one for the Șetref Pass-Pietrosul Mare peak (fig. 5), and one for the main summit between Șetref Pass and Rotunda Pass (fig. 6) to observe the sequence of peaks and saddles; based on these schematic profiles, it was established the rank of the peaks, the relations of subordination between them, and key saddles for each peak; the lower ends of the ridge is Șetref Pass saddle (826 m) to the west, and Rotunda Pass saddle (1277 m) to the east, to which it relates Pietrosul Mare peak (2303 m), and Ineu peak (2279 m); inside the ridge there are numerous saddles that define peaks, and acts as key saddles;

c) manually calculating of the prominences based on online topographic maps 1: 25,000 of https://portal.geomil.ro/arcgis/home/webmap/viewer.html; the prominence of parent peak Pietrosul Mare was calculated by related it to Setref Pass (826 m), and the prominence of subpeak of rank I Ineu was calculated related to Rotunda Pass (1277 m); the prominences of the other subpeaks of rank I was calculated by comparing them to the deepest saddles of the ridge, and the prominences of the subpeaks of rank II-III were calculated by comparing them to subpeaks of rank I and to neighboring key saddles that genetic connecting these peaks, because the lower rank peaks gravitate towards higher peaks rank; 4 peaks were determined by rank I, to which revolve peaks of II and III ranks, in the 4 groups (Rebra, Puzdrele, Gărgălău and Ineu) (fig. 6);

e) noting the resulting data in the table (table 1) and determining the status of the analyzed structures: peaks or summits; adopting UIAA rules, the structures which prominence over 30 m are considered peaks, and those below this value have the status of summits.

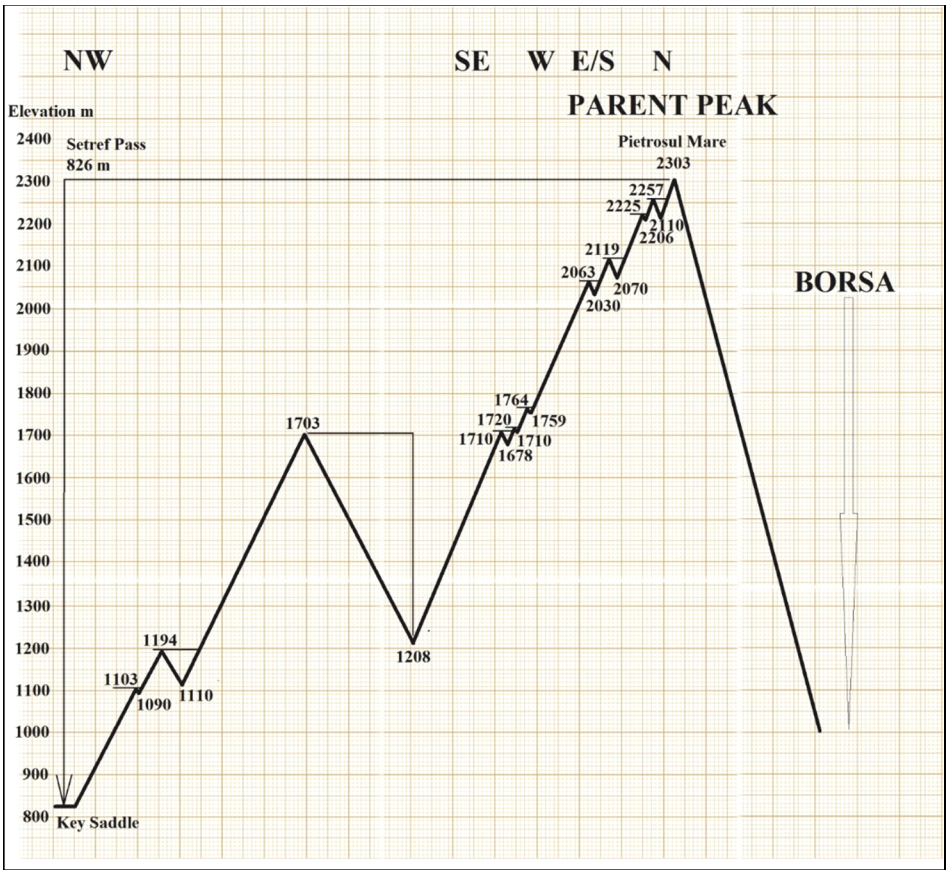

Fig. 5. Graphic of Şetref Pass-Pietrosul Mare sector illustrating the peaks and the key-saddles
(Source: https://portal.geomil.ro/arcgis/home/webmap/viewer.html)

Results and discussions

a) The peak issue

According to Online Romanian Dictionary (DEXLR), the peak is the uppermost (sharp) of tall objects (houses, trees, etc.) or of certain landforms (hill, mountain). After Oxford Advanced Learner's Dictionary, the peak is the most sharp part of a mountain, while the highest part is called summit. UIAA believes that the peak must have a prominence at least 30 m (length of climbing rope) and the height of the mountain must have a prominence of less than 300 m.

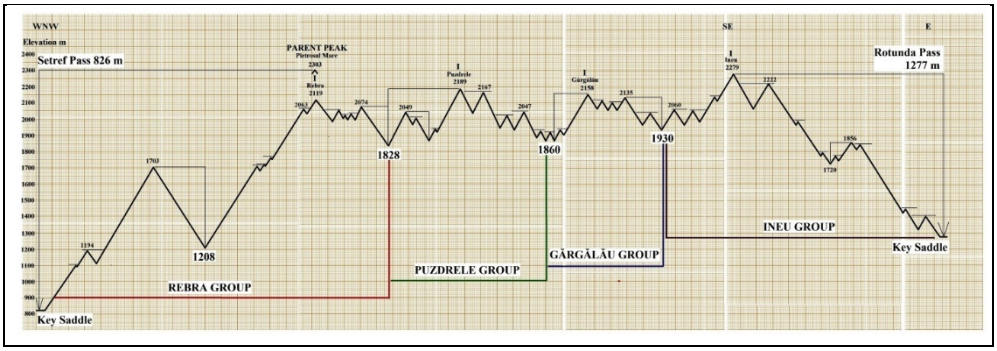

Fig. 6. Graphic of Șetref Pass-Rotunda Pass sector illustrating the rank of the peaks, the subordonation of the peaks and the key-saddles
(Source: https://portal.geomil.ro/arcgis/home/webmap/viewer.html)

Mountains and hills are distinguished, in terms of morphometric, by area, length, width, vertically extending or elevation. Vertically extending presents a high point, which is the uppermost part, called peak.

The peak is not an independent structure, but is attached to a mountain or hill, represents the highest and most obvious part of it, or the upper end thereof. It is characterized by the following features:

a) morphographic elements: base, shape, flanks, and the top (the top end, the top side); the top can be sharp, rounded, beveled or uneven / irregular;

b) morphometric elements: elevation, slopes and prominence.

The prominence is the gap between top and base of the peak. The same base is the lowest in the surrounding areas (saddles, col). The peaks of mountains are carved by erosional processes (fluvial, glacial, periglacial) that detached it from the original surface of the respectively mountain and are located at the intersection of slopes and ridges. These erosional processes operate differently, depending on the structural lines, the hardness of the rock, and the surrounding basal levels, resulting in fragmentation of the withdrawal and slopes that intersect at the point represented by the peak.

At the volcanic mountains, the peak is located in the highest part of the cone or caldera (ex. Elbrus, Damavand, Ararat, Pico Orizaba, Pietrosul Călimanilor etc.). In the folded mountains, the peak can be located at the intersection of two slopes on a residual ridge (Shishapangma Hillary Peak, Negoiu, Vânătarea lui Buteanu, Mytikas etc.) or at the intersection of at least three slopes (ex. Everest, K2, Lhotse, Annapurna, Mont Blanc, Doufurspitze, Liksamm etc.).

UIAA proposed three criteria for determining the relevance of peaks for climbing or mountaineering:

1) topographical criteria: any height at least 30 m (length of a climbing rope) level difference towards neighboring saddles can be considered peak;

2) morphological criteria: to be considered a peak, a height must have a certain shape (conical, pyramidal);

3) leisure criteria: the peak must provide access routes, cultural and historical connotations, flows of visitors.

b) The analysis of prominence of major peaks from Rodnei Mountains main ridge

The topographic map analysis established on the main ridge of Rodnei Mountains a total of 39 peaks, presenting relevant morphological characteristics for the present study (elevation, shape, microrelief) (fig.7).

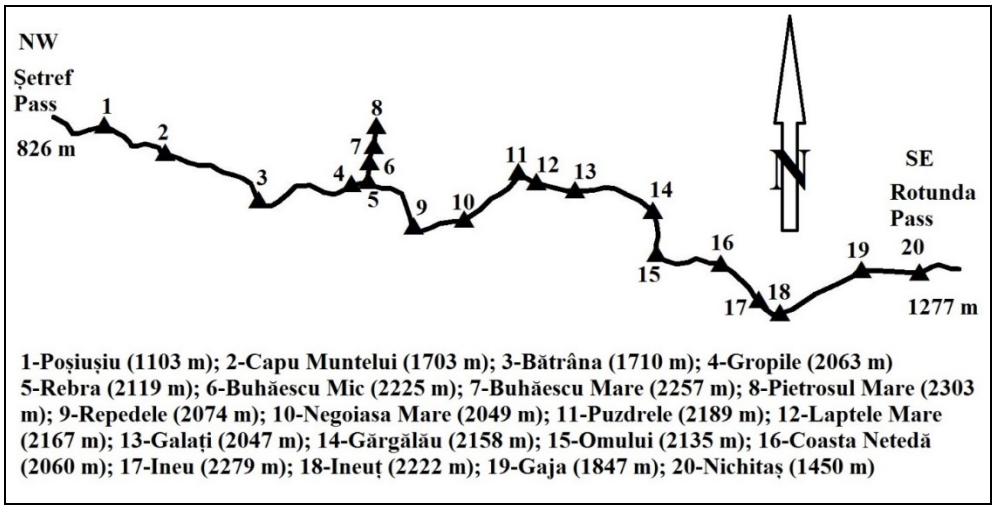

Fig. 7. The most important peaks from Main Ridge of Rodnei Mountains (Source: Online Topographic Map of Romania 1:25000 from https://portal.geomil.ro/arcgis/home/webmap/viewer.html)

After manual calculating of prominence, following data were obtained (table 1):

Table 1. The prominence and the status of peaks from main ridge of Rodnei Mountains

Crt. no.	The peak	Elevation (m)	Prominence (m)	Key saddle (m)	Status
1	Poşiuşiu	1103	13	1090	Summit
2	Făget	1194	84	1110	Peak
3	Capul Muntelui	1703	495	1208	Peak
4	Bătrâna 1	1710	32	1678	Peak
5	Bătrâna 2	1720	10	1710	Summit
6	Bătrâna 3	1764	5	1759	Summit
7	Gropile	2063	33	2030	Peak
8	Rebra	2119	49	2070	Peak
9	Buhăescu Mic	2225	19	2206	Summit
10	Buhăescu Mare	2256	146	2110	Peak
11	Pietrosul Mare	2303	1477	826	Parent peak
12	Obârşia Rebrei	2054	73	1981	Peak
13	La Cătâni	2025	23	2002	Summit
14	Cormaia	2033	43	1990	Peak
15	Repedele	2074	246	1828	Peak
16	Negoiasa Mare	2049	184	1865	Peak
17	Negoiasa Mică	2010	45	1965	Peak
18	Bârsan	1939	19	1920	Summit
19	Puzdrele 1	2167	17	2150	Summit
20	Puzdrele 2	2189	361	1828	Peak
21	Laptele Mare	2167	132	2035	Peak
18	Negoiescu	1972	32	1940	Peak
19	Galaţi	2047	117	1930	Peak
20	Cimpoiaşu	1930	50	1880	Peak
21	Piatra Rea	1922	62	1860	Peak
22	Izvorul Cailor	1945	45	1900	Peak
23	Gărgălău	2158	298	1860	Peak
24	Claia	2117	57	2060	Peak
25	Cepelor	2102	52	2050	Peak
26	Omului	2135	205	1930	Peak
27	Cişa	2039	79	1960	Peak
28	Coasta Netedă	2060	100	1960	Peak
29	Tomnatic	2051	71	1980	Peak
30	Bila	2140	30	2110	Peak
31	Ineu	2279	1002	1277	Peak
32	Ineuţ	2222	162	2060	Peak
33	Pietros	1977	17	1960	Summit
34	Curmătura Gajei 1	1798	28	1770	Summit
35	Curmătura Gajei 2	1771	31	1740	Peak
36	Dosu Gaja	1856	136	1720	Peak
37	Gaja	1847	37	1810	Peak
38	Nichitaş	1450	20	1430	Summit
39	Rotundu	1405	35	1370	Peak

Depending on the prominence, can be separated following peaks categories:

a) very high prominence peaks: over 1000 m (Pietrosu Mare, Ineu);
-these are iconic peaks, coveted by mountaineers;
-they have a rough configuration (steep flanks, glacial cirques, chimneys, ridges);

b) peaks with the largest prominence: between 200-400 m (Gărgălău, Omului, Puzdrele, Capu Muntelui);
-these are coveted by mountaineers;
-provides panoramic view;
-they have a slightly uneven configuration (rock formations on the sides, scree slopes, chimneys);

c) peaks with medium prominence: 100-200 m;
-some are coveted by the mountaineers (Coasta Netedă, Galaţi, Laptele Mare, Buhăescu Mare, Ineuţ, Negoiasa Mare);
-they have conical shape and slightly uneven configuration (rocky slopes, chimneys, ridges);

d) peaks with low prominence: 30-100 m;
-they are not very coveted by mountaineers, possibly for scenic view;
-they have beveled configuration (Obârşia Rebri, Cormaia, Negoiasa Mică, Cişa), conical and sharp configuration (Rebra, Claia), narrow and elongated configuration (Tomnatic, Bila), or rocky configuration (Gropile, Cepele);

e) summits: prominence under 30 m (Poşiuşiu, Bătrâna 2 and 3, Buhăescu Mic, La Cățâni, Bârsan, Puzdrele 1, Pietros, Curmătura 1, Nichitaş).

Based on prominence and elevation, it was established the orometric dominance of each peak. This parameter was introduced in 2004 by Peter Grimm and Claus Roderich Mattmüller, and shows the percentage of independence of a peak, regardless of altitude and prominence. It is calculated as P / Alt x 100 (table 2).

Depending on the orometric dominance, established following peaks categories:

-supreme peaks: OD = 43.96-64.13 (Pietrosul Mare, Ineu);
-dominant peaks: OD = 11.86-29.06 (Capu Muntelui, Repedele, Gărgălău, Puzdrele);
-major peaks: OD = 5.71-9.60 (Galaţi, Laptele Mare, Buhăescu Mare, Făget, Ineuţ, Dosu Gaja, Negoiasa Mare, Omului);
-regular peaks: OD = 1.40-4.85.

Table 2. The orometric dominance of the peaks from main ridge of Rodnei Mountains

Crt. no.	Peak	Elevation (m)	Prominence (m)	Dominance (m)
1	Făget	1194	84	7,03
2	Capul Muntelui	1703	495	29,06
3	Bătrâna 1	1710	32	1,87
4	Gropile	2063	33	1,59
5	Rebra	2119	49	2,31
6	Buhăescu Mare	2256	146	6,47
7	Pietrosul Mare	2303	1477	64,13
8	Obârşia Rebrei	2054	73	3,55
9	Cormaia	2033	43	2,11
10	Repedele	2074	246	11,86
11	Negoiasa Mare	2049	184	8,97
12	Negoiasa Mică	2010	45	2,23
13	Puzdrele	2189	361	16,49
14	Laptele Mare	2167	132	6,09
15	Negoiescu	1972	32	1,62
16	Galaţi	2047	117	5,71
17	Cimpoiaşu	1930	50	2,59
18	Piatra Rea	1922	62	3,22
19	Izvorul Cailor	1945	45	2,31
20	Gărgălău	2158	298	13,80
21	Claia	2117	57	2,69
22	Cepelor	2102	52	2,47
23	Omului	2135	205	9,60
24	Cişa	2039	79	3,87
25	Coasta Netedă	2060	100	4,85
26	Tomnatic	2051	71	3,46
27	Bila	2140	30	1,40
28	Ineu	2279	1002	43,96
29	Ineuţ	2222	162	7,29
30	Curmătura Gajei 2	1771	31	1,75
31	Dosu Gaja	1856	136	7,32
32	Gaja	1847	37	2,00
33	Rotundu	1405	35	2,49

c) Tourist relevance of orometric prominence

Following the manual calculation of the prominence, on the main ridge of Rodnei Mountains have revealed some geomorphological structures with peaks status (P=over 30 meters) and summit status (P = less than 30 m) (fig. 8).

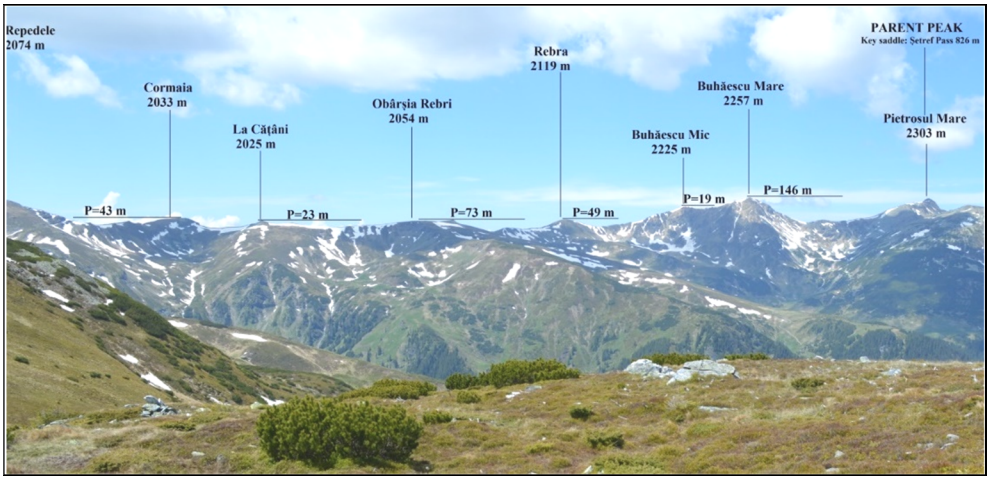

Fig. 7. The Main Ridge of Rodnei Mountains. Repedele-Pietrosul Mare sector showing elevation and prominence of the peaks

Peaks have competitive value for mountaineers, and by altitude, prominence, shape and microrelief are attractions for practicing hiking, scrambling, ecotourism, mountain biking, running and ski touring (table 3).

Table 3. The number of tourists and visitors in Rodnei Mountains National Park (2019)

Tourist season	Days number/year	Average number of tourists/day	Total tourists/season
Full season (July-August)	60	300	18000
Transition season (May-June, September-October)	120	70	8400
Extra-season (November-April)	185	10	1850
Total number of tourists/year	365	380	28250

Source: Rodnei Mountains National Park Office

Based on these aspects and according to mountaineering flows, on the main ridge of Rodnei Mountains stand out following peaks of major interest:

1) Pietrosul Mare (2303m):
   -access from Borşa (80%);
   -access from other directions (20%);
2) Ineu (2279 m):
   -access by Lala Valley (30%);
   -access from Alpina Blazna Resort (40%);
   -access from Rotunda Pass (20%);
   -access from other directions (10%);
3) Gărgălău (2158 m):
   -access from Borşa (40%);
   -access from Prislop Pass (30%);
   -access from other directions (30%).

Conclusions

After the calculations made during this study, on the main ridge of Rodnei Mountains, there are two categories of geomorphological structures: peaks (P = over 30 meters) and summits (P = less than 30 m). The peaks are attractions for hiking enthusiasts, and those showing high prominence are highly competitive, and are escalated for performance, because during this sport activity there are many physical and technical demands.

From methodological perspective, this study sets out the steps leading to the process of manual calculation of the peaks prominence, such as: analysis of topographic map, creating a geomorphological profile, and the diagram/graphic to bring out the peaks in a particular sector, the setting of the rank of the peaks, the subordination relations between the peaks, and the key saddles.

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