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CONTENTS

THE RELATIONSHIP BETWEEN ANTHROPOLOGICAL CHARACTERISTICS OF KINESIOLOGY STUDENTS AND SWIMMING SPEED

Original Scientific Paper

Damira Vranešić Hadžimehmedović, Slobodan Klačar, Damir Đedović, Almir Popo, Marko Đurović

ABSTRACT: The aim of this research was to examine whether there is a statistically significant relationship between anthropological characteristics and swimming speed short distance in kinesiology students. The study included 16 participants 22 years old, male and female that attended swimming class in the third semester at the Faculty of Kinesiology University of Sarajevo. The study was applied to 6 measuring instruments: measuring instruments for the assessment of anthropological characteristics (5) and measuring instrument for the assessments of swimming speed (1). Spearman's correlation coefficient was used to determine the level of interconnection for assessing the relationship between two variables. Data collection for anthropological characteristics was conducted using an anthropometric meter and caliper, while swimming speed was measured with a digital stopwatch. The analysis of the results demonstrate significant correlations were found among limb lengths and some skinfold measures, there is no evident relationship between these anthropometric characteristics and swimming speed over 25 meters in this sample. These results imply that other factors, perhaps strength, technique, or conditioning, may play a more substantial role in swimming performance.

Keywords: *shoulder anthropological characteristics, correlation, swimming speed, kinesiology students*

INTRODUCTION

Pure sport swimming is characterized as an individual, cyclical, continuous, closed, and mixed activity that depends on genetic, contextual, psychological (Fernandes, Aleixo, Soares and Vilas – Boas, 2008). Swimming performance can also be affected by the variability of body composition (Charmas and Gromisz, 2019) and anthropometric characteristics (i.e. weight, body mass index, height, and wingspan) (Morais et al., 2012; Zuniga et al., 2011). It is also evident that body size will influence propulsion. More specifically, hand size and arm length for the arm strokes, and foot size and leg length for the kicking actions seems to influence the propulsive actions of humans (Kjendlie and Stallman, 2011). None of the anthropometrical parameters were correlated with swimming speed and only arm length, leg length, and axilla cross sectional area were negatively correlated to stroke rate (Zamparo, Antonutto, Capelli, Francescato, Girardis, Sangoi, Soule, Pendergast, 1996). Swimming speed can be affected by several factors one of the factors is the flexibility of the shoulders (Astawa at al., 2023). Success in swimming is determined by several factors: anthropological, functional, and metabolic characteristics, efficient biomechanical execution of movements in water, conative and cognitive characteristics, and a legitimate plan and program that respects the laws of growth and development (Šiljeg, Zoretić, Leko, 2009). The swimming implies the ability to maintain the body in water and ability to move through the water with the proper movement of arms, legs and body (Madić et al., 2007). Several studies have found swimmers to be taller and larger than same aged non-athletes, gymnasts, soccer players or tennis players (Avloniton et al., 1997, Boulgakova, 1990, Brauer et al., 2007, Damsgaard et al., 2000, Erlandson et al., 2008). Sprinters should have a taller stature than middle and long distance swimmers, due to their need for higher hull speeds (Kjendlie and Stallman, 2011). A taller swimmer will create less wave resistance at the same speed, and the tall swimmer will have a greater potential for maximal velocity due to a higher hull speed (Kjendlie and Stallman, 2011).

It is also generally agreed that sprint free stylers are taller, heavier and more muscular than middle and long distance free stylers and than other stroke specialists. Also, in all strokes and distances (except 800-1500 meter races), the very best are taller and heavier than the next best (Kjendlie and Stallman, 2011). Performance seems to be influenced by size, as shown by studies on children, elite swimmers and master swimmers. A bigger, taller or more muscular swimmer swims faster (Kjendlie and Stallman, 2011).

METHODS

Participants

The study included students with an average body weight 77,7 ±16,42 kg and 179 ±9 cm, male (N=11) and female (N=6), in the third semester at the Faculty of Kinesiology University of Sarajevo (N=16) 22 years old that attended swimming class in the third semester.

Instruments

The study was applied to 6 measuring instruments: measuring instruments for the assessment of anthropological characteristics (5) and measuring instrument for the assessments of swimming speed (1). Data collection for anthropological characteristics

was conducted using an anthropometric meter and caliper, while swimming speed was measured with a digital stopwatch.

Statistical analysis

The data analysis tehnique used in this research is descriptive statistics analysis and the Pearson's analysis. Descriptive statistical measures, including the mean (M) and standard deviation (SD). The mean reflects the average outcomes, while the standard deviation reveals the extent of deviation from the mean, emphasizing the level of variability among participants. The Pearson's analysis of the research results was applied to determine the correlation between certain variables included in the study. This statistical test is used to measure the strength and direction of a linear relationship between two continuous variables, with a correlation coefficient (r) that can range from -1 to +1. A value of +1 indicates a perfect positive correlation, -1 a perfect negative correlation, while a value close to 0 indicates a weak or non-existent relationship between the variables.

RESULTS

Table 1. Descriptive Statistical Analysis

VARIABLES	MEAN	STD. DEV.	N
ARM LENGTH	80.019	6.1844	16
LEG LENGTH	94.781	8.8656	16
SUBSCAPULAR SKINFOLD	15.219	9.3808	16
SUPRAILIAC SKINFOLD	5.250	2.7689	16
TRICEPS SKINFOLD	14.781	7.4004	16
SWIMMING SPEED 25M	20.9994	3.67254	16

The Table 1. Descriptive Statistical Analysis presents descriptive statistics for various anthropometric measurements and swimming speed, highlighting mean values, standard deviations, and sample sizes (N=16) for each variable. The mean arm length of participants is 80.019 cm with a standard deviation of 6.1844 cm, while the mean leg length is 94.781 cm with a higher variability, as indicated by a standard deviation of 8.8656 cm. These measures reflect general limb dimensions in this sample, with leg lengths showing slightly greater variability. Skinfold thickness, which estimates subcutaneous fat distribution, was assessed at three sites: the subscapular, suprailiac, and triceps regions. The mean subscapular skinfold measurement is 15.219 mm (SD = 9.3808), indicating the highest variability in fat thickness. The suprailiac skinfold has the lowest mean (5.250 mm, SD = 2.7689), suggesting less fat accumulation at this site. The triceps skinfold shows an intermediate value with a mean of 14.781 mm and a standard deviation of 7.4004 mm. The mean swimming speed over 25 meters is 20.9994 seconds with a standard deviation of 3.67254 seconds. This body fat distribution are not strongly associated with performance in short-distance swimming.measure indicates the average swimming performance among participants, with moderate variability, likely due to differences in training, strength, or technique within the sample. Overall, the table provides a snapshot of participants' physical characteristics and performance metrics, essential for exploring how morphological traits might correlate with swimming speed in subsequent analyses. The variability within skinfold and limb measurements could be particularly relevant in assessing their influence on swimming performance. The table presents the Pearson correlation coefficients among six variables: arm length, leg length, subscapular skinfold, suprailiac skinfold, triceps skinfold, and swimming speed over 25 meters. These correlations highlight potential relationships, with significance indicated by asterisks. A significant positive correlation ($r=0.629$; $p<0.01$; $r = 0.629$; $p < 0.01$; $r=0.629$, $p<0.01$) exists between arm length and leg length, suggesting that individuals with longer arms also tend to have longer legs. This is a common anthropometric relationship, as limb lengths often correlate with overall body size. There is a moderate, significant positive correlation between the subscapular and suprailiac skinfolds ($r=0.564$, $p<0.05$; $r = 0.564$; $p < 0.05$; $r=0.564$; $p<0.05$), indicating that individuals with greater fat in one area also tend to have higher fat in the other.The subscapular skinfold has a strong positive correlation with the triceps skinfold ($r=0.743$; $p<0.01$; $r = 0.743$; $p < 0.01$; $r=0.743$; $p<0.01$), suggesting consistent fat distribution across these regions. None of the measured anthropometric variables show a significant correlation with swimming speed, as indicated by all low and non-significant correlation values (e.g., arm length: $r=-0.240$; $r = -0.240$; $r=-0.240$; leg length: $r=-0.154$; $r = -0.154$; $r=-0.154$; subscapular skinfold: $r=-0.334$; $r = -0.334$; $r=-0.334$). This suggests that within this sample, factors such as limb length and body fat distribution are not strongly associated with performance in short-distance swimming.

DISCUSSION

The anthropometric characteristics of swimmers are closely related to each other and serve major roles in sports performance (Fernandes, Barbosa, and Vilas-Boas, 2002a). The way people float when passively lying in a prone or supine position is affected by gender, age and body size (Kjendlie and Stallman, 2011). The so called passive floating torque exists due to the difference in position of center of mass and center of volume. This torque was found to be less in boys than in men (Kjendlie et al.,2004). Males have a higher passive leg-sinking torque than females and passive floating torque increases with age, body weight and height (Zaparo et al., 1996). Furthermore, passive torque seems to be linked closely to the energy cost of swimming at sub maximal speeds . Swimming seems to be an exception since advantages associated with a higher proportion of fat mass have been reported, such as greater buoyancy that results in lower energy expenditure (Fernandes et al., 2002; Wells, Schneiderman-Walker and Plyley, 2006; Zuniga et al., 2011).

A number of anthropometrical measures were investigated to find the relationships to swimming

speed in 107 swimmers aged 7-17 (Sprague, 1976). In this research biceps size, skinfold measures and waist size correlated significantly with swimming sprint speed. Furthermore, in 9-13 year old Australian state championship finalists, height, body mass and triceps skinfold correlated with freestyle and butterfly performance. Also, endomorphy, % body fat and density correlated significantly with butterfly performance (Blanksby et al., 1986). Swimming performance, as measured by race times, is influenced by body size, in many studies -being bigger means better performance (Kjendlie and Stallman, 2011). Additionally, performance can also be affected by the variability of body composition (Charmas and Gromisz., 2019) and anthropometric characteristics (i.e. weight, body mass index, height, and wingspan) (Morais et al., 2012; Zuniga et al., 2011). If the swimming technique is not properly acquired the influence of flexibility and other motor skills onto the swimming efficacy is reduced and limited (Okičić et al., 2007). Other correlations, particularly those involving swimming speed, do not reach statistical significance. This may indicate that additional factors not measured in this study could play a significant role in swimming performance over short distances. In a study to investigate anthropometrical influences on stroke length, stroke rate and swimming speed (Grimston and Hay, 1986) found none of the 21 parameters to significantly correlate with swimming speed. The way people float when passively lying in a prone or supine position is affected by gender, age and body size. The so called passive floating torque exists due to the difference in position of center of mass and center of volume (Kjendlie and Stallman, 2011). This study included a heterogeneous group of students, both male and female, who are not professional swimmers. This diversity may explain the absence of statistical significance in the relationship between anthropometric variables and swimming speed over 25 meters. Further research with a larger sample size and more anthropological measurements may be needed to explore relationships between swimming speed and antrophological measurements in greater depth.

Table 2. Pearson Correlation

VARIABLES		ARM LENGTH	LEG LENGTH	SUBSCAPULA SKINHOLD	SUPRAILIACA SKINHOLD	TRICEPS SKINHOLD	SWIMMING SPEED 25M
ARM LENGTH	Pearson Corr.	1	.629**	0.108	-0.089	0.080	-0.240
LEG LENGTH	Pearson Correlation	.629**	1	-0.037	-0.025	-0.146	-0.154
SUBSCAPULAR SKINHOLD	Pearson Correlation	0.108	-0.037	1	.564*	.743**	-0.334
SUPRAILIACA SKINHOLD	Pearson Correlation	-0.089	-0.025	.564*	1	0.328	0.051
TRICEPS SKIN-HOLD	Pearson Correlation	0.080	-0.146	.743**	0.328	1	-0.165
SWIMMING SPEED 25M	Pearson Correlation	-0.240	-0.154	-0.334	0.051	-0.165	1

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DIFFERENCES IN MOTOR SKILLS BETWEEN PRESCHOOL CHILDREN ABOUT INVOLVEMENT IN KINDERGARTEN SPORTS PROGRAMS

Original Scientific Paper

Ilma Tutnjić, Adis Bekrić, Ekrem Čolakhodžić, Almir Atiković

ABSTRACT: This research was conducted on a sample of a total of 71 children aged 3 to 6 years, with the aim of establishing whether there are differences in morphological and motor skills between three different age groups. The sample of variables consisted of two anthropometric measures and ten motor tests. Measures of central tendency were used for data analysis: arithmetic mean, standard deviation, minimum and maximum score, and analysis of variance (ANOVA) was used for the significance difference, while the post-hoc Bonferroni test was used to determine between which specific age groups there are significant differences . The research results showed that there is a significant difference in motor tests in the three groups. There is no difference in the bench press test between the groups. These results confirmed our assumption that there will be a difference between individual age groups of 3-4, 3-5 and 4-5 years.

Keywords: *morphological characteristics, motor abilities, ANOVA, preschool age, children*

INTRODUCTION

Motor abilities are part of anthropological characteristics, and are based on the specific level of development of the basic latent dimensions of human movement and the ability to participate in solving and performing motor tasks. They enable successful movement regardless of whether they are acquired through training or not. Many studies of the motor segment of the anthropological status of man have determined that motor abilities cannot be characterized by just one dimension (factor), but that it is a multidimensional approach. Each individual motor ability is regulated by the appropriate mechanisms of the central nervous system that manage it, and are connected to other human abilities (Pejčić, 2005).

In the development of a child's motor skills, it is characteristic that at the very beginning they react to stimuli with their whole body. For the further development of a child's motor skills, the most important thing is maturation and learning (practice), which results in independent movement in the environment. From the age of three to six, a child seeks play in the company of other children, because they are social beings, and play is an instinctive need for movement. Play is certainly the most important activity for a child during this period, through which excess energy is released, after which peace of mind and body is achieved (Sindik, 2009; Marinac, 2018; Atiković et al., 2024)

When choosing motor activities for children, preference should be given to those movements and activities that stimulate functional improvement of the heart, blood circulation and breathing. Although there is no reliable evidence that physical activity prolongs life, it is known that it prevents, alleviates and even eliminates risk factors, for example: psychological stress, blood cholesterol levels, high blood pressure, excessive body weight. In this way, the child's health improves. On the other hand, relaxation achieved through physical exercise (kinesiological activities) is an irreplaceable giant in the fight against mental overload and stressful situations that abound in today's life. Everyone should be aware that there is nothing more important in life than satisfying the so-called biological needs of a child, which, in addition to movement or exercise, also include the need for oxygen, sleep, fluids and food (Andrilović and Čudina-Obradović, 1994; Andrijašević, 2000; Užičanin et al., 2023).

Physical exercise is complex and involves a number of behavioral factors, including subjective elements (as in sports) as well as quantifiable elements (e.g., frequency, duration, and intensity). One of the most crucial movement skills is locomotion, which allows a child to manage an object in real-world circumstances like throwing a ball. A high level of movement proficiency could boost physical activity engagement (Holfelder & Schott, 2014).

There is a wealth of research on the connections between hand grip strength and many functional medical indicators in various populations. Measurement of hand grip strength is non-invasive, simple, and affordable. It may enable the investigation of acute changes in nutritional status as well as the evaluation and prognosis of muscular strength in juvenile idiopathic arthritis, congenital myotonic dystrophy, and traumatic hand injuries (Lee-Valkov et al., 2003; Hoeksma et al., 2014; Johnson et al., 2016; Jensen et al., 2017, Atiković et al., 2023). Height, weight, bone density, and muscle mass are all factors that influence children's HGS (Molenaar et al., 2010).

It is important to instill in children the habits of regular and varied nutrition, as well as physical activities such as gymnastics and universal sports schools, experts advise. The Aladin Tuzla Preschool and the Tuzla Gymnastics Club know how important the role of gymnastics is in everything, where they have jointly launched a program in 2012 in which preschoolers have been practicing the basics of gymnastics and universal sports schools through play for 12 years. The primary goal of this work is to determine the level of quantitative and qualitative differences in morphological characteristics and motor

abilities of children aged 3 to 6. These results will give us information about the level of anthropological development of the three groups of subjects and to plan activities in the classroom to improve anthropological characteristics, especially in different age categories of children.

MATERIALS AND METHODS

Participants

In this study, the sample of respondents was children from the preschool institution (kindergarten) "Aladin" Tuzla, of both sexes. This study included n = 73 preschool children aged 3–6 years (mean age of boys and girls: 4.40, standard deviation: 0.81). The sample included n = 26 kids (age 3-3.99 yrs.), n = 27 kids (4-4.99 yrs.) and n = 20 kids (5-5.99 yrs.). Children were enrolled in private preschools in Tuzla, Bosnia and Herzegovina. Motor activities for children who attend an additional sports section are chosen according to the capabilities of the children of that age. Classes are organized twice a week in the playroom of the Aldina kindergarten and last 30 minutes per training session. Children were excluded if they had had upper limb orthopedic or neuromuscular surgery, musculoskeletal problems, or neurological disorders that affected their upper and lower extremities, participated in regular sports or had visual, auditory, or vestibular defects.

Testing procedures and instrumentation

The collected data

Before providing written consent, the subjects' parents were informed about the protocol and procedures. To reduce inter-observer bias, all data were collected by the same examiner who trained all children to perform the procedures. Each child's age and gender were recorded. Body weight and height were measured with an accuracy of 0.05 kg and 0.1 cm, respectively, using a standard digital weighing scale and a standard height scale. The variables used to assess physical fitness (Čolakhodžić et al., 2017; Emić et al., 2017, Atiković et al., 2023) included three motor tests measured on both body sides: *frequency of movement* (hand and foot tapping, f/15 sec. (1 cycle = 2 taps) are counted; *maximal strength* (grip strength, kg); *whole body coordination* (bear walk forward 9 meters sec.), *speed* test on 20 meters from standing position (sec.), *explosive strength of the lower extremities* standing broad jump (cm), *flexibility* standing hamstring stretch (cm).

Grip strength: to squeeze a Takei dynamometer as strongly as possible with a hand that is in a rotationally neutral position; the width of the grip is individually adjusted; the test is executed. Before beginning the test, the examiner demonstrated standardized positioning for holding the hand dynamometer bulb. All participants were given the same instructions: "Squeeze the bulb as hard as you can for the count of three seconds". A 2–5 sec. rest period was provided between trials, allowing the examiner to record the maximal hand grip strength. Three trials were performed with each hand to avoid fatigue, alternating between dominant and non-dominant hands by TAKEI (Takei equipment) Analog dynamometer grip A for infants (TKK5825).

Data analysis

We calculated the measures of central tendency (mean and standard deviation), and then performed an ANOVA was performed using multiple comparison analysis testing. Results with a $p \leq 0.05$ were considered significant. All comparisons were performed using SPSS 27.0 for Windows (IBM Corporation, New York, NY, United States).

RESULTS

Table 1 shows the results of descriptive statistics related to the motor abilities of preschool girls and boys aged 3-6 years. The values in the variables [BWF 9m (sec.)] bear walk forward 9 meters (sec.) and [STSP 20m] speed test on 20 meters from standing position (sec.), (sec.) (speed) are inversely scaled, while in all other variables, a higher result value means a better test result. All differences are in favor of older age.

Table 1. Descriptive characteristics

Variables		N	Mean	Std. Dev.	Std. Err.	95% Confidence Interval for Mean		Min.	Max.
						Lower Bound	Upper Bound		
BH (cm)	3-3.99	25	101.472	4.624	.924	99.562	103.381	93.50	109.00
	4-4.99	27	109.229	5.301	1.020	107.132	111.326	99.00	123.00
	5-5.99	19	115.547	4.521	1.037	113.367	117.726	106.10	124.00
	Total	71	108.188	7.366	.874	106.445	109.932	93.50	124.00
BW (kg)	3-3.99	25	16.680	2.408	.481	15.685	17.674	11.80	22.30
	4-4.99	27	18.651	3.945	.759	17.091	20.212	14.10	34.30
	5-5.99	19	21.394	3.754	.861	19.585	23.204	16.80	33.50
	Total	71	18.691	3.850	.456	17.780	19.602	11.80	34.30
Age (year)	3-3.99	26	3.503	.368	.072	3.355	3.652	2.76	3.99
	4-4.99	27	4.533	.269	.051	4.426	4.640	4.01	4.93
	5-5.99	20	5.392	.233	.052	5.282	5.501	5.01	5.91
	Total	73	4.402	.811	.094	4.212	4.591	2.76	5.91
BWF 9m (sec.)	3-3.99	25	11.006	3.193	.638	9.687	12.324	5.59	16.60
	4-4.99	26	8.988	2.941	.576	7.800	10.176	4.73	15.89
	5-5.99	17	8.063	2.944	.714	6.549	9.577	4.88	16.90
	Total	68	9.499	3.228	.391	8.717	10.280	4.73	16.90
SBJ (cm)	3-3.99	25	55.640	17.075	3.415	48.591	62.688	12.00	93.00
	4-4.99	26	81.846	18.535	3.635	74.359	89.332	43.00	125.00
	5-5.99	17	93.764	16.735	4.058	85.160	102.369	60.00	121.00
	Total	68	75.191	23.385	2.835	69.530	80.851	12.00	125.00
SMS (cm)	3-3.99	22	19.590	5.234	1.115	17.270	21.911	5.00	28.00
	4-4.99	21	21.714	5.523	1.205	19.199	24.228	5.00	30.00
	5-5.99	14	20.857	5.842	1.561	17.483	24.230	10.00	32.00
	Total	57	20.684	5.474	.725	19.231	22.136	5.00	32.00
STSP 20 m (sec.)	3-3.99	25	9.117	1.667	.333	8.429	9.805	7.16	13.52
	4-4.99	26	7.484	1.446	.283	6.900	8.069	5.94	12.32
	5-5.99	17	6.752	.771	.187	6.356	7.149	5.59	8.61
	Total	68	7.901	1.694	.205	7.491	8.312	5.59	13.52
HTR-right hand (freq.)	3-3.99	23	8.260	2.178	.454	7.318	9.203	5.00	12.00
	4-4.99	21	13.000	2.489	.543	11.866	14.133	7.00	16.00
	5-5.99	14	15.214	2.547	.680	13.743	16.685	11.00	20.00
	Total	58	11.655	3.730	.489	10.674	12.636	5.00	20.00
HTL-left hand (freq.)	3-3.99	23	7.695	1.743	.363	6.941	8.449	5.00	11.00
	4-4.99	21	11.857	2.555	.557	10.694	13.020	7.00	16.00
	5-5.99	14	14.428	2.408	.643	13.037	15.819	11.00	19.00
	Total	58	10.827	3.510	.460	9.904	11.750	5.00	19.00
LTR-right leg (freq.)	3-3.99	23	6.869	2.360	.492	5.848	7.890	4.00	12.00
	4-4.99	21	11.809	1.400	.305	11.171	12.447	9.00	14.00
	5-5.99	14	12.285	1.815	.485	11.237	13.334	10.00	16.00
	Total	58	9.965	3.167	.415	9.132	10.798	4.00	16.00
LTL-left leg (freq.)	3-3.99	23	7.260	2.027	.422	6.384	8.137	4.00	11.00
	4-4.99	21	11.142	1.930	.421	10.263	12.021	7.00	14.00
	5-5.99	14	11.928	1.542	.412	11.038	12.819	9.00	14.00
	Total	58	9.793	2.795	.367	9.058	10.528	4.00	14.00
HGSR-right hand (kg)	3-3.99	25	7.460	2.258	.451	6.527	8.392	4.00	13.50
	4-4.99	25	8.960	2.999	.599	7.721	10.198	2.50	13.50
	5-5.99	17	10.852	1.783	.432	9.936	11.769	6.50	13.50
	Total	67	8.880	2.769	.338	8.205	9.556	2.50	13.50
HGSR-left hand (kg)	3-3.99	25	6.560	2.237	.447	5.636	7.483	3.00	11.00
	4-4.99	25	8.880	2.057	.411	8.030	9.729	4.00	13.50
	5-5.99	17	9.941	2.263	.548	8.77	11.104	5.00	14.00
	Total	67	8.283	2.563	.313	7.65	8.908	3.00	14.00

Levene's test showed that there was no homogeneity of variance and gave the following significance level for the significant outliers, e.g., age ($p \leq .017$); frequency of movement foot tapping right leg ($p \leq .031$), and maximal strength grip strength right leg ($p \leq .045$).

Table 2. Tests of Homogeneity of Variances

Variables		Levene Statistic	df1	df2	Sig.
BH (cm)	Based on Mean	.356	2	68	.702
BW(kg)	Based on Mean	.653	2	68	.524
Age (year)	Based on Mean	4.344	2	70	.017
BWF 9m (sec.)	Based on Mean	.602	2	65	.551
SBJ (cm)	Based on Mean	.188	2	65	.829
SMS (cm)	Based on Mean	.158	2	54	.855
STSP 20 m (sec.)	Based on Mean	3.124	2	65	.051
HTR-right hand (freq.)	Based on Mean	.069	2	55	.934
HTL-left hand (freq.)	Based on Mean	1.910	2	55	.158
LTR-right leg (freq.)	Based on Mean	3.692	2	55	.031
LTL-left leg (freq.)	Based on Mean	1.259	2	55	.292
HGSR-right hand (kg)	Based on Mean	3.255	2	64	.045
HGSR-left hand (kg)	Based on Mean	.272	2	64	.763

The mean standing hamstring stretch (cm) difference between the 3 groups in Table 3 was not statistically significant ($F(2,54) = .812$, $p \leq .449$). However, these data did not show any significant differences. By observing the values of the ANOVA presented in Table 3, it can be assumed that the ANOVA for independent samples was used to determine the differences between the three groups of participants. The findings revealed no significant differences between preschool boys and girls in one out of eight tested variables.

Table 3. ANOVA

Variables		Sum of Squares	df	Mean Square	F	Sig.
BH (cm)	Between Groups	2185.957	2	1092.978	46.100	.000
	Within Groups	1612.194	68	23.709		
	Total	3798.151	70			
BW (kg)	Between Groups	240.038	2	120.019	10.233	.000
	Within Groups	797.557	68	11.729		
	Total	1037.595	70			
Age (year)	Between Groups	41.044	2	20.522	227.396	.000
	Within Groups	6.317	70	.090		
	Total	47.361	72			
BWF 9m (sec.)	Between Groups	98.583	2	49.291	5.342	.007
	Within Groups	599.745	65	9.227		
	Total	698.327	67			
SBJ (cm)	Between Groups	16572.311	2	8286.156	26.838	.000
	Within Groups	20068.203	65	308.742		
	Total	36640.515	67			
SMS (cm)	Between Groups	48.998	2	24.499	.812	.449
	Within Groups	1629.318	54	30.173		
	Total	1678.316	56			
STSP 20 m (sec.)	Between Groups	63.893	2	31.946	16.154	.000
	Within Groups	128.545	65	1.978		
	Total	192.438	67			
HTR-right hand (freq.)	Between Groups	480.312	2	240.156	42.228	.000
	Within Groups	312.792	55	5.687		
	Total	793.103	57			
HTL-left hand (freq.)	Between Groups	429.406	2	214.703	43.276	.000
	Within Groups	272.870	55	4.961		
	Total	702.276	57			
LTR-right leg (freq.)	Between Groups	367.227	2	183.614	49.333	.000
	Within Groups	204.704	55	3.722		
	Total	571.931	57			
LTL-left leg (freq.)	Between Groups	249.582	2	124.791	35.030	.000
	Within Groups	195.935	55	3.562		
	Total	445.517	57			
HGSR-right hand (kg)	Between Groups	116.742	2	58.371	9.596	.000
	Within Groups	389.302	64	6.083		
	Total	506.045	66			
HGSR-left hand (kg)	Between Groups	129.871	2	64.935	13.682	.000
	Within Groups	303.741	64	4.746		
	Total	433.612	66			

In the Table 4 Bonferroni post hoc test indicates the following results, which do not have statistically significant differences between age groups and variables.BW 3-3.99-4-4.99 p ≤ .125; BWF 9m 3-3.99-4-4.99 p ≤ .062; 4-4.99-5-5.99 p ≤ .998; SBJ (cm) 4-4.99-5-5.99 p ≤ .100; SMS (cm) 3-3.99-4-4.99 p ≤ .632; 3.99-5-5.99 p ≤ 1.000; 4-4.99-5-5.99 p ≤ .100; STSP 20 m (sec.) 4-4.99-5-5.99 p ≤ .300; LTR-right leg (freq.) 4-4.99-5-5.99 p ≤ 1.000; LTL-left leg (freq.) 4-4.99-5-5.99 p ≤ .698; HGSR-right hand (kg) 3-3.99-4-4.99 p ≤ .106; 4-4.99-5-5.99 p ≤ .052; HGSR-left hand (kg) 4-4.99-5-5.99 p ≤ .379.

Table 4. Multiple Comparisons Post Hoc Tests

Dependent Variable Bonferroni	(I) Grupe_1_2_3	(J) Grupe_1_2_3	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
BH (cm)	3-3.99	4-4.99	-7.757*	1.351	.000	-11.075	-4.440
	3-3.99	5-5.99	-14.075*	1.481	.000	-17.713	-10.437
	4-4.99	5-5.99	-6.317*	1.458	.000	-9.896	-2.738
BW (kg)	3-3.99	4-4.99	-1.971	.950	.125	-4.305	.361
	3-3.99	5-5.99	-4.714*	1.042	.000	-7.273	-2.156
	4-4.99	5-5.99	-2.742*	1.025	.028	-5.260	-.225
Age (year)	3-3.99	4-4.99	-1.029*	.082	.000	-1.232	-.827
	3-3.99	5-5.99	-1.888*	.089	.000	-2.107	-1.669
	4-4.99	5-5.99	-.858*	.088	.000	-1.075	-.640
BWF 9m (sec.)	3-3.99	4-4.99	2.017	.850	.062	-.073	4.108
	3-3.99	5-5.99	2.942*	.954	.009	.595	5.289
	4-4.99	5-5.99	.924	.947	.998	-1.403	3.253
SBJ (cm)	3-3.99	4-4.99	-26.206*	4.921	.000	-38.301	-14.110
	3-3.99	5-5.99	-38.124*	5.523	.000	-51.699	-24.550
	4-4.99	5-5.99	-11.918	5.480	.100	-25.387	1.549
SMS (cm)	3-3.99	4-4.99	-2.123	1.675	.632	-6.264	2.017
	3-3.99	5-5.99	-1.266	1.877	1.000	-5.906	3.373
	4-4.99	5-5.99	.857	1.895	1.000	-3.825	5.540
STSP 20 m (sec.)	3-3.99	4-4.99	1.632*	.393	.000	.664	2.600
	3-3.99	5-5.99	2.364*	.442	.000	1.277	3.450
	4-4.99	5-5.99	.731	.438	.300	-.346	1.809
HTR-right hand (freq.)	3-3.99	4-4.99	-4.739*	.719	.000	-6.516	-2.961
	3-3.99	5-5.99	-6.953*	.808	.000	-8.949	-4.957
	4-4.99	5-5.99	-2.214*	.822	.028	-4.246	-.182
HTL-left hand (freq.)	3-3.99	4-4.99	-4.161*	.672	.000	-5.821	-2.501
	3-3.99	5-5.99	-6.732*	.755	.000	-8.597	-4.868
	4-4.99	5-5.99	-2.571*	.768	.004	-4.469	-.673
LTR-right leg (freq.)	3-3.99	4-4.99	-4.939*	.582	.000	-6.377	-3.502
	3-3.99	5-5.99	-5.416*	.653	.000	-7.031	-3.801
	4-4.99	5-5.99	-.476	.665	1.000	-2.119	1.167
LTL-left leg (freq.)	3-3.99	4-4.99	-3.881*	.569	.000	-5.288	-2.475
	3-3.99	5-5.99	-4.667*	.639	.000	-6.247	-3.087
	4-4.99	5-5.99	-.785	.651	.698	-2.393	.822
HGSR-right hand (kg)	3-3.99	4-4.99	-1.500	.697	.106	-3.215	.215
	3-3.99	5-5.99	-3.392*	.775	.000	-5.299	-1.486
	4-4.99	5-5.99	-1.892	.775	.052	-3.799	.013
HGSR-left hand (kg)	3-3.99	4-4.99	-2.320*	.616	.001	-3.834	-.805
	3-3.99	5-5.99	-3.381*	.684	.000	-5.064	-1.697
	4-4.99	5-5.99	-1.061	.684	.379	-2.744	.622
*. The mean difference is significant at the 0.05 level							

DISCUSSION AND CONCLUSION

Today's scientific and technological achievements are leading to people moving less and less, which is associated with various health problems that are occurring more and more frequently. Numerous studies confirm the positive impact of physical activity on overall human health. That is why it is important to include children in sports from preschool age because this is the age when their development and the creation of positive habits can be most influenced (Užičanin et al., 2024).

The results of the study indicate that children who are involved in specialized kindergarten sports programs achieve better results in motor skills assessment tests than children who are not involved in specialized sports programs. This is supported by previous research (Nović, 2017), which leads to the conclusion that additional physical activity has a positive impact on the development of motor skills in preschool children. It is important to emphasize that the development of a child's motor skills in the so-called first triad, or nursery age, is predominantly influenced by phylogenetic events. Then, in the second triad, or kindergarten age, there is a more significant influence of ontogenetic events, since in this period the learning of new kinesiological motor skills is increasingly important (Neljak, 2009). In conclusion, states Neljak

(2009), children after the age of three, and especially during the fifth and sixth years, learn ontogenetically conditioned movements to a greater extent, and thus it is precisely these unlearned movements that contribute to the development of the child's motor skills.

The overall results of the research encourage reflection on integrated sports programs offered by sports kindergartens in different EU countries and should be applied in Bosnia and Herzegovina, preferably free of charge so that all children have the necessary facilities. Unfortunately, this garden of specialized sports activities is currently only available to children whose parents pay for additional hours. The results of other studies have shown that children who play sports and actively participate in training at least twice a week have better results in motor skills compared to children who engage in sports activities from a very early age (Nović, 2017). It can be concluded that it is important to stimulate the development of a certain ability during the critical or sensitive period, to bring about significant changes in that ability. Even if adequate stimulation is not present, an increase in the level of ability can occur during its critical developmental period. Therefore, it is concluded that it is most appropriate to work on the development of motor abilities precisely during the critical period because then it is possible to expect the greatest effect (Krstulović & Pašalić, 2018; Kraljić, 2022).

The sample is too small to draw a general conclusion. It is necessary to research a significantly larger sample. We suggest comparing children who practice this type of sports activity twice a week with children who do not have additional specialized sports facilities in kindergarten.

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REASONS FOR EARLY CESSATION OF SPORTS ACTIVITY AMONG YOUNG ATHLETES IN THE AREA OF THE CITY OF MOSTAR

Original Scientific Paper

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ABSTRACT: The aim of this research was to examine the reasons for early cessation of sports among young athletes in the area of the city of Mostar. The research was conducted through an online questionnaire. For the purpose of carrying out the research, a survey questionnaire with six general and six specific questions was used, which was adapted to the research. The general set of questions refers to gender, beginning of training, ending of training, and discipline. A specific set of questions refers to reasons for termination of training, such as: relationships between athlete and coach, athlete and parent, parent and coach, own abilities and relationships with other members of the group/club, socioeconomic status and other subjective factors. The respondents were young athletes in the area of the city of Mostar who stopped playing sports (N=100).

Keywords*: termination of sports activity, young athletes, adolescence, socioeconomic status, motivation.*

INTRODUCTION

Playing sports offers physical activity, experiencing success, a way to learn how to accept failure, teamwork, dealing with the consequences of teamwork, as well as an escape from the ubiquity of screens and technology in our lives. "Top sport as a professional activity requires enormous dedication (emotional and temporal), and this is exactly the specificity because it completely determines and occupies the individual, so the chosen sport becomes the only social environment known to him" (Stewart and Taylor, 2000). Young people need sports more than ever in the new era. However, there is a decline in sports among young people, as well as premature termination of sports.

According to a number of sports psychologists, youth development experts and practitioners, the dropout rate from sports at the age of 12 or 13 and often earlier, is a major concern (Wallace, 2016). They systematized the reasons into three groups: intrapersonal, interpersonal and structural limitations.

RESEARCH METHODOLOGY

The statistical method was used in the research. The statistical method is inductively generalizing, because based on the characteristics of a certain number of elements of a group or series of phenomena, a general conclusion is made about the average value of the characteristic, the deviation from the medium value.

A sample of respondents

The respondents were young athletes in the area of the city of Mostar who stopped playing sports (N=100). The research was conducted through an online questionnaire. In order to carry out the research as accurately as possible, a survey questionnaire with six general and six specific questions (Ljubičić et al., 2016) was used, which was adapted to the research. The general set of questions refers to gender, start time of training, time of end of training, and discipline. A specific set of questions refers to the reasons for stopping training, such as: the relationships between athlete and coach, athlete and parent, parent and coach, own abilities and relationship with other members of the group/club, socioeconomic status and other objective factors. At the beginning of the questionnaire, it was emphasized that the survey is anonymous, and that the data will be used for the purpose of creating a thesis.

Table 1 shows the gender structure of the sample. The number of female respondents is 43, while the number of male respondents is 57. The sample consists of 100 respondents, that is, young athletes from the area of the city of Mostar who have stopped playing sports.

Table 1. Gender structure of the sample

Gender	Frequency	%
Female	43	43.0
Male	57	57.0
Total	100	100.0

Table 2 shows the number of respondents in relation to the age at which they started playing sports. The age at which respondents in our sample started playing sports ranges from 4 to 16 years old, with the largest number of respondents starting to play sports between the ages of 10 and 12. The smallest number of respondents stopped playing sports at the age of 4, 5, 6 and 8.

Table 2. The number of respondentsin relation to the age at which they started playing sports

Age at the start of playing sport	Frequency	%
4	1	1.0
5	1	1.0
6	1	1.0
7	12	12.0
8	1	1.0
10	17	17.0
11	12	12.0
12	18	18.0
13	15	15.0
14	10	10.0
15	10	10.0
16	2	2.0
Total	100	100.0

Table 3 shows the number of respondents in relation to the age at which they stopped playing sports. The age at which the respondents in our sample stopped playing sports ranges from 10 years to 28 years. The largest number of respondents stopped playing sports at the age of 20.

Table 3. The number of respondent in relation to the age at which they stopped playing sport

Age at the end of playing sport	Frequency	%
10	4	4.0
11	4	4.0
13	5	5.0
14	7	7.0
15	12	12.0
16	14	14.0
17	8	8.0
18	5	5.0
19	5	5.0
20	16	16.0
22	6	6.0
23	4	4.0
24	4	4.0
25	5	5.0
28	1	1.0
Total	100	100.0

Table 4 shows the number of respondents in relation to the type of sport they played. The largest number of respondents was engaged in karate and football, and the smallest number of respondents in tennis, handball and swimming.

Table 4. The number of respondents in relation to the type of sport they played

Type of sport	Frequency	%
Football	24	24.0
Volleyball	16	16.0
Basketball	16	16.0
Swimming	7	7.0
Karate	27	27.0
Handball	6	6.0
Tennis	4	4.0
Total:	100	100.0

Sample variables

With regard to the aim and tasks of the study, the dependent variable is the termination of playing sports, while the independent variables are factors that include the relationships between athlete and coach, athlete and parent, parent and coach, own abilities and relationships with other members of the group/club, socioeconomic status and others objective factors.

Data processing methods

The collected data were analyzed using the SPSS 20.0 for Windows statistical program for personal computers. We used descriptive indicators to determine the number of respondents in relation to individual groups of questions that include the relationships between athletes and coaches, athletes and parents, parents and coaches, own abilities and relationship with other team members, and socioeconomic status.

RESULTS AND DISCUSSION

The first group of questions related to the relationship between athletes and coaches. The results are shown in table 5. Within this group, the most significant reason that influenced the decision to stop training 40.0% of respondents was the lack of support from the coach after a bad result or failure. Then comes poor communication with the trainer, which is the reason that influenced the decision to stop training for 34.0% of respondents in our sample.

Table 5. Presentation of the results of the answers to the questions - the relationship between athletes and coaches

	It did not affect the cessation of sports at all.	It had a slight effect on the cessation of sports.	It had a moderate effect on the cessation of sports.	It had a significant impact on the cessation of sports.	It greatly influenced the cessation of sports.
I had bad communication with the coach.	31.0%	6.0%	29.0%	21.0%	13.0%
The coach did not encourage me to feel effective and confident	27.0%	17.0%	25.0%	21.0%	10.0%
The coach did not encourage me to feel cared for, trusted and respected	22.0%	26.0%	29.0%	13.0%	10.0%
The coach often criticized me for my characteristics	34.0%	34.0%	21.0%	8.0%	3.0%
I didn't have the support of a coach after a bad result/failure	30.0%	13.0%	17.0%	26.0%	14.0%
The coach punished me after a bad result/failure	62.0%	21.0%	14.0%	7.0%	6.0%

The second group of questions related to the relationship between athletes and parents. Table 6 shows the results. Their relationship had a smaller influence on the cessation of coaching than the relationship with the coach. The most significant answer concerning the relationship with parents and which largely influenced the cessation of training of athletes in our sample (29.0%) is disapproval (lack of praise and reward) of success by parents. Then comes the insensitivity and inattention of parents to the problems and feelings of athletes, which is the reason that influenced the cessation of sports for 23% of respondents in our sample.

Table 6. Presentation of the results of the answers to the grouping of questions - the relationship between athletes and parents

	It did not affect the cessation of sports at all.	It had a slight effect on the cessation of sports.	It had a moderate effect on the cessation of sports.	It had a significant impact on the cessation of sports.	It greatly influenced the cessation of sports.
I had no support from my parents in case of failure, fear or discouragement	45.0%	23.0%	14.0%	12.0%	6.0%
My parents didn't show me that they believed in my abilities	56,0%	10.0%	24.0%	6.0%	4.0%
My parents did not approve (praise, reward) my successes	27.0%	17.0%	27.0%	16.0%	13.0%
My parents didn't listen to my problems or pay attention to my feelings	38.0%	13.0%	26.0%	6.0%	17.0%
y parents would criticize me when I did a bad result or failed	40.0%	9.0%	26.0%	14.0%	11.0%

Table 7 shows the results of answers to the grouping of questions related to the relationship between parents and coaches. The most significant reason within this group of questions that influenced the cessation of playing sports in our sample of respondents was the parents' requests to the coach to achieve even better results, which influenced 29% of the respondents. The second most important reason in this group of questions is the expression of anger and disappointment of parents towards the coach due to the bad result achieved (27%).

Table 7. Presentation of the results of the answers to the grouping of questions - the relationship between coaches and parents

	It did not affect the cessation of sports at all.	It had a slight effect on the cessation of sports.	It had a moderate effect on the cessation of sports.	It had a significant impact on the cessation of sports.	It greatly influenced the cessation of sports.
Poor communication between coaches and parents	30.0%	12.0%	33.0%	16.0%	9.0%
Parents' suggestions to the coach on how to conduct training	34.0%	15.0%	29.0%	8.0%	14.0%
Parents' requests to the coach to achieve even better results	33.0%	14.0%	24.0%	15.0%	14.0%
Expression of anger and disappointment of parents towards the coach due to the achieved bad result	38.0%	13.0%	22.0%	6.0%	21.0%

The results shown in table 8 show that relationships with own abilities and relationships with group/ club members are not of great importance for the cessation of training among young athletes in our sample compared to the relationship with the coach and the relationship with parents. The most significant reason that influenced the cessation of sports in this group of answers in 43% of respondents refers to the loss of motivation to go to trainings and competitions. Oversaturation of training demands and lack of support from other members of the club or group are also significant factors in this context.

Table 8. Presentation of the results of answers to the grouping of questions - own abilities and relationships with group or club members

	It did not affect the cessation of sports at all.	It had a slight effect on the cessation of sports.	It had a moderate effect on the cessation of sports.	It had a significant impact on the cessation of sports.	It greatly influenced the cessation of sports.
I believe that I did not have sufficient abilities to achieve success	47.0%	13.0%	26.0%	8.0%	6.0%
I could not successfully complete the set training requirements	52.0%	17.0%	21.0%	7.0%	3.0%
The set training goals were too high to achieve	52.0%	21.0%	22.0%	5.0%	0.0%
I was overwhelmed by the demands of training.	34.0%	26.0%	21.0%	19.0%	0.0%
I had no more motivation to go to trainings and competitions	21.0%	10.0%	26.0%	26.0%	17.0%
Members of the group/club gossiped or belittled me	52.0%	21.0%	13.0%	8.0%	6.0%
I did not have the support of other members of the group/club	44.0%	20.0%	17.0%	13.0%	6.0%

The results of the group of questions related to socioeconomic status and subjective factors are presented in Table 9. Their influence on the cessation of training of young athletes is more significant in relation to the previous factors that were analyzed. The most important reasons for stopping training in this group are the loss of the feeling of happiness and fulfillment during training (35%), not getting credit from the club for the results achieved (35%), and the impression that other members of the club have greater privileges in the club (32%). The distance of the place of training from the place of residence (30%) and the poor material conditions in which the training takes place (30%) also have a significant influence.

Table 9. Results of answers to grouping of questions - socioeconomic status and subjective factors

	It did not affect the cessation of sports at all.	It had a slight effect on the cessation of sports.	It had a moderate effect on the cessation of sports.	It had a significant impact on the cessation of sports.	It greatly influenced the cessation of sports.
I was not interested in sports (but in other activities)	59.0%	4.0%	26.0%	5.0%	6.0%
I didn’t feel happy and fulfilled during training	17.0%	17.0%	31.0%	20.0%	15.0%
Serious injury	43.0%	9.0%	25.0%	14.0%	9.0%
The timing of training didn’t suit me	34.0%	13.0%	26.0%	8.0%	19.0%
The location of the training was too far from the place of residence.	34.0%	6.0%	30.0%	17.0%	13.0%
Bad material conditions in which we trained	26.0%	13.0%	34.0%	17.0%	13.0%
The demands of the school were too great for me to come to training.	30.0%	13.0%	30.0%	10.0%	17.0%
I did not receive credit from the club for the results achieved	26.0%	13.0%	26.0%	18.0%	17.0%
Other members of the club had greater privileges in the club.	34.0%	13.0%	21.0%	6.0%	26.0%

In order to check the obtained results in more detail, we analyzed the average values obtained by the respondents on these five variables. Table 10 shows the results. It can be seen that the respondents achieve the highest average result on the grouping of answers related to socioeconomic status and subjective factors. The lowest average result was obtained on the grouping of answers related to the relationship between coaches and parents. Thus, socioeconomic status and other subjective factors have the most significant influence on the cessation of sports among young athletes in our sample.

Table 9. Average response values according to all five groups of responses

	N	Minimum	Maximum	Mean
Relationship with the coach	100	6.00	30.00	14.9900
The relationship between athletes and parents	100	5.00	25.00	11.7200
Relationship between coaches and parents	100	4.00	20.00	10.3700
Own abilities and relationships with group or club members	100	7.00	33.00	15.3000
Socioeconomic status and subjective factors	100	9.00	45.00	23.7200

Looking at the general results based on the conducted research to determine the reasons why young athletes in the area of the city of Mostar stop playing sports, it was noted that the variable that has the most significant impact is socioeconomic status and subjective factors. Within this variable, 35% of the respondents cited the loss of the feeling of happiness and fulfillment during training as the most significant factor for stopping training. Also, 35% of the respondents stated that they did not receive credit from the club for the results achieved, and 32% of the respondents believed that other members of the club have greater privileges in the club compared to them. 30% of respondents cite the distance of the place of training from their place of residence as a reason that significantly affects the cessation of training, while 30% of them cite poor material conditions in which they train. It is important to note that within the variable athlete-coach relationship, 40.0% of respondents cite the lack of support from the coach after a bad result or failure as the reason that had the greatest impact on stopping coaching. Within the group of responses related to one's own abilities and relationship with other members of the club, as the most significant reason that influenced the cessation of playing sports in this group of responses, 43% of the respondents cited loss of motivation to go to trainings and competitions, which confirms the statements of 35%. about stopping training due to the loss of the feeling of happiness and fulfillment during training.

CONCLUSION

Taking into account the results of this research, we can conclude that socioeconomic status and subjective factors have the most significant influence on the cessation of training in our sample of young athletes. The main problems cited by the respondents are the loss of a sense of happiness and fulfillment during training, not receiving credit from the club for the results achieved, the impression that other members of the club have greater privileges in the club compared to them, the distance between the place of training and the place of residence, and poor material conditions in which trains. Also significant problems that the young athletes in our sample mention are the lack of support from the coach after a bad result or failure, and the loss of motivation to go to trainings and competitions.

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THE DIFFERENCES IN RESPECT TO DEGREE OF BODY MASS INDEX AMONG ELEMANTARY SCHOOL CHILDREN

Original Scientific Paper

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ABSTRACT: The subject of this research is the analysis of the results obtained by calculating the body mass index (BMI) among pupils of certain elementary schools in Sarajevo Canton. The results of the research are presented in accordance with the differences among the groups of pupils in respect to their body mass index (BMI). This research provides an insight into the important information that refers to the expounded research subject. The research in this field illuminates the relationship between expounded fields and shows their mutual connection. The research on the above stated subject was conducted upon the sample of 508 pupils in total, from three different elementary schools on the territory of Sarajevo Canton, in grades 6th to 9th, aged between 10 and 14 years old, and in total consisting of 51,77% male and 48.22% female pupils. From the total number of males who participated in the study, 55.13% have normal body weight, 23.95% are overweight, 17.49% male pupils are obese and 3.42% are underweight. From the total number of female pupils that participated, 63.26% have normal body weight, 19.59% are overweight, 11.02% are obese and 6.12% are underweight. In comparison of the results obtained from both male and female pupils it can be concluded that it is more likely that the male pupils will be overweight.

Keywords: *prevention, obesity, overweight, underweight*

INTRODUCTION

Childhood and adolescent obesity have garnered attention as a "disease in itself" and due to its secondary consequences. Preventing obesity requires a multidisciplinary approach involving families and all levels of educational and healthcare systems. Teams coordinating prevention programs at local and national levels should include physical education teachers, nutritionists, and psychologists. The primary prevention goal is to encourage children to adopt healthy lifestyles—a challenging endeavor requiring long-term motivation among diverse participants. Secondary prevention targets individuals or populations at risk of obesity, focusing on early detection of excessive body weight and related illnesses. BMI is a key metric for monitoring body weight appropriateness. Obesity is defined as the accumulation and storage of excess body fat, while being overweight is defined as a pre-obese state, which involves an increased body mass index (according to reference charts) (Ogden & Fegal, 2010). The World Health Organization (WHO) has defined obesity as a disease in which excess fat tissue accumulates to such an extent that it endangers health (Poirier et al., 2011). Parents' lifestyles significantly influence children, as family environments often fail to fulfill children's needs for physical activity and p lay. It is a widely accepted view that every child has the right to develop in accordance with their individual capabilities and abilities. Today's children increasingly spend their free time watching television, playing, and exploring on computers instead of on playgrounds and in nature. Studies show that children of obese parents have an 80% likelihood of becoming obese, compared to 40% if only one parent is obese (Sothern M.S., 2004). Conversely, only 7% of children with non-obese parents develop obesity during childhood. Research also shows that parental physical inactivity strongly predicts children's inactivity. Furthermore, a mother's diet during pregnancy influences a child's future obesity and the occurrence of chronic diseases, making childhood a critical period for obesity development (Sothern M.S., 2004). The issue of increased body weight and obesity in children requires special attention, primarily due to the health complications associated with this condition, which can manifest in childhood. There is also a high probability that an obese child will remain obese into adulthood (Freedman et al., 2007). According to the American Academy of Pediatrics, there is a strong correlation between childhood obesity and adult obesity. The likelihood of obesity persisting into adulthood increases with age, reaching 40% for four-year-olds and an alarmingly high 80% among adolescents (AAP, 2003). Canning, Courage and Frizzell (2004) highlighted the growing problem of an increasing number of obese individuals, adolescents, and preschool-aged children. Research conducted in Canada indicates that 57% of adult males and 35% of adult females are obese, which is a significant risk factor for cardiovascular problems, diabetes, gallbladder disease, and some types of cancer. Between 1981 and 1996, obesity rates among schoolchildren in Canada rose from 15% to 34.4%. The authors emphasize that the most significant risk factor for childhood obesity is parental obesity and that interventions after obesity occurs are often unsuccessful (Pinhas and Zietler, 2000). Therefore, it is important to determine the age at which obesity begins to appear. Nawalyah and Bong (2004) studied 60 obese primary school children from Malaysia (36 boys and 24 girls) aged eleven years. Based on measured body height and weight, as well as a written survey on socioeconomic status, the type and quantity of consumed food, daily physical activity, and the inclusion of children in a three-day reduction diet, they aimed to determine the connection between physical activity and dietary habits. The research revealed statistically significant differences in height

and weight and showed a strong association between socioeconomic status and BMI. Obese children mainly came from families with a middle socioeconomic status, where a negative attitude toward physical activities was present. In any case, the observed pattern was unsatisfactory, and the authors considered it responsible for the occurrence of obesity in children. The relationship between physical activity and BMI among 871 children aged seven to fourteen was studied by Raustorp and associates (2004). They used body height, weight measurements, and physical activity levels measured by a pedometer over four days. Among the participants, 13.2% of boys and 14.5% of girls were found to be overweight, while the percentage of obese children was as high as 4.5%. The authors believe that the study results highlight the need to compare the measured BMI values and children's physical activity levels with values obtained in studies conducted by other researchers. They also propose comparing these values at an international level.Research on the nutritional status of children in the Republic of Croatia showed no classic malnutrition in terms of energy-protein deficiency but revealed the presence of mineral and/or vitamin deficiencies, mostly in subclinical forms (Antonić Degač K. et al., 2004). Among schoolchildren aged 7-15, 70% demonstrated normal body dimensions, 11% were overweight, 5% were obese, and 1% were undernourished. The trend of obesity is particularly noticeable in urban areas, as indicated by the doubling of obese children over the last few years (Antonić Degač K. et al., 2007). Parzikova (2008) concluded that childhood obesity is closely related to parental obesity, their education, eating habits, and physical activity. Like many others, the author emphasized that physically active preschool children have lower body fat, higher HDL cholesterol levels, greater aerobic endurance, better motor skills, and higher motor knowledge. According to research conducted by the Ministry of Education, Science, and Youth of the Sarajevo Canton (2016), every second child has a nutritional disorder (43.3%), which is extremely concerning. Based on the results of the study, which included a total of 33,200 students, an exceptionally large number of children with increased body weight was recorded. Of the total number of students included in the study, as many as 39.6% were obese. Observing boys and girls separately, it can be noted that obesity is more prevalent among boys. Specifically, of the total number of boys, 43.9% have increased body weight or are obese, while 35.2% of the total number of girls have increased body weight or are obese.

Research Methods

The subject of this research is the analysis of results obtained by calculating the Body Mass Index (BMI) of students from selected primary schools in the Sarajevo Canton. The research results are presented according to the differences between groups of students in relation to their Body Mass Index (BMI). The problem addressed in this study is defined as the obesity of primary school students and the differences within this population compared to their peers. For the purposes of this research, a purposive sampling method was used, as it was necessary to include respondents actively attending an educational institution and belonging to the primary school age group. However, within the sample of N=515 respondents, consisting of 263 boys and 252 girls, the participants were selected randomly. The research was conducted on a sample of students from three primary schools in the Sarajevo Canton, from grades VI to XI, aged 10 to 14 years. The variables used in this research were obtained through the measurement of anthropometric characteristics. To achieve precise results for the Body Mass Index (BMI), two measures of the respondents' morphological characteristics were required: Body mass measurement – body weight, and Longitudinal dimensionality measurement – body height.

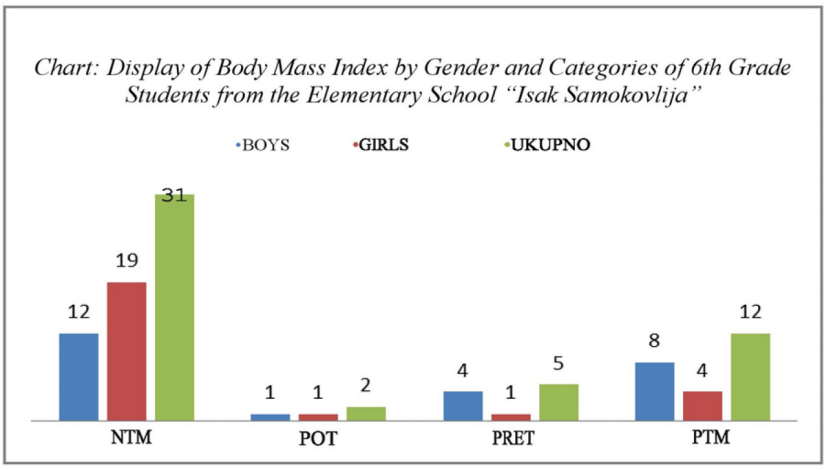
DATA PROCESSING METHODS

In the process of data analysis based on the characteristics and sample size, subject, problem, research goals, and hypotheses, statistical methods for data processing and analysis were determined. To calculate the frequencies of the criterion and predictive spaces, the following parameters were calculated: minimum value – min; maximum value – max; central value – median; arithmetic value – mean; standard deviation – std. deviation; standard error – error; and percentage – %.

After analyzing and processing all of these parameters, the next step was to determine the correlation and statistical significance of the criterion and predictor spaces, divided by groups (boys/girls, individually by grade, gender, and age). Based on all the data, it was determined whether there were clear statistically significant differences between the mentioned groups. We observed similarities and differences in body mass index. To ensure regularity and smooth fieldwork for the research process, approvals and permissions were obtained from the school directors, pedagogues, and teaching councils of the public institutions: "Isak Samokovlija" Elementary School, "Fatima Gunić" Elementary School, and "Amer Ćenanović" Elementary School. Data necessary for this research were collected through fieldwork, measuring morphological characteristics (body weight and height), with the results used for the purposes of this study. The testing was conducted within a time frame that was in line with the schedule for physical and health education classes.

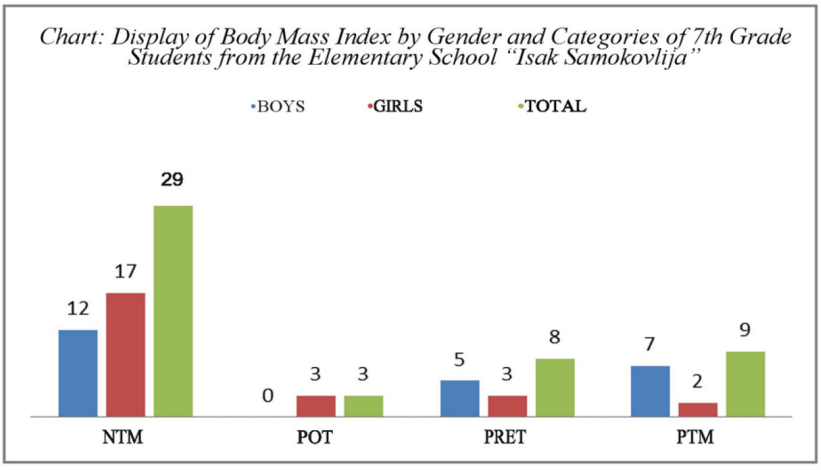
RESULTS AND DISCUSSION

Chart 1. Display of Body Mass Index by Gender and Categories of 6th Grade Students from the Elementary School "Isak Samokovlija"



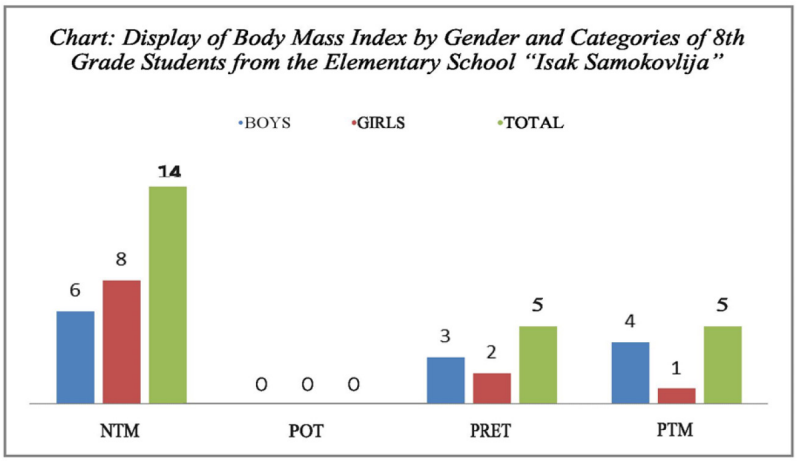
According to the chart showing the body mass index by gender and categories of 6th grade students from the Elementary School "Isak Samokovlija," in a total sample of 50 students, 31 (62%) students have a normal body mass (12 (24%) boys and 19 (38%) girls). There are 2 (4%) underweight students (1 boy (2%) and 1 girl (2%)), 12 (24%) students have excess body weight (8 (16%) boys and 4 (8%) girls), and 5 (10%) students are obese (4 (8%) boys and 1 (2%) girl).

Chart 2. Display of Body Mass Index by Gender and Categories of 7th Grade Students from the Elementary School "Isak Samokovlija"



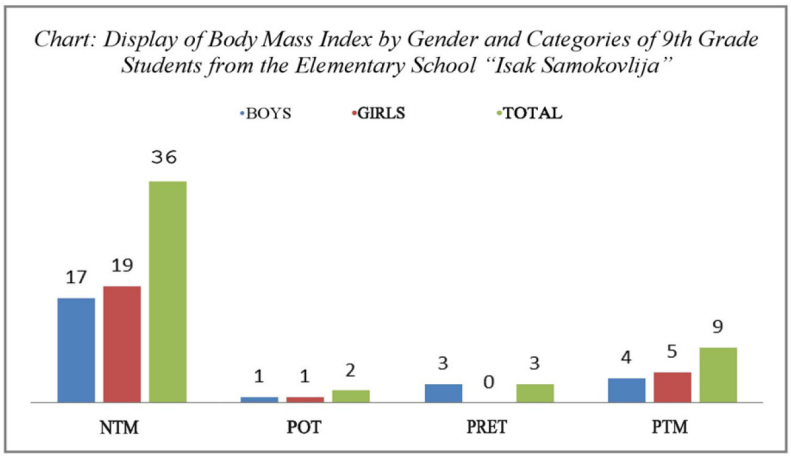
According to the chart showing the body mass index by gender and categories of 7th grade students from the Elementary School "Isak Samokovlija," in a total sample of 49 students, 29 (59.18%) students have a normal body mass (12 (24.48%) boys and 17 (34.69%) girls). There are 3 (6.12%) underweight students (0% boys and 3 (6.12%) girls), 9 (18.36%) students have excess body weight (7 (14.28%) boys and 2 (4.08%) girls), and 8 (16.32%) students are obese (5 (10.20%) boys and 3 (6.12%) girls)

Chart 3. Display of Body Mass Index by Gender and Categories of 8th Grade Students from the Elementary School "Isak Samokovlija"



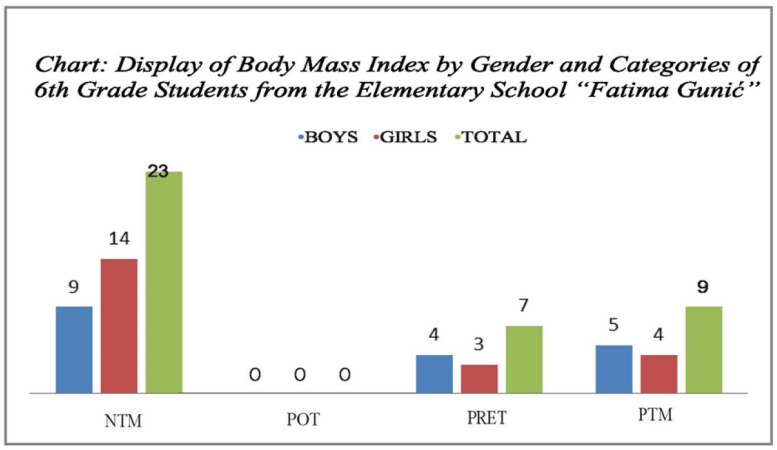
According to the chart showing the body mass index by gender and categories of 8th grade students from the Elementary School "Isak Samokovlija," in a total sample of 24 students, 14 (58.33%) students have a normal body mass (6 (25%) boys and 8 (33.33%) girls). There are no underweight students (0%), 5 (20.83%) students have excess body weight (4 (16.66%) boys and 1 (4.16%) girl), and 5 (20.83%) students are obese (3 (12.5%) boys and 2 (8.33%) girls).

Chart 4. Display of Body Mass Index by Gender and Categories of 9th Grade Students from the Elementary School "Isak Samokovlija"



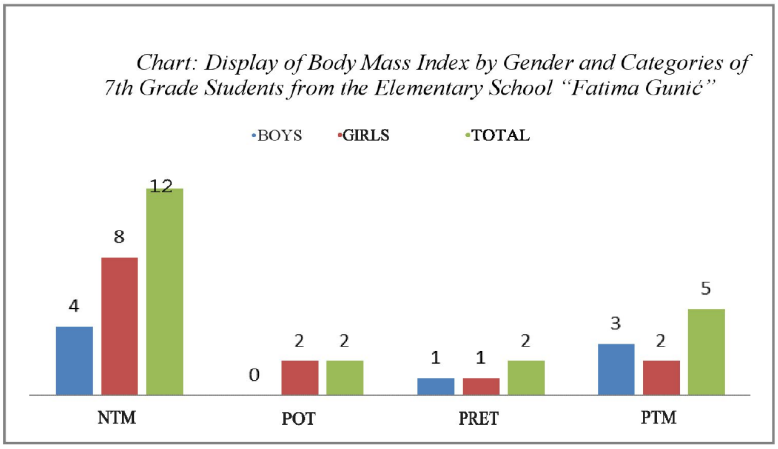
According to the chart showing the body mass index by gender and categories of 9th grade students from the Elementary School "Isak Samokovlija," in a total sample of 50 students, 36 (72%) students have a normal body mass (17 (34%) boys and 19 (38%) girls). There are 2 (4%) underweight students (1 (2%) boy and 1 (2%) girl), 9 (18%) students have excess body weight (4 (8%) boys and 5 (10%) girls), and 3 (6%) students are obese (3 (6%) boys and no girls).

Chart 5. Display of Body Mass Index by Gender and Categories of 6th Grade Students from the Elementary School "Fatima Gunić"



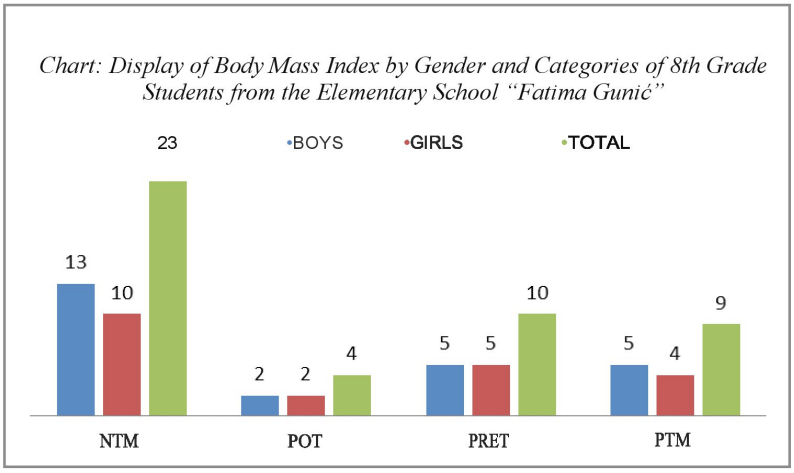
According to the chart showing the body mass index by gender and categories of 6th grade students from the Elementary School "Fatima Gunić," in a total sample of 39 students, 23 (58.97%) students have a normal body mass (9 (23.07%) boys and 14 (35.89%) girls). There are no underweight students (0%), 9 (23.07%) students have excess body weight (5 (12.82%) boys and 4 (10.25%) girls), and 7 (17.94%) students are obese (4 (10.25%) boys and 3 (7.69%) girls).

Chart 6. Display of Body Mass Index by Gender and Categories of 7th Grade Students from the Elementary School "Fatima Gunić"



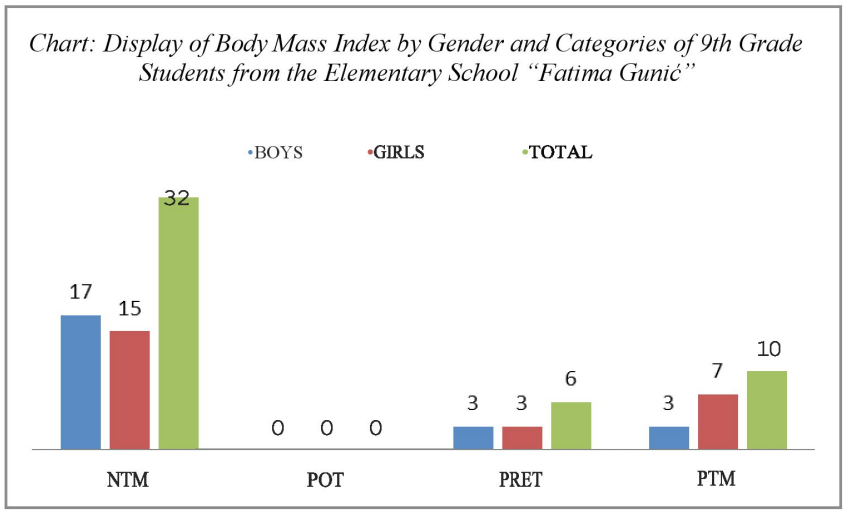
According to the chart showing the body mass index by gender and categories of 7th grade students from the Elementary School "Fatima Gunić," in a total sample of 21 students, 12 (57.14%) students have a normal body mass (4 (19.04%) boys and 8 (38.09%) girls). There are 2 (9.52%) underweight students (0% boys and 2 (9.52%) girls), 5 (23.80%) students have excess body weight (3 (14.28%) boys and 2 (9.52%) girls), and 2 (9.52%) students are obese (1 (4.76%) boy and 1 (4.76%) girl).

Chart 7. Display of Body Mass Index by Gender and Categories of 8th Grade Students from the Elementary School "Fatima Gunić"



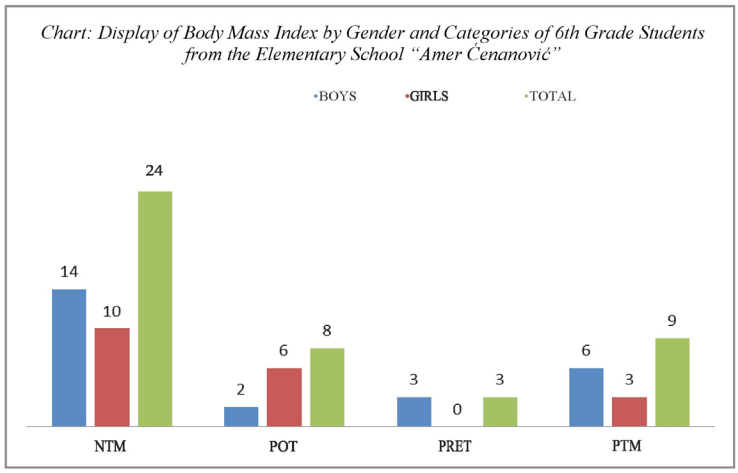
According to the chart showing the body mass index by gender and categories of 8th grade students from the Elementary School "Fatima Gunić," in a total sample of 46 students, 23 (50%) students have a normal body mass (13 (28.26%) boys and 10 (21.71%) girls). There are 4 (8.69%) underweight students (2 (4.34%) boys and 2 (4.34%) girls), 9 (19.56%) students have excess body weight (5 (10.86%) boys and 4 (8.69%) girls), and 4 (8.69%) students are obese (2 (4.34%) boys and 2 (4.34%) girls).

Chart 8. Display of Body Mass Index by Gender and Categories of 9th Grade Students from the Elementary School "Fatima Gunić"



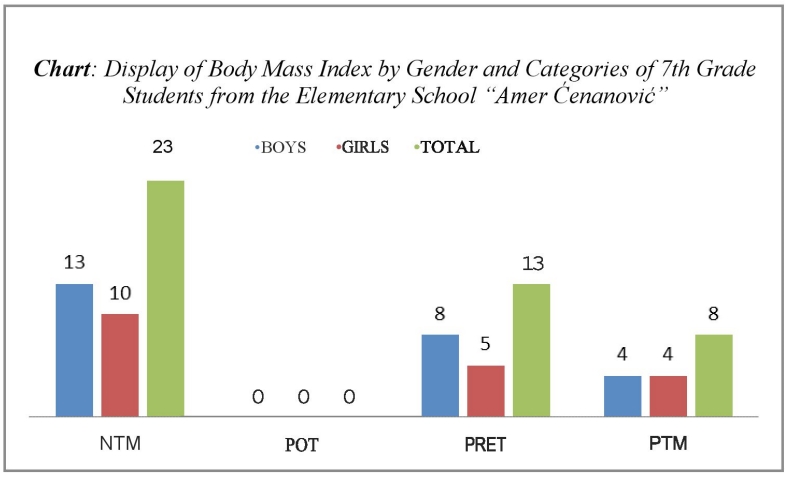
According to the chart showing the body mass index by gender and categories of 9th grade students from the Elementary School "Fatima Gunić," in a total sample of 48 students, 32 (66.66%) students have a normal body mass (17 (35.41%) boys and 15 (31.25%) girls). There are no underweight students (0%), 10 (20.83%) students have excess body weight (3 (6.25%) boys and 7 (14.58%) girls), and 6 (12.5%) students are obese (3 (6.25%) boys and 3 (6.25%) girls).

Chart 9. Display of Body Mass Index by Gender and Categories of 6th Grade Students from the Elementary School "Amer Ćenanović"



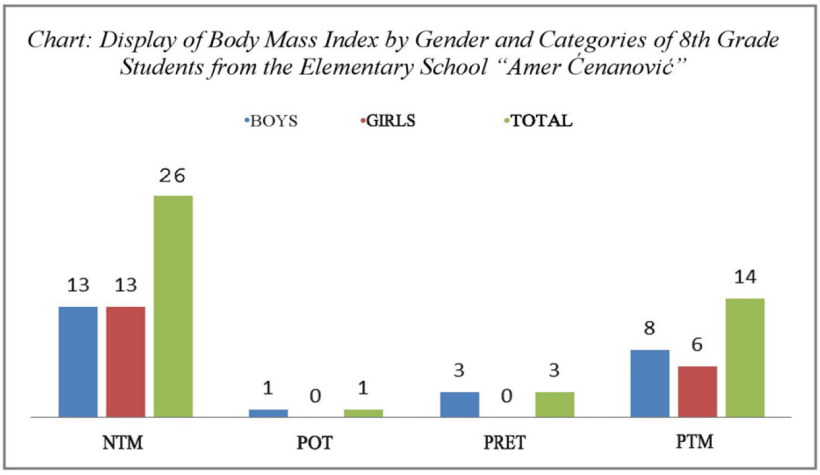
According to the chart showing the body mass index by gender and categories of 6th grade students from the Elementary School "Amer Ćenanović," in a total sample of 44 students, 24 (54.54%) students have a normal body mass (14 (31.81%) boys and 10 (22.72%) girls). There are 8 (18.18%) underweight students (2 (4.54%) boys and 6 (13.63%) girls), 9 (20.45%) students have excess body weight (6 (13.63%) boys and 3 (6.81%) girls), and 3 (6.81%) students are obese (3 (6.81%) boys and no girls).

Chart 10. Display of Body Mass Index by Gender and Categories of 7th Grade Students from the Elementary School "Amer Ćenanović"



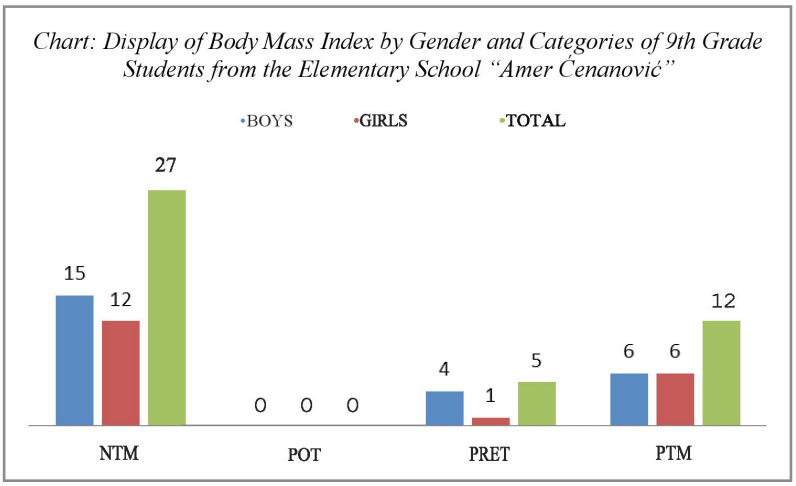
According to the chart showing the body mass index by gender and categories of 7th grade students from the Elementary School "Amer Ćenanović," in a total sample of 44 students, 23 (52.27%) students have a normal body mass (13 (29.54%) boys and 10 (22.72%) girls). There are no underweight students (0%), 8 (18.18%) students have excess body weight (4 (9.09%) boys and 4 (9.09%) girls), and 13 (29.54%) students are obese (8 (18.18%) boys and 5 (11.36%) girls).

Chart 11. Display of Body Mass Index by Gender and Categories of 8th Grade Students from the Elementary School "Amer Ćenanović"



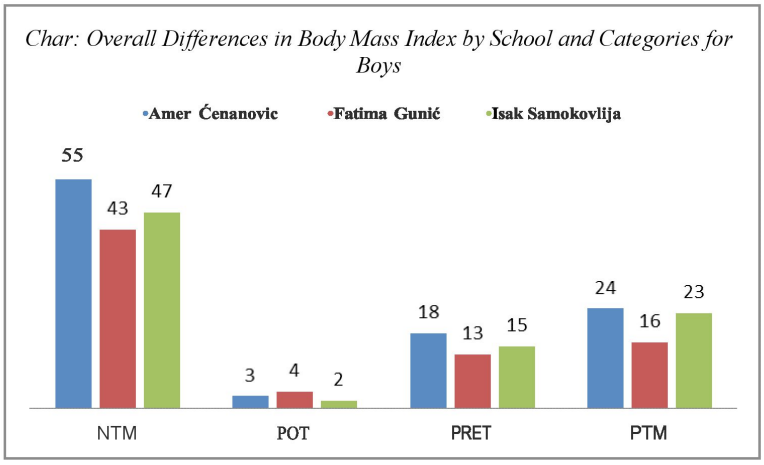
According to the chart showing the body mass index by gender and categories of 8th grade students from the Elementary School "Amer Ćenanović," in a total sample of 44 students, 26 (59.9%) students have a normal body mass (13 (29.54%) boys and 13 (29.54%) girls). There is 1 (2.27%) underweight student (1 (2.27%) boy and no girls), 14 (31.81%) students have excess body weight (8 (18.18%) boys and 6 (13.63%) girls), and 3 (6.81%) students are obese (3 (6.81%) boys and no girls).

Chart 12. Display of Body Mass Index by Gender and Categories of 9th Grade Students from the Elementary School "Amer Ćenanović"



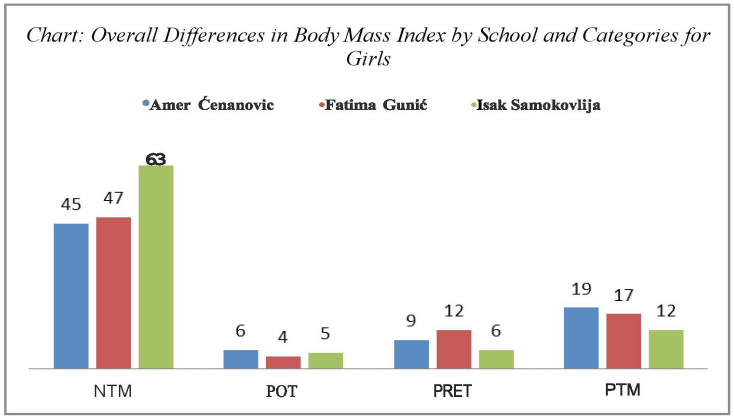
According to the chart showing the body mass index by gender and categories of 9th grade students from the Elementary School "Amer Ćenanović," in a total sample of 44 students, 27 (61.36%) students have a normal body mass (15 (34.09%) boys and 12 (27.27%) girls), there are no underweight students (0%), 12 (27.27%) students have excess body weight (6 (13.63%) boys and 6 (13.63%) girls), and 5 (11.36%) students are obese (4 (9.09%) boys and 1 (2.27%) girl).

Chart 13. Overall Differences in Body Mass Index by School and Categories for Boys



According to the chart showing the overall differences in body mass index by school and categories for boys in a total sample of 263 boys, 145 (55.13%) boys have a normal body mass (55 (20.91%) boys in "Amer Ćenanović" Elementary School, 47 (17.87%) boys in "Isak Samokovlija" Elementary School, 43 (16.34%) boys in "Fatima Gunić" Elementary School). There are 9 (3.42%) underweight boys (4 (1.52%) boys in "Fatima Gunić" Elementary School, 3 (1.14%) boys in "Amer Ćenanović" Elementary School, 2 (0.76%) boys in "Isak Samokovlija" Elementary School). There are 63 (23.95%) boys with excess body weight (24 (9.12%) boys in "Amer Ćenanović" Elementary School, 23 (8.74%) boys in "Isak Samokovlija" Elementary School, 16 (6.08%) boys in "Fatima Gunić" Elementary School). There are 46 (17.49%) obese boys (18 (6.84%) boys in "Amer Ćenanović" Elementary School, 15 (5.70%) boys in "Isak Samokovlija" Elementary School, 13 (4.94%) boys in "Fatima Gunić" Elementary School).

Chart 14. Overall Differences in Body Mass Index by School and Categories for Girls



According to the chart showing the overall differences in body mass index by school and categories for girls in a total sample of 245 girls, 155 (63.26%) girls have a normal body mass (63 (25.71%) girls in "Isak Samokovlija" Elementary School, 47 (19.18%) girls in "Fatima Gunić" Elementary School, 45 (18.36%) girls in "Amer Ćenanović" Elementary School). There are 15 (6.12%) underweight girls (6 (2.44%) girls in "Amer Ćenanović" Elementary School, 5 (2.04%) girls in "Isak Samokovlija" Elementary School, 4 (1.63%) girls in "Fatima Gunić" Elementary School). There are 48 (19.59%) girls with excess body weight (19 (7.75%) girls in "Amer Ćenanović" Elementary School, 17 (6.93%) girls in "Fatima Gunić" Elementary School, 12 (4.89%) girls in "Isak Samokovlija" Elementary School). There are 27 (11.02%) obese girls (12 (4.89%) girls in "Fatima Gunić" Elementary School, 9 (3.67%) girls in "Amer Ćenanović" Elementary School, 6 (2.44%) girls in "Isak Samokovlija" Elementary School).

Of the total number of boys involved in this study, 55.13% have a normal body mass, 23.95% have excess body weight, 17.49% are obese, and 3.42% are underweight. Of the total number of girls involved

in this study, 63.26% have a normal body mass, 19.59% have excess body weight, 11.02% are obese, and 6.12% are underweight. Looking at boys and girls separately, it can be observed that obesity is more prevalent among boys.

CONCLUSION

For many years, experts and science have emphasized the positive impact of physical activity and movement. However, in today's world, with numerous benefits from modern life and technological advancements, both the adult population and young people, including children, are increasingly practicing a sedentary lifestyle. As a result, obesity has become a global problem and one of the main obstacles to the prevention of non-communicable diseases. In addition to adults, obesity is also significantly increasing among children, primarily caused by improper nutrition and a lack of physical activity. This research has provided significant information regarding the treated subject of study. Studies within this field shed light on the relationships of the treated areas and show their mutual connection. Based on a sample of 508 students from three elementary schools in the Sarajevo Canton, from 6th to 9th grade, aged 10 to 14 years, and in total, 51.77% of the students are boys, and 48.22% are girls. The data was processed using statistical methods with SPSS 21.0 software. Based on statistical analysis of all variables, the following conclusions were drawn. In the 6th-grade group, the highest percentage of students with excess body weight or obesity is in "Fatima Gunić" Elementary School (41.01%), while the lowest is in "Amer Ćenanović" Elementary School (27.26%), and in "Isak Samokovlija" Elementary School (34%). The highest percentage of underweight students is in "Amer Ćenanović" Elementary School (18.18%), while there are no underweight students in "Fatima Gunić" Elementary School, and only 4% in "Isak Samokovlija" Elementary School. In the 7th-grade group, the highest percentage of students with excess body weight or obesity is in "Amer Ćenanović" Elementary School (47.72%), while the lowest is in "Fatima Gunić" Elementary School (33.32%), and in "Isak Samokovlija" Elementary School (34.68%). The highest percentage of underweight students is in "Fatima Gunić" Elementary School (9.52%), while there are no underweight students in "Amer Ćenanović" Elementary School, and 6.12% in "Isak Samokovlija" Elementary School.

In the 8th-grade group, the highest percentage of students with excess body weight or obesity is in "Isak Samokovlija" Elementary School (41.66%), while the lowest is in "Fatima Gunić" Elementary School (28.25%), and in "Amer Ćenanović" Elementary School (38.62%). The highest percentage of underweight students is in "Fatima Gunić" Elementary School (8.69%), while there are no underweight students in "Isak Samokovlija" Elementary School, and 2.27% in "Amer Ćenanović" Elementary School. In the 9th-grade group, the highest percentage of students with excess body weight or obesity is in "Amer Ćenanović" Elementary School (38.63%), while the lowest is in "Isak Samokovlija" Elementary School (24%), and in "Fatima Gunić" Elementary School (33.33%).

The highest percentage of underweight students is in "Isak Samokovlija" Elementary School (4%), while there are no underweight students in "Fatima Gunić" and "Amer Ćenanović" Elementary Schools. Of the total number of boys involved in this study, 55.13% have a normal body mass, 23.95% have excess body weight, 17.49% are obese, and 3.42% are underweight. Of the total number of girls involved in this study, 63.26% have a normal body mass, 19.59% have excess body weight, 11.02% are obese, and 6.12% are underweight.

Looking at boys and girls separately, it can be observed that obesity is more prevalent among boys.

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FITNESS PROFILE OF ELITE YOUTH FOOTBALL PLAYERS IN BOSNIA AND HERZEGOVINA – DIFFERENCES BY PLAYING POSITION

Original Scientific Paper

Amel Jazvin, Natalija Kurtović

ABSTRACT: The aim of this study was to compare the fitness profile (anthropometric and physical fitness characteristics) of youth football players in Bosnia and Herzegovina by playing positions.The number of respondents included in this research was n=129, elite youth football players from U17 Bosnian Premier League. The players were divided in 6 groups (goalkeepers, centre-backs, full-backs, midfielders, wingers and attackers). Selected variables in this study covered the area of anthropometric characteristics (5 variables; body height, body mass, body fat, body muscle mass, BMI), and the area of physical fitness characteristics (5 variables; sprint; S5M, S10M, S20M, agility; 505A and CMJ Height). Goalkeepers are the highest and haviest in the team, while the full-backs are the lowest, and the wingers are the lightest. One way ANOVA showed statistical significant difference in body height and body mass by playing position Attackers have highest body fat, while the wingers have lowest body fat and there is no statistical significant difference in body fat between positions. Goalkeepers have the highest body muscle mass, while the wingers have lowest body muscle mass. Differences in body muscle mass between positions are statistical significant. Attackers are the best in 505A agility test, while the goalkeepers are the slowest. There no statistical significant differences between positions. Wingers have the highest CMJ height, and attackers have the lowest CMJ height. Differences between positions in CMJ variable are not statistical significant. Kruskal Wallis test showed that wingers are the fastest in the sprint tests, while the goalkeepers are slowest. There are statistical significant difference between positions in S10M, while there are no statistical significant difference between positions in Body Mass Index, S5M and S20M.

Keywords: *fitness profile, football, youth players, sprint, vertical jump, agility*

INTRODUCTION

Soccer as it is played today is a physical activity that requires a high level of conditioning in addition to proficient technical and tactical skills. The game can be characterized as a predominant aerobic exercise combined with frequent intermittent short intense actions with a high rate of the anaerobic energy turnover. Despite the soccer game being dependent predominantly on the aerobic metabolism, it should be argued that the most decisive actions are covered by means of the anaerobic metabolism (i.e., sprinting, jumping, etc.), (Boone, 2012). These game characteristics (and the technical and tactical requirements) impose that the physical performance of elite soccer players is based on the combination of endurance, speed, agility, and strength. Soccer players therefore are bound to have both a high power and capacity of the aerobic and anaerobic metabolism to be able to perform at the highest level. The combined importance of these physical determinants is specific to soccer, and in this way, soccer training needs to be well balanced and structured to optimize the player performance without inducing overreaching and overtraining (Boone, 2012). In elite football, coaches are constantly seeking the most effective formula for identifying and developing talented young players, and the role of the youth academy is vital in the long-term development of soccer players (Le Gall, 2010). Injury risk (Le Gal, 2008), training history and match experience (Ford, 2006) (Helsen, 2000), psychological (Morris, 2000), technical (Reilly, 2000), motor and perceptualcognitive (Williams, 2000) skills have been investigated as predictors of expertise and successful performance in youth soccer. Additionally, anthropometric and physiological characteristics, maturity status and the influence of the period during the selection year in which players are born have been shown to be predictors of success in young soccer players (Le Gal, 2010). Considering that the different positions on the field are characterized by specific physical activities and demands, it should be noted, however, that the these physical fitness demands of a soccer game have to be seen in view of the player's position. It was observed that the anthropometric features and the aerobic and anaerobic performance differed among the different playing positions (Sporiš, 2009). Regarding to these introduction and previous researches, the aim of this research was to determine the differences in fitness profile variables (anthropometric and physical fitness variables) between youth football players regarding to playing position.

METHODS

This research was transversal study with the aim of determining differences in fitness profile (anthropometric and physical fitness variables) of youth football players regarding to playing position.

Sample of respondents

The sample of respondents consisted of n=129 youth male football players, from U17 Bosnian Premier League, divided in six groups by playing position (goalkeepers, centre-backs, full-backs, midfielders, wingers and attackers).

Sample variables

This research included sample of 5 anthropometric variables (body height, body mass, body fat, body muscle mass, BMI), and 5 physical fitness variables (sprint 5m, sprint 10m, sprint 20m, 505 agility test and CMJ height).

Data processing methods

The obtained results were processed in the statistical package SPSS (version 26.0; SPPS, Inc., Chicago, IL, USA). Central and dispersion parameters were calculated for each applied variable. The normality of the distrubution of the results was examined on the basis of the skewness coefficient and the elongation coefficient (Kurtosis), and Kolmogorov-Smirnov test. For differences analysis between variables which did have normal distribution of results we used one way ANOVA test, and for the variables which did not have normal distribution of results, we used non-parametric Krusskal-Wallis test.

Table 1. Frequency of respondents by playing positions

Playing position	Frequency	Percentage (%)
Goalkeeper	14	10,9
Centre-back	25	19,4
Full-back	21	16,3
Midfielder	39	30,2
Winger	17	13,20
Attacker	13	10,1

Table 1. shows us the frequency of all players by playing positions distribution: goalkeepers: 14 (10,9%), centre-backs 25 (19,4%), full-backs 21 (16,3), midfielders 39 (30,2%), wingers 17 (13,2%), attackers 13 (10,1%). Most of them are midfielders (30,2%), and the least is attackers (10,1%) goalkeepers (10,9%).

Table 2. Descriptive statistics for all players

Variables	Mean	Min.	Max.	SD	Skewness	Kurtosis
Age (years)	15.25	14	16	0.685	-,362	-,845
Body Height (cm)	180,80	165,00	193,00	6,32	-,199	-,459
Body mass (kg)	66,93	46,10	93,40	7,44	,364	,667
Body Fat (%)	10,19	3,00	19,00	3,15	,316	-,258
Body Muscle mass (kg)	57,02	42,40	78,50	5,58	,562	1,500
Body Mass Index	20,27	14,7	25,60	2,45	-3,699	29,244
S5M (s)	1,01	0,91	1.27	0,05	1.12	3.91
S10M (s)	1,76	1,61	2,12	0,08	1,008	2,989
S20M (s)	3,05	2.37	3,60	0,16	-,817	4,975
505A (s)	2,41	2,06	3,04	0,15	,658	1,489
CMJ Height (cm)	37,02	27,00	49,00	4,78	,375	,625

RESULTS AND DISCUSSION

Table 2. shows us descriptive statistics parameters for all of 129 football players. The average respondents body height was 180,80 cm (range 165–193 cm, SD=6,32), skew (-0,199), body mass average is 66,93 kg (range 46,1–93,4 kg, SD=7,44), skew (0,364). Body fat average is 10,19% (range 3–19%, SD=3,15), body muscle mass average is 57,02 (range 42,4–78,5, SD=5,58), Body Mass Index average is 20,27 (range 14,7–25,6, SD=2,45). S5M average value 1,01 s (SD=0,05), S10M average 1,76 s (SD=0,08), S20M 3,05 s (SD=0,16). 505A average is 2,41 s (range 2,06–3,04 s, SD=0,15) and CMJ Height average is 37,02 cm (range 27–49 cm, SD=4,78). Before the analysis of differences, we did the Kolmogorov-Smirnov test to check normal distribution of results.

Table 3. Kolmogorov-Smirnov test

Variables	Skewness	Kurtosis	K-S	P
Body Height (cm)	-,199	-,459	,062	>0.05
Body Mass (kg)	,364	,667	,061	>0.05
Body Fat (%)	,316	-,258	,064	>0.05
Body Muscle mass (kg)	,562	1,500	,056	>0.05
Body Mass Index	-3,699	29,244	,126	<0.05
S5M (s)	1.12	106,036	,132	<0.05
S10M (s)	1,008	2,989	,116	<0.05
S20M (s)	-,817	16,388	,073	<0.05
505A (s)	,658	1,489	,052	>0.05
CMJ Height (cm)	,375	,625	,085	>0.05

As we can see in the table 3. variables body height (cm), body mass (kg), body fat (%), body muscle mass (kg), 505A (sec) and CMJ height (cm) has normal distribution and we will use one way ANOVA test for differences analysis, while variables Body Mass Index, S5M (sec), S10M (sec), S20M (sec) are not normally distributed so we will use Kruskall Wallis test.

Table 4. Descriptive statistics by playing position and ANOVA test for variables; body height (cm), body mass (cm), body fat (%), body muscle mass (kg), 505A (sec), CMJ (cm)

		N	Xsr	SD +/-	95% CI		Min.	Max.
					Lower	**Upper**		
Body Height (cm)	Goalkeeper	14	186,42	5,52	183,23	189,62	173,00	192,00
	Full-back	21	177,04	6,18	174,23	179,86	165,00	188,00
	Winger	17	177,94	6,58	174,55	181,32	166,00	192,00
	Centre-back	25	184,92	4,86	182,91	186,92	175,00	193,00
	Midfielder	39	178,58	4,85	177,01	180,16	169,00	187,00
	Attacker	13	183,23	4,36	180,59	185,86	175,00	190,00
F=10.88; P=0.00								
Body Mass (cm)	Goalkeeper	14	74,63	9,52	69,13	80,13	54,80	93,40
	Full-back	21	64,17	7,70	60,66	67,68	53,00	79,50
	Winger	17	63,07	4,60	60,70	65,44	54,30	69,50
	Centre-back	25	68,55	7,07	65,63	71,47	46,10	78,90
	Midfielder	39	64,90	5,34	63,16	66,63	54,90	78,20
	Attacker	13	71,06	5,81	67,55	74,58	64,00	81,60
F=7.11; P=0.00								
Body Fat (%)	Goalkeeper	14	10,30	4,18	7,89	12,72	4,10	17,10
	Full-back	21	10,04	3,26	8,55	11,52	4,50	15,80
	Winger	17	9,59	2,74	8,18	11,00	4,00	14,70
	Centre-back	25	10,20	3,01	8,95	11,44	3,00	15,20
	Midfielder	39	10,00	3,14	8,98	11,02	5,50	19,00
	Attacker	13	11,62	2,60	10,05	13,19	7,90	15,80
F=0.691; P=0.631								
Body muscle mass (kg)	Goalkeeper	14	63,47	7,50	59,13	67,80	48,70	78,50
	Full-back	21	54,69	5,54	52,17	57,21	45,40	67,20
	Winger	17	54,34	4,02	52,27	56,41	47,60	61,00
	Centre-back	25	58,38	5,01	56,30	60,45	42,40	66,30
	Midfielder	39	55,39	3,70	54,19	56,59	47,20	65,20
	Attacker	13	59,61	4,17	57,09	62,13	54,40	67,00
F=8.82; P=0.00								
505A (sec)	Goalkeeper	14	2,45	,15	2,37	2,54	2,19	2,74
	Full-back	21	2,42	,16	2,34	2,50	2,14	2,74
	Winger	17	2,38	,10	2,33	2,44	2,23	2,56
	Centre-back	25	2,42	,16	2,35	2,48	2,19	2,67
	Midfielder	39	2,40	,15	2,35	2,45	2,06	3,04
	Attacker	13	2,33	,12	2,25	2,40	2,11	2,56
F=1.129; P=0.349								
CMJ Height (cm)	Goalkeeper	14	38,78	2,96	35,09	42,46	34,60	42,20
	Full-back	21	39,10	5,71	32,01	46,19	35,10	49,00
	Winger	17	40,20	2,12	21,14	59,25	38,70	41,70
	Centre-back	25	38,08	2,74	35,79	40,37	34,20	41,50
	Midfielder	39	35,77	6,04	31,93	39,61	27,00	48,70
	Attacker	13	33,22	3,21	29,22	37,21	29,70	37,40
F=1.465; P=0.230								

On the Table 4. we can see descriptive statistics parametrics and ANOVA test. The highest average body height have goalkeepers (186,42 cm), while the full-backs are the lowest (177,04 cm). ANOVA analysis is showing statistical significant difference by playing position (F=10,88; P=0,00). Goalkeepers are the heaviest (74,63 kg), while the wingers are the lightest (63,07 kg). Differences by playing position are statistically significant (F=7,11; P=0,00). Different from some previous research where the midfielders were significantly shorter and lighter than players of other playing positions (Wong et al., 2008). It was

noted in previous researches also that goalkeepers and defenders are tallest and haviest players in the team (Gil, 2007., Wong, 2009., Portes, 2015), and that there are significant positional differences in anthropometry; body mass, height and BMI (Wong, 2009). Attackers have highest body fat (11,62%), while the wingers have lowest body fat (9,59%). There are no statistically significant differences between positions (F=0,691; P=0,631). Goalkeepers have the highest body muscle mass (63,47), while the wingers have lowest body muscle mass (54,34). Differences between positions are statistically significant (F=8,82; P=0,00). Attackers are the best in 505A agility test (2,33 s), while the goalkeepers are the slowest in agility (2,45 s). There are no statistical significant differences between positions (F=1,129; P=0,349). Wingers have the highest CMJ vertical jump, and attackers have the lowest CMJ. Differences between positions in CMJ variable are not statistically significant (F=1,465; P=0,230), which is different from research of Marques (2016), where there is statistical significant differences in CMJ Height. For the variables that had statistically significant difference we did the Post Hoc test, to see in which positions there are difference between (Table 5.)

Table 5. The Post Hoc test for variables Height (cm), Weight (kg), Muscle mass (kg)

Height (cm)			
Position 1	Position 2	Mean difference	Sig
Goalkeeper	Full-Back	9,38095*	,000
Goalkeeper	Winger	8,48739*	,000
Goalkeeper	Midfielder	7,83883	,000
Full-Back	Centre-Back	-7,87238	,000
Full-Back	Attacker	-6,18315	,018
Centre-Back	Midfielder	6,33026	,000
Centre-Back	Winger	6,97882	,001
Weight (kg)			
Position 1	Position 2	Mean difference	Sig
Goalkeeper	Full-Back	10,45952	,000
Goalkeeper	Winger	11,56513	,000
Goalkeeper	Midfielder	9,73571	,000
Winger	Attacker	-7,99864	,017
Midfielder	Attacker	-6,16923	,048
Full-Back	Attacker	-6,89304	,043
Muscle mass (kg)			
Position 1	Position 2	Mean difference	Sig
Goalkeeper	Full-Back	8,77619*	,000
Goalkeeper	Winger	9,12437*	,000
Goalkeeper	Midfielder	8,07656	,000
Goalkeeper	Centre-Back	5,09143	,027

On the table 5. we can see the Post Hoc test for variables Height (cm), Weight (kg), Muscle mass (kg). In variable Height (cm) there are statistical significant difference between positions; goalkeeper-full-back, goalkeeper-winger, goalkeeper-midfielder, full-back-centre-back, full-back-attacker, centre-back-midfielder, centre-back-winger. In weight (kg) there are statistical significant difference between positions; goalkeeper-fullback, goalkeeper-winger, goalkeeper-midfielder, winger-attacker, midfielder-attacker, full-back-attacker. In muscle mass (kg) there are statistical significant difference between positions; goalkeeper-full-back, goalkeeper-winger, goalkeeper-midfielder, and goalkeeper-centre-back. For the variables which did not have normal distribution of results (BMI, S5M, S10M and S20M), we did the Kruskal-Wallis test.

Table 6. Kruskal Wallis test for variables: Body Mass Index (BMI), S5M (sec), S10M (sec), S20M (sec)

Variables	Position	N	Average range	H	P
Body Mass Index (BMI)	Goalkeeper	14	80,82	7,650	,177
	Full-Back	21	64,31		
	Winger	17	55,68		
	Centre-Back	25	56,42		
	Midfielder	39	63,58		
	Attacker	13	82,04		
S5M (sec)	Goalkeeper	14	72,36	6,024	,304
	Full-Back	21	65,14		
	Winger	17	49,97		
	Centre-Back	25	60,10		
	Midfielder	39	73,58		
	Attacker	13	60,19		
S10M (sec)	Goalkeeper	14	81,39	11.914	.036
	Full-Back	21	65,19		
	Winger	17	44,15		
	Centre-Back	25	62,22		
	Midfielder	39	74,06		
	Attacker	13	52,46		
S20M (sec)	Goalkeeper	14	80,54	10.516	.062
	Full-Back	21	62,07		
	Winger	17	42,68		
	Centre-Back	25	63,54		
	Midfielder	39	72,88		
	Attacker	13	61,35		

Kruskal Wallis test on the table 6. is showing average ranges for Body Mass Index and sprint variables for different playing positions, with results of statistical tests (H i P). Highest range in Body Mass Index have attackers (82,04), while the lowest have wingers (55,68). Test H=7,650 and P=0,177 are showing that the differences between positions are not statistically significant, which is not in line with some previous researches where there is statistical significant positional differences in BMI (Wong, 2009). Midfielders have highest range at S5M (73,58), while the wingers have lowest range (49,97). Test H=6,024 and P=0,304 are showing that differences between positions are not statistically significant. Goalkeepers have highest range on S10M (81,39), while the wingers have lowest (44,15). Test H=11,914 and P=0,036 are showing statistically significant differences between positions which is not similar with finidings of Marques, (2016). At variable S20M goalkeepers again have highest range (80,54), while the wingers have lowest range again (42,68). Test H=10,516 and P=0,062 indicates on significance, but does not fulfill statistical significance threshold (P<0,05). These results are showing that the differences in S10M are statistically significant, while the other variables (Body Mass Index, S5M, S20M) are not statistically significant. Wingers are the fastest in the sprint tests, while the goalkeepers have high ranges because of higher times (they are slowest).

CONCLUSION

Goalkeepers are the tallest and the haviest players in the team, while the full-backs are the lowest, and the wingers are the lightest. Attackers have highest body fat, while the wingers have lowest body fat. Goalkeepers have the highest muscle mass, while the wingers have lowest muscle mass. Attackers are the best in 505A agility test, while the goalkeepers are the slowest in agility. Wingers have the highest CMJ Height, and attackers have the lowest CMJ Height.). ANOVA analysis showed that there are statistical significant difference between positions in variables height, weight and muscle mass, and there are no statistical significant differences between positions in variables body fat, 505 agility and CMJ Height. Wingers are the fastest in the sprint tests, while the goalkeepers are slowest. Kruskal-Wallis test showed statistical significant differences between positions in S10M, while there are no statistical significant differences between positions in S5M, S20M and Body Mass Index. We may conclude that anthropometric and physiological differences exist among soccer players who play in different positions, but in this research some of them are statistical significant and some of them are not. These differences fit with their different specific game requirements and different workload in a game. Therefore, training programs should include specific sessions for each positional role. This results point to the fact that soccer players of certain field positions present specific characteristics. This information can help coaches to optimize training tasks and performance enhancements during the soccer game. In addition, these results can provide support in the definition of evaluation criteria for anthropometrics and physical fitness level for talent identification and selection of young soccer players.

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ANALYSIS OF THE IMPACT OF VAR TECHNOLOGY ON SITUATIONAL EFFICIENCY IN FOOTBALL

Original Scientific Paper

Damir Obad

ABSTRACT: The main goal of this research was to analyze the application of VAR technology in football. We are witnesses that the video Assistant Referee causes controversy every week not only in the Wwin League of Bosnia and Herzegovina, but also within the leagues of major European football powers, and even in UEFA and FIFA competitions. The question of all questions is "how are decisions made and are they correct?". This was precisely the problem of this mini-research, to determine through theoretical and comparative analysis how and to what extent VAR technology helps or hinders the performance of football clubs. In order to better understand the application of VAR technology, we conducted a comparative analysis of the English Premier League and the German Bundesliga regarding VAR technology interventions. For this purpose, we applied descriptive statistical indicators, and based on their results, we determined the differences between variables that are directly under the control of the VAR technique using the Kruskal-Wallis ANOVA test. The results show that the use of VAR technology is statistically more significant in the English Premier League than in the German Bundesliga.

Keywords: *football, situational efficiency, var technology.*

INTRODUCION

The goal of the game of football itself is to score as many goals as possible in relation to the opposing team and thus achieve a successful result. Successful results are primarily conditioned by a series of anthropological characteristics and abilities of the players, on which the construction of the football game setup, the speed of game transformation and the technical performance of the player potential of a given team directly depend. The complexity of the execution of these player actions and the impact on the successful results has been further complicated by the introduction of the VAR technique, which aims to only partially clarify controversial situations during the game itself.

However, the limited analysis of controversial situations by the terrible VAR technique has certainly further complicated the process of the game itself, and according to previous indicators has reduced the efficiency of the playing staff, thereby reducing situational efficiency. On the other hand, looking globally at the issues of modern football, a visible partial progress has been achieved in the process of making referee decisions, as well as additional space left for the main referees to accept or not accept the suggestion of the VAR technique.

Since its introduction, the VAR (Video Assistance Referee) system has had a significant impact on refereeing, players, coaches, officials and fans in a football match, and gradually on the way the game is played and on football as a whole. The four situations in which the VAR is competent to control them are: the situation of whether there was a goal or no goal, the incident for a penalty kick or not, the incident for a direct red card and the incident of mistaken identity. The goal of the VAR system is not to achieve 100% accuracy of all decisions, but to influence the refereeing and the football game, so that major mistakes that affect the final outcome of the match are corrected.

Analyzing data from the largest European leagues, the influence of VAR on the final outcome of matches is visible, as well as the different "arches" of the application of VAR technology in relation to opposing opponents, or even third parties who are waiting for the desired outcome of the match under the direction of the refereeing team. The number of fouls, yellow and red cards, attempts to simulate was significantly reduced, and the number of penalty kicks awarded due to VAR intervention increased.

FIFA research (2018-2023) showed that before the introduction of VAR, a major key error occurred on average every third match, and after the introduction of VAR, this is much less common and occurs on average every 10 to 15 matches. However, in the Wwin League of Bosnia and Herzegovina, complaints about VAR decisions have increased significantly and, according to relevant indicators, have contributed to the impact on the performance. In this paper, we have analyzed the impact of VAR in a positive and negative sense in relation to the overall situation of the game on the field during the match.

RESEARCH METHODOLOGY

Theoretical consideration and analysis of the strengths and weaknesses of VAR technology

Video Assistance Referee or video assistant referee, or VAR, was designed with the intention of reducing critical errors in the decision-making of football referees, thereby increasing the perception of "justice and fair judging" (Samuel, Galily, Filho, & Tenenbaum, 2020: 1).

The use of this technology is allowed only if the organizer of the match or competition has fulfilled all the requirements of the Implementation Assistance and Approval Program (hereinafter IAAP) as stated in the FIFA IAAP documents (Principles of VAR - IFAB).

Consequently, the use of the VAR system is based on a series of principles (Principles of VAR - IFAB) (AFC 2020: 9-10): 1. The video assistant referee is

a match official who has independent access to the match footage and who, in the event of a clear and obvious error or serious refereeing omission regarding (FIFA, 2018):

- awarded or non-awarded goal,
- awarded/unawarded penalty kick,
- given a direct red card and in the event
- substitution of player identity when the referee cautions or sends off the wrong player of the offending team reacts to the situation.

According to the rules of VAR technology, the head referee in all disputed situations on the field must make a decision in relation to the situation on the field in order to be able to access VAR technology at all in the further decision-making phase. To clarify, the referee is not allowed to rule "no decision" and then use VAR technology to ultimately make the final decision. The original decision made by the referee will not be changed unless the video review clearly suggests a "clear and obvious error".

Only the referee in doubtful situations can initiate a VAR review, while at the same time VAR referees can only recommend a review or re-review, which the referee of the match does not have to accept. This is certainly a rule of Var technology that leaves a lot of room for subjective evaluation and abuse of the rules of the football game. Also, these and similar situations have a direct impact on the final success of the match. Which favors one of the opponents

The final decision is always made by the referee, regardless of whether it is based on information from VAR technology or after the referee has performed an on-field inspection (hereinafter referred to as OFR). There is no time limit for the review process because accuracy is more important than speed, so we are witnessing that this check sometimes lasts 3-5 minutes, thus taking away the effective time for the game, which the referees often and non-reimbursements, which is also considered to have a direct impact on the final outcome of the game . The players themselves on the field are put in a subordinate position in terms of interruption of the game, loss of continuity of the game, drop in body temperature (hypothermia) and the possibility of injury in the further course of the game with long-term consequences.

The good side of the Var decision is that the players and officials of both teams are forbidden to approach the referee and thus try to influence the revision of the decision or influence the final decision. The referee must remain "visible" during the review process to ensure full transparency. If play continues after an incident which is then reviewed, any disciplinary action taken in the period following the incident is not overturned, even if the original decision is changed (other than a caution/sending for stopping or disrupting a promising attack).

As an example, we will also show the scenario of a missed penalty kick for team A. After a missed kick, team B has a chance to counter attack.

In order to prevent this, a player of team A commits an interruption which is sanctioned with a yellow card. After reviewing the contested penalty for team B, even if a penalty kick is awarded from the beginning of the example, the yellow card will not be overturned. If play is stopped and restarted, the umpire may not conduct a "review" except in the case of mistaken identity or a potential sending off offense involving violent behavior, spitting, biting or grossly offensive behavior and/or offensive actions. At the moment of these and similar disputed situations, VAR technology will automatically "check" every situation or decision, behavior and reaction of the coach to the decision, players or other official staff and they cannot in any case request a "review" of the disputed situation. For the purpose of practical demonstration of the use of VAR technology, an example is given with the analysis and determination of differences in the application of VAR in the English Premier League and the German Bundesliga.

Sample of respondents

The sample in this study was taken as a sample of controversial situations in which the VAR technician reacted, in 72 matches played (36 processed matches in the English Premier League and 36 processed matches in the German Bundesliga, in the 2022/2023 and 2023/2024 competition seasons.

Sample of variables

The following variables/situations during the match that are directly under the jurisdiction of the VAR technique were taken as a sample of variables: Total number of VAR interventions (UBRVINT), Change of decision (PROMODL), Recognized goals (PRIGOLO), Disallowed goals (PONGOLO), Awarded penalty kick (DOSKUDA), Awarded penalty kick for handball (DOSKUIR), canceled penalty kick (POKAZUD), Retaken penalty kick (POIZKAU), Cancelled goals for offside (PONGOZ), Recognized goals after an incorrect offside call (PRGNPDZ), Cancelled goals for handball (POGZIGR), Disallowed goals due to fouls (POGZPRE), Red cards (CRVKART), Disallowed yellow card (PONZKAR), Wrong identity (POGIDEN).

Data processing methods

To process the data obtained after the analysis of the matches, the method of determining descriptive statistical indicators, graphical display, was used, and based on the results of the same, we determined the differences between the variables of the Var technique applied in the English Premier League and the German Bundesliga in the 2023/2024 season using the Kruskal-Wallis ANOVA test.

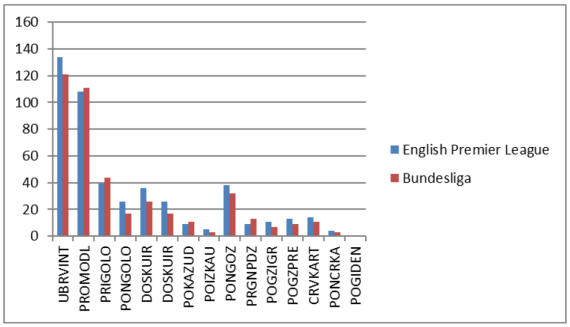
Research results with discussion

To process the data obtained after the analysis of the matches, the method of determining a descriptive statistical indicator, a graphic display was used, and based on the results of the same, we determined the differences between the variables of the Var technique applied in the English Premier League and the German Bundesliga in the 2023/2024 season using the Kruskal-Wallis ANOVA test.

Table 1. VAR statistics for English and German Bundesliga matches in the 2023/2024 season. year

VAR INTERVENTIONS	English	Bundesliga
TOTAL NUMBER OF VAR INTERVENTIONS	134	121
DECISION CHANGES	108	111
GOALS AWARDED	39	44
GOALS DISMISSED	26	17
PENALTIES AWARDED	54 (out of 68 awarded)	26 (out of 56 awarded)
PENALTIES AWARDED FOR HAND LAY	26	17
PENALTIES DISMISSED	9	11
PENALTIES RE-TAKEN	5	3
GOALS DISMISSED FOR OFFSIDE	38	32
GOALS AWARDED AFTER WRONG OFFSIDE	9	13
GOALS DISMISSED FOR HAND LAY	11	7
GOALS DISMISSED FOR OFFSIDE	13	9
RED CARDS	14	11
RED CARDS OVERRULED	4	3
MISCONCEPTED IDENTITY	0	0

Graph.1. Graphical representation of VAR intervention in the English Premier League and the German Bundesliga



The data analysis used an identical number of clubs and matches to provide a more relevant representation of the use of VAR (18 clubs and 36 matches).

Table 2. Determining differences in the investigated variables of the VAR technique in the English Premier League and the German Bundesliga using the Kruskal-Wallis ANOVA test

VARIABLE	English	Bundesliga	Z	p-value
UBRVINT	134	121	-2,31	0,02
PROMODL	108	111	2,09	0,04
PRIGOLO	39	44	2,45	0,01
PONGOLO	26	17	2,03	0,03
DOSKUIR	54	26	2,10	0,04
DOSKUIR	26	17	2,21	0,03
POKAZUD	9	11	-2,29	0,02
POIZKAU	5	3	-1,81	0,07
PONGOZ	38	32	-2,11	0,01
PRGNPDZ	9	13	2,17	0,04
POGZIGR	11	7	2,41	0,01
POGZPRE	13	9	2,33	0,01
CRVKART	14	11	2,05	0,04
PONCRKA	4	3	0,57	0,42
POGIDEN	0	0	0,23	0,82

LEGEND: Rank Sum Group 1- total in group 1, Rank Sum Group 2 - total in group 2, U-value obtained for testing the statistical significance of the differences, Z-Z value to which it is approximated, p-value - the amount of error that shows that the difference is statistically significant Variable

LEGEND: Total number of Var interventions (UBRVINT), Decision change (PROMODL), Goals conceded (PRIGOLO), Goals disallowed (PONGOLO), Penalty kick awarded (DOSKUDA), Penalty kick awarded for handball (DOSKUIR), penalty kick disallowed (POKAZUD), Penalty kick retaken (POIZKAU), Goals disallowed for offside (PONGOZ), Goals conceded after wrongly awarded offside (PRGNPDZ), Goals disallowed for handball (POGZIGR), Goals disallowed for fouls (POGZPRE), Red cards (CRVKART), Wrong identity (POGIDEN).

It is evident that there is a statistically significant difference in several researched variables for assessing the effectiveness of VAR technology (8 variables), which speak of a greater or more frequent use of VAR technology in the English Premier League compared to the German Bundesliga, in which statistical significance speaks in favor of the same in 4 researched variables, while in 3 researched variables there is no statistically significant difference, which was determined by the Mann Whitney test. So it is evident that VAR technology was used more in the English Premier League, and that it had a statistically significant impact on the situational efficiency of the football game.

CONCLUSION

In the methodology of this paper, a detailed theoretical analysis of the application of the VAR technique was made, in order to assess the positive and negative sides of this technology for monitoring and supervising the match. Also, for the purpose of showing practical use, an overview of the use of the VAR technique in the English Premier League and the German Bundesliga was given. From a theoretical consideration as well as a practical presentation, it is evident that VAR technology has introduced significant changes to the rules of modern football with the key intention to eliminate doubts in certain situations on the field during the match, as well as to make the best possible insight into the overall events of the match including all actors both on and off the field.

The intention was also to significantly reduce the subjective influence of the referees on the overall events on the field as well as the influence on the results of individual clubs. However, we will all agree that this segment still remains under the full control of the head referees due to the rule that the head referee may or may not accept intervention from the VAR room, which leaves a lot of room for the abuse of the head referee's duties and the possibility of directly influencing the final results, which we already had the opportunity to see and see for ourselves within the domestic Wwin league.

The fact that the referees were penalized but the result achieved, which was created by the direct decision of the referees, was verified as an official result without the possibility of any change. Therefore, in the end, the question of applying VAR technology justifiably arises, how and to what extent to persuade referees to consistently implement all registered situations and irregularities by VAR technology.

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ATTITUDES OF EDUCATORS ABOUT THE IMPORTANCE OF PHYSICAL ACTIVITY FOR THE PROPER DEVELOPMENT OF PRESCHOOL CHILDREN

Original Scientific Paper

Jasmin Budimlić, Lejla Lončar, Estela Hadžikadunić, Berina Turković-Malkić, Ilić Nikola

ABSTRACT: This research examines the attitudes of educators in kindergartens and preschool institutions regarding the importance of physical activity for the physical, emotional, and cognitive development of preschool children. We investigated and analyzed educators' perspectives on the role of physical activity in the daily lives of preschoolers and assessed the extent to which physical activity is integrated into daily activities and work plans in preschool settings. The results of this study provide insights into how educators' perceptions of physical activity influence their practices and how these practices can be improved to better incorporate physical activity into preschool programs. Understanding educators' attitudes offers a perspective on the integration of physical activity into educational programs and how their knowledge and perceptions shape practices and policies in kindergartens. The study involved 20 educators from public and private preschool institutions in the city of Bihać, all of whom hold degrees in preschool education and have passed professional certification exams.

Keywords*: physical activity, preschool children, motor skills, educators' attitudes*

INTRODUCTION

In today's world, more and more children spend time sitting or lying down indoors, while physical activity is becoming less prevalent. Many parents, due to work obligations, are unable to monitor their children's physical activity and are often not sufficiently informed about the importance and benefits of physical activity from an early age. Physical activity is a basic human need, particularly emphasized in children, who are constantly doing something—crawling, walking, running, and exploring their environment. It is of critical importance during preschool age, as children undergo various complex processes of growth and development. Additionally, physical activity plays a significant role in achieving optimal health and reducing the risk of various diseases.

A lack of movement and insufficient physical activity negatively impacts a child's health, growth, and development. It can result in problems with socialization, lack of self-confidence, and communication difficulties. Moreover, insufficient movement can lead to obesity, poor posture, and hinder the normal functioning of bodily organs, with long-term consequences for their future well-being (Prskalo & Sporiš, 2016).

It is crucial to encourage preschool children to engage in physical activity. There are various ways to achieve this. First, by creating an environment that motivates children to move and play, including providing toys, equipment, and tools that encourage activity (Mraković, 1992). Another approach is organizing structured physical education activities. These activities can be implemented in preschool institutions and include exercises, games, and sports activities tailored to children's age. Insufficient physical activity can affect the development of a child's cognitive, emotional, and social skills (Bungić & Barić, 2009).

According to the World Health Organization (WHO) guidelines, preschool children should engage in at least 180 minutes of physical activity each day, including activities such as outdoor play, dancing, strength exercises, and flexibility exercises. These activities not only promote the healthy development of muscles and bones but also enhance concentration and academic success later in life. Well-designed, organized, and guided physical exercise programs in kindergartens positively impact the anthropological characteristics of children.

Movement in preschool-aged children is essential, and they need as much physical activity as possible to positively influence their growth and development. The role of educators in preschool institutions is pivotal in shaping and promoting physical activity as an integral part of children's daily lives. Understanding educators' attitudes can provide insight into how physical activity is integrated into educational programs and how their perceptions and knowledge influence practices and policies in kindergartens.

RESEARCH METHODS

The subject of this research is the attitudes of educators in kindergartens and preschool institutions regarding the importance of physical activity for the physical, emotional, and cognitive development of preschool children. The aim of the research is to examine and analyze educators' attitudes about the importance of physical activity in the daily lives of preschool children and to determine how physical activity is integrated into daily activities and work plans in preschool institutions.

The specific objectives of this research are to identify educators' attitudes, perceptions, and beliefs regarding the role of physical activity in the development of preschool children, to analyze current practices to investigate how physical activity is currently implemented in preschool institutions and to what extent it is included in daily schedules, to identify barriers and facilitators affecting the implementation of physical activity in preschool institutions and provide recommendations for improving practices.

The research sample consists of educators from the city of Bihać, employed in both public and private preschool institutions. A total of 20 educators participated in the research. All participants have completed a Faculty of Preschool Education and passed a professional qualification exam.

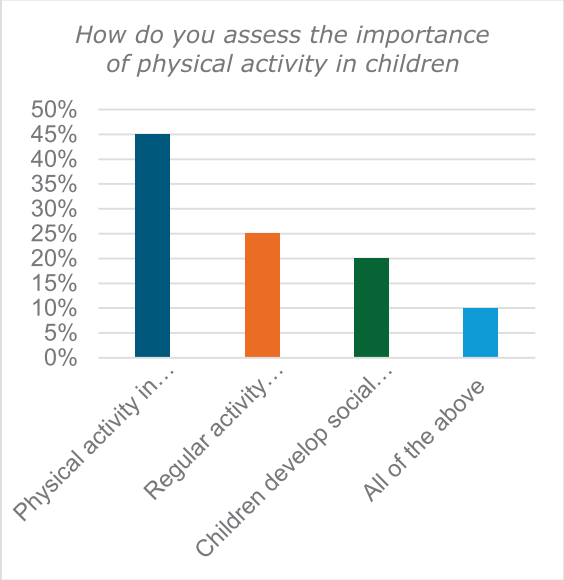
For the purpose of this research, a survey questionnaire was used as the measuring instrument, containing 18 questions designed to reflect the educators' attitudes and opinions on the defined research subject.

DATA PROCESSING METHODS

Relevant statistical methods were applied in this research. Statistical data processing was performed using the SPSS 20 software for macOS. Response frequencies for each question from the applied questionnaire were presented for each category of participants, and the results were also expressed as percentages. Furthermore, the results were visualized in graphical form.

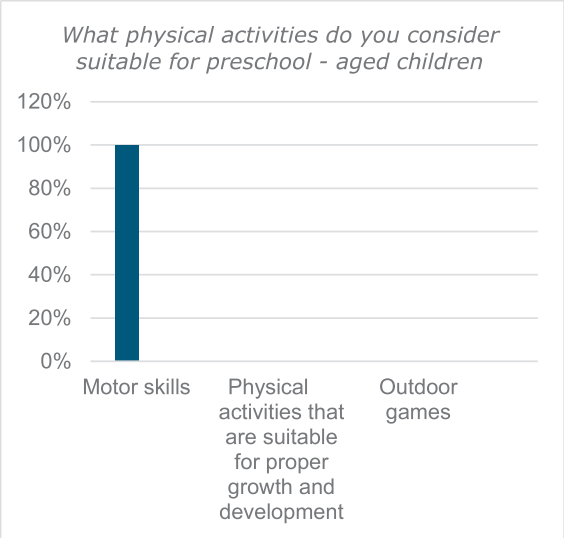
RESULTS AND DISCUSSION

Graph 1. Importance of physical activity for children



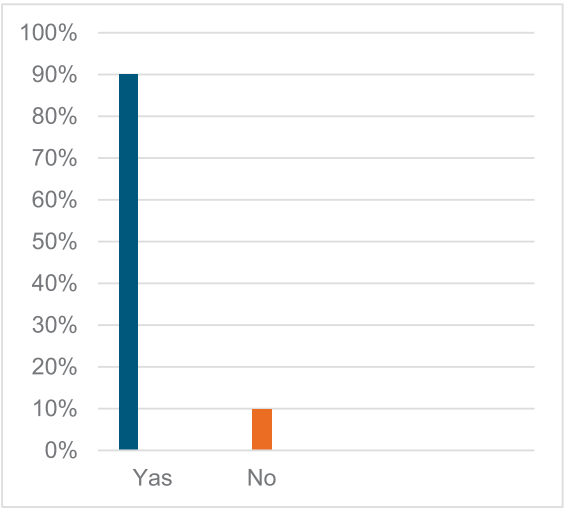
The chart reveals that nine respondents (45%) emphasize that physical activity is crucial for developing children's motor skills, especially during sensitive developmental periods. This response emphasizes the importance of physical activity in development of basic motor skills such as coordination, balance, and fine motor abilities. Five respondents (25%) believe that regular physical activity promotes proper physical growth and development, highlighting its role in maintaining overall health and preventing issues like obesity and weak muscle tone. Four respondents (20%) state that physical activity contributes to developing social traits, including cooperation and positive interactions among children. This response suggests that physical activity is viewed as a tool for fostering social skills and emotional growth through interaction and play. Lastly, two respondents (10%) recognize that physical activity encompasses all these aspects, reflecting a comprehensive understanding of its significance across various dimensions of child development.

Graph 2. Physical activity suitable for preschool children



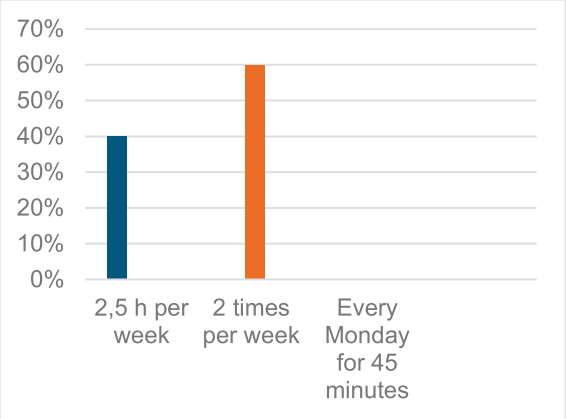
All 20 respondents (100%) agree that physical activities are essential for children's proper growth and development, indicating a unanimous acknowledgment of their importance in preschool-age children. Suitable activities include running, jumping, climbing, ball games, dancing, and other movement-based games. These not only aid in motor skill development, coordination, and general fitness but also support social and emotional growth, providing opportunities for peer interaction and skill-building. This consensus highlights a shared understanding of the pivotal role of physical development and health in the overall development of preschool children.

Graph 3. Physical activity in kindergarten daily schedule. Do you plan physical activities in the daily schedule of the kindergarten?



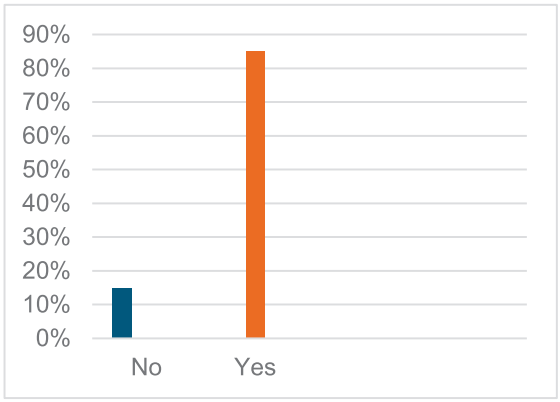
Eighteen respondents (90%) integrate physical activities into children's daily schedules, recognizing their importance for motor development, coordination, and health. This practice helps establish routines and promotes positive habits early on. However, two respondents (10%) report not scheduling daily physical activities, possibly due to challenges like limited space, time constraints, or lack of resources. These challenges highlight the need for better organization and support for daily physical activity implementation. Here, educators face challenges in organizing schedules or other factors that make it difficult to include physical activities every day.

Graph 4. Number of hours of physical activities according to the Curriculum
According to the plan and program, and the program contents, how many hours are estimated for physical activities for children in your preschool institution



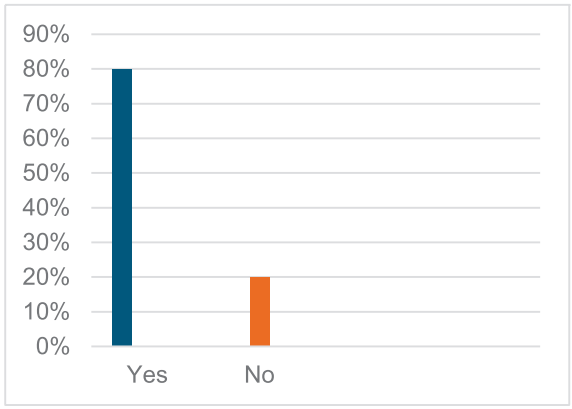
The chart shows that most respondents (60%) plan physical activities twice weekly, while 40% plan for a total of 2.5 hours weekly. The former suggests shorter, regular sessions, while the latter indicates more extensive or diverse activities, potentially offering deeper engagement and benefits for motor development and overall health. This approach can provide children with regular opportunities for physical activity, but given the frequency, it may result in shorter durations for each session. On the other hand, planning 2.5 hours of physical activity weekly, as reported by 40% of respondents, indicates an overall greater amount of time dedicated to physical activity. This approach may involve longer or more diverse activities, allowing deeper engagement of children in physical activities, which can offer additional benefits for their motor development and overall health.

Graph 5. Improvement of children's physical activities
Do you collaborate with other educators or specialists to improve children's physical activity



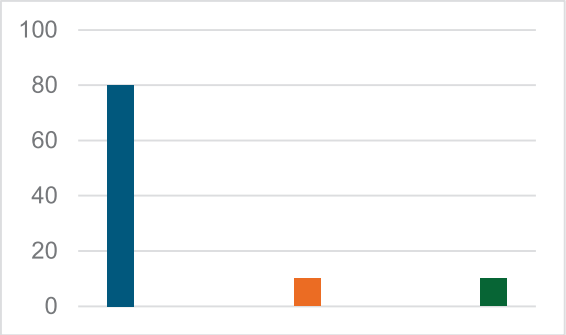
Seventeen respondents (85%) confirm collaboration, reflecting a high level of collegial and professional cooperation aimed at improving children's physical activities. This collaboration may involve sharing best practices, co-planning activities, or engaging experts for additional education and resources. Conversely, three respondents (15%) do not collaborate, potentially due to resource or organizational challenges. They may face limitations in terms of the availability of specialists, time constraints, or other organizational barriers that hinder collaboration.

Graph 6. Parental support for physical activity in and out of kindergarten
Do you involve parents in supporting their children's physical activity both inside and outside the kindergarten



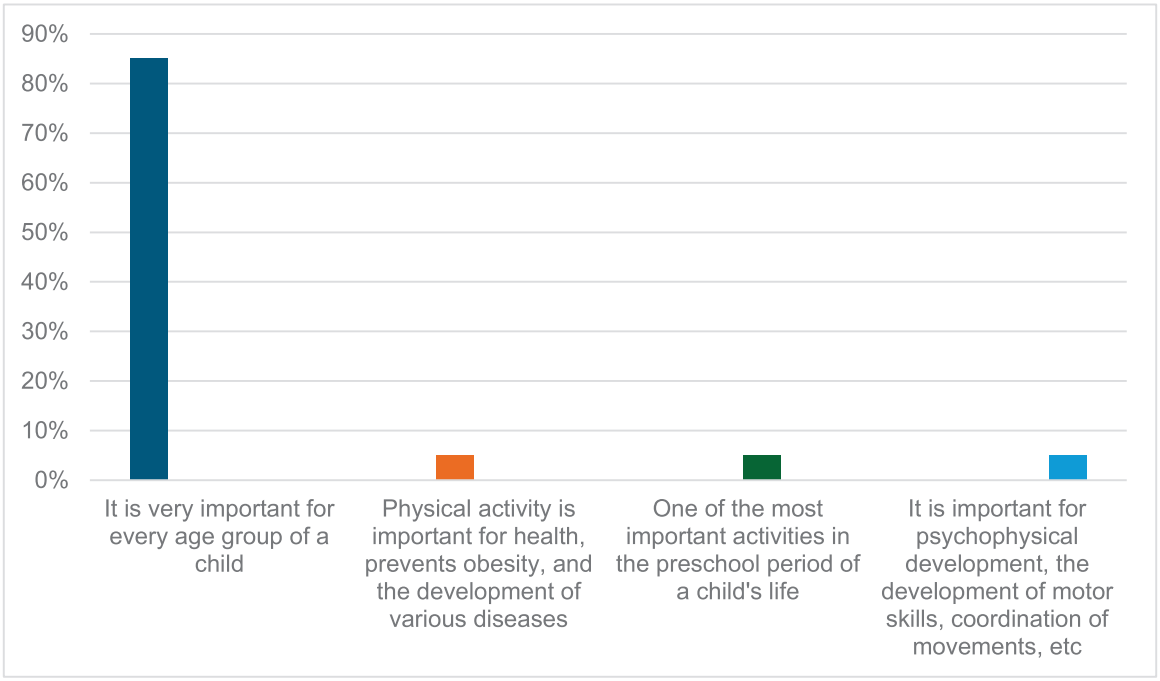
Sixteen respondents (80%) actively involve parents, emphasizing the awareness of the importance of shared responsibility for children's physical development. Parental involvement ensures continuity of activity beyond preschool. Four respondents (20%) do not involve parents, which may be due to communication or collaboration barriers. Possible reasons for this could be a lack of time, resources, or interest on both sides, which may make it challenging to integrate physical activity into the child's daily life outside of preschool.

Graph 7. Obstacles in implementing physical activites Are there any major obstacles you face when implementing physical activity in the kindergarten



Analyzing Graph 7, we can see that educators face numerous obstacles when implementing physical activities, which can significantly impact the quality and frequency of physical activity in preschool age. Two respondents (10%) stated that large group sizes pose a challenge, making it difficult to organize physical activities. When there are many children in a group, educators find it hard to give enough attention to each child. Sixteen respondents (80%) reported that the lack of equipment, such as balls, hoops, mats, and other tools, which is often limited or outdated. Without adequate equipment, educators are forced to improvise or limit the activities they can conduct with children, which can reduce the diversity and quality of physical education. Another two respondents (10%) indicated that many preschools lack sufficient space for conducting physical activities properly, especially indoors. The absence of large halls or equipped rooms means activities often have to be conducted in confined spaces, which can restrict the type and scope of exercises that can be performed.

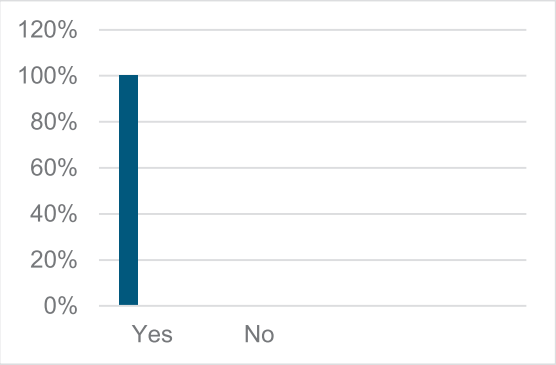
Graph 8. Assessing the importance of physical activity How do you assess the importance of physical activity



Analyzing Graph 8, we can see that most respondents, specifically seventeen (85%), stated that physical activity is important for every stage of a child's development. It promotes motor skills, develops coordination, balance, and fundamental physical abilities that will be essential throughout life. Among the other respondents, one (5%) emphasized that physical activity plays a key role in maintaining a healthy body weight. In an era where childhood obesity is an increasing concern, regular physical activity helps prevent excessive fat accumulation and reduces the risk of developing type 2 diabetes, heart disease, and other related health issues.

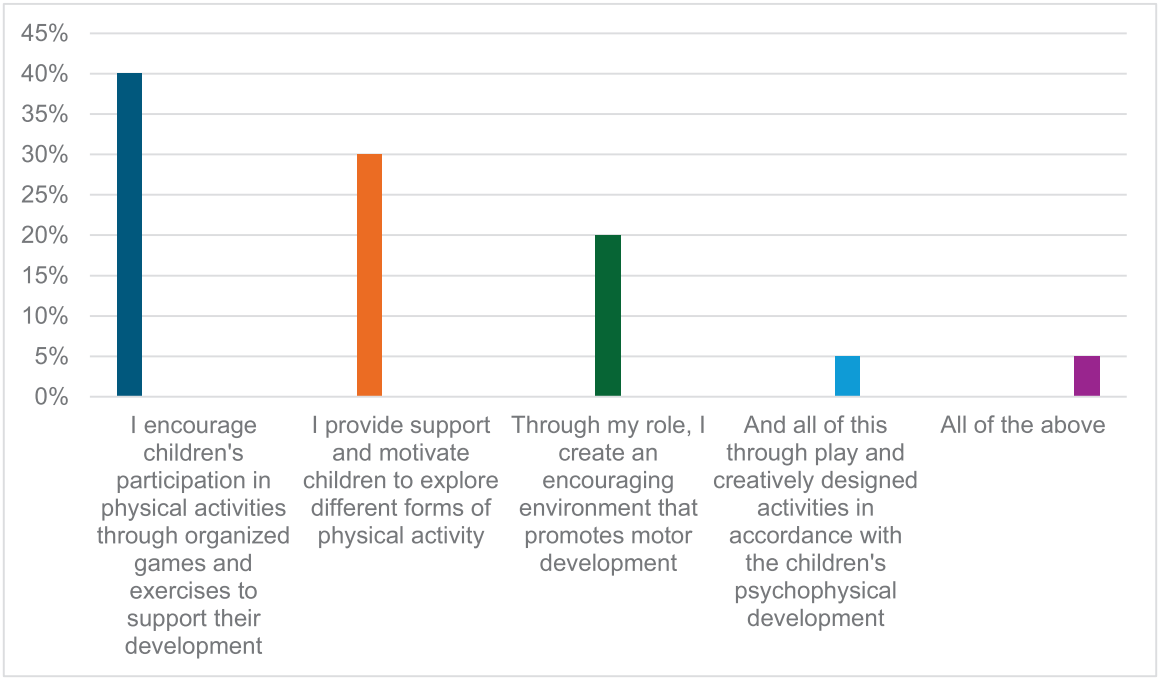
Another respondent (5%) highlighted that physical activity is one of the most crucial activities in preschool age, holding a central role in development. A third respondent (5%) stated that physical activity is essential for the overall psychophysical development of a child. It not only contributes to physical health but also to mental well-being. Active children often have better moods and fewer problems with anxiety and stress.

Graph 9. Physical activity is equall y important as other aspects of education in kindergarten Do you consider physical activity to be as important as other aspects of education in the kindergarten



An analysis of Graph 9 reveals that all twenty respondents (100%) consider physical activity equally important as other aspects of preschool education, highlighting a widespread awareness of its vital role in a child's overall development. This unanimous opinion among educators demonstrates that physical activity is not merely an addition to the educational program but a key component on par with other aspects of development, such as social, emotional, and cognitive growth. This unity in the educators' views also emphasizes the need for adequate resources and support in preschools to ensure that physical activity can be conducted effectively. Despite its recognized importance, challenges such as a lack of space, equipment, or time can hinder the effective integration of physical activities. Therefore, this insight can serve as a strong argument for improving conditions and programs that support physical activity in preschools.

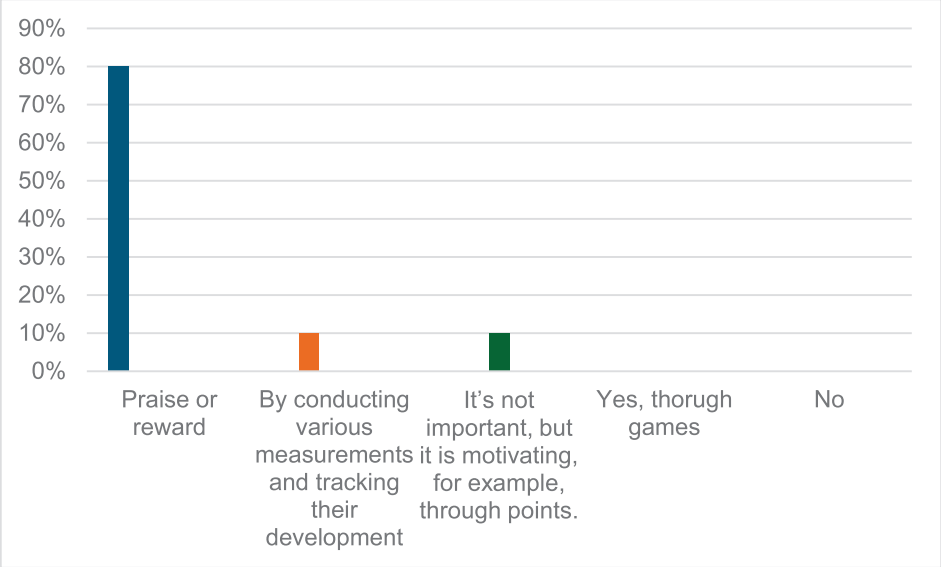
Graph 10. Encouraging children to participate in physical activities
How would you describe your role in encouraging children to participate in physical activities



An analysis of Graph 10 shows that eight respondents (40%) emphasize the importance of organized games and exercises as key tools for encouraging children's participation in physical activities. This approach relies on guiding children through planned activities designed to support their physical development. Organized games and exercises enable children to develop motor skills and coordination through structured movement and enjoyable activities. On the other hand, four respondents (20%) highlight the importance of providing support and motivation to children to explore various forms of physical activity. This approach focuses on children's autonomy and natural curiosity, allowing them to independently discover and choose activities that interest them. By offering encouragement and motivation, educators inspire children to experiment with different types of movement, fostering creativity and individual interests in physical activities.

Additionally, six respondents (30%) state that they play a role in creating an encouraging environment that promotes motor development, cooperation, and socialization through physical activity. One respondent (5%) mentioned utilizing all these strategies, while another respondent (5%) said they promote physical activity through play and creatively designed activities tailored to children's psychophysical capabilities.

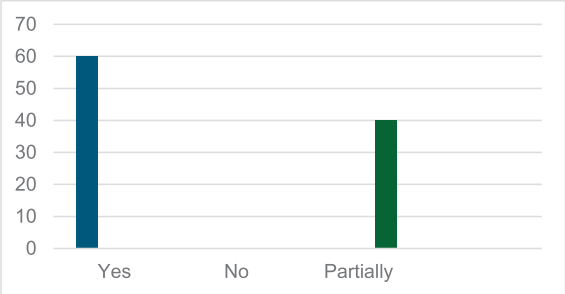
Graph 11. Assessing children's physical activity
Do you think it is important to assess children's physical activity? If so, in what way?



An analysis of Graph 11 reveals that sixteen respondents (80%) believe that evaluating children's physical activity is important, but the emphasis is not on traditional grading, such as assigning formal grades. Instead, the focus is on encouraging and motivating children through positive feedback. Praise or rewards are most commonly used, maintaining an approach that encourages children to participate in activities through affirming support. Praise and rewards serve as motivational tools, encouraging children to continue engaging in physical activities with enthusiasm and joy. Two respondents (10%) emphasize a more formal approach, focusing on measuring and monitoring children's development, highlighting the importance of objectively tracking progress in physical development. This approach allows for systematic monitoring of children's physical abilities and motor development, which can be useful for tailoring activities to the individual needs and capabilities of each child. While this method has its advantages in terms of precision and program customization, it is less commonly used by educators.

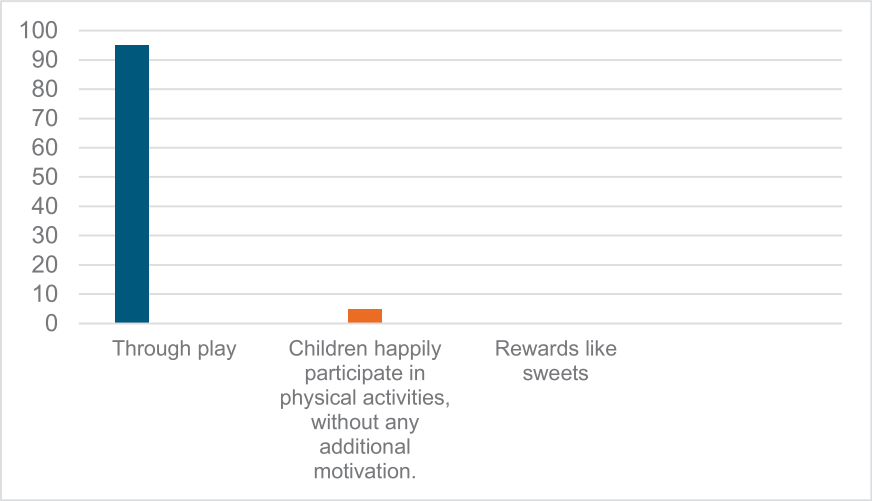
The remaining respondents (10%) do not consider formal evaluation important but still use certain motivational mechanisms, such as points, to encourage children to participate. This approach recognizes the value of motivation but does not emphasize formal grading as a key element. Instead, a point system is used as a form of play and fun, further encouraging children to engage in physical activity.

Graph 112.. Promote physical activity
Does your kindergarten promote physical activity



The results show that the vast majority of educators believe that their kindergarten actively promotes physical activity, which indicates a recognition of the importance of physical activity in preschool education. The percentage of 60% of respondents who responded affirmatively suggests that many kindergartens have implemented programs and activities aimed at encouraging children to engage in regular physical activity. This practice can include various forms of organized sports activities, daily physical games, and directed movement that is integrated into the daily routine of the kindergarten. However, the remaining 40% of respondents who responded "partially" indicate the existence of certain obstacles or shortcomings in some kindergartens when it comes to the systematic promotion of physical activity. This response may indicate that although physical activity is promoted, it may not be sufficiently organized or it takes place on a secondary basis without a clear program. Possible reasons for partial promotion of physical activity may include limited resources, such as lack of space or equipment, lack of time in the daily schedule, or insufficient support and education for parents.

Graph 13. Motivating children for physical activities
How do you motivate children to participate in physical activities



In Graph 13, responses indicate that 95% of respondents use play as a motivational tool, emphasizing the understanding that play is the most natural and effective way to engage children in physical activities. Play allows children to participate in activities that promote their physical development through fun, without pressure, and with a sense of freedom.

On the other hand, one respondent (5%) states that children are eager to participate in physical activities without the need for additional motivation. This response suggests a situation where physical activities are already well-integrated and accepted in children's daily lives, implying that the children have developed a positive attitude toward physical activity.

Graph 14. Attitudes towards physical activity
How do you align your own views on physical activity with the pedagogical approach in working with children

Analyzing Graph 14, fifteen respondents (75%) believe that their personal attitudes are fully aligned with the pedagogical approach, emphasizing that physical activity and play are recognized as key elements in promoting children's health, motor development, and overall well-being. Here, educators clearly view physical activity as an essential part of the child's overall development, naturally integrating it into their daily practices and interactions with children. On the other hand, five respondents (25%) place special emphasis on play as the most important aspect of a child's life, with physical activities being an integral part of that play. These respondents recognize play as the natural medium through which children develop key motor skills, such as running, jumping, climbing, and crawling. This approach highlights play not only as a tool for physical activity but also as the fundamental way in which children engage with the world.

CONCLUSION

A number of studies have confirmed the importance of physical activity in preschool age. As mentioned in the paper, physical activity in early childhood significantly influences proper growth and development. Additionally, physical activity helps regulate a child's weight and reduces the likelihood of various diseases, which are increasingly common among children today. In modern times, children are engaging less in physical activities, particularly outdoors, and spending more time in sedentary positions, often

in front of computers. Therefore, it is crucial that parents and educators take an active role in guiding children towards physical activities. Their support and encouragement can significantly contribute to changing this trend and help develop healthy habits that will positively impact children's overall health and development. Educators in preschools should regularly practice various physical activities to encourage children to move and exercise actively. The physical activities carried out with children should be tailored to their abilities, capacities, and needs. Preschool children love to be active. They are born with a desire for physical activity—running, playing, jumping, and dancing. Physical activity must be encouraged within the child's natural desire for movement. Parents, educators, and others working with children must nurture this need daily in a positive and cooperative environment. Motor skills activities must focus on the development of motor abilities and skills and should be chosen in accordance with the abilities of preschool children. Through this work, the insights gained help understand how educators' perceptions of physical activity reflect on their practice and how the approach to physical activity in preschools can be improved.

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DIFFERENCES IN THE PARAMETERS OF MOTOR SKILLS OF THE CENTERS DIFFERENT LEVELS OF SUCCESS

Original Scientific Paper

Aleksa Stanković, Alem Kukić, Nermin Salkanović

ABSTRACT: The main objective of this study was to determine intrapositional differences in motor skills. The set of variables in this study was composed of 12 motor tests. Groups of trotters of centers of different levels of success statistically do not differ significantly in a linear combination of dependently variable variables of motor skills. However, it is observed that the group of more successful centers than less successful centers shows better results in all tests of reflective power, locomotor speed and two out of three agility tests (T-test and Line test). The following tests have a unique statistical significance for distinguishing the groups: T – agility test (Sig=.000), Line agility test (Sig=.001), 20m run (Sig=.014) and 15m run (Sig=.021) and CMJ Stifness 10 (Sig=.036). The results of this research can be part of the contribution to the segment of the research area of specialists for determining their desirable profiles, as well as motor skills profiles, and their comparison with the profiles of top basketball players is unavoidable.

Keywords: *differences, motor skills, basketball, centers*

INTRODUCTION

The basketball coach must supervise and ensure the balanced development of the players, i.e. its physique, improvement of visual and motor coordination, development of necessary basic and specific motor skills taking into account evolutionary processes related to the pace of growth and maturation of players. (Sánchez-Muñoz, Zabala, Williams, 2012; Šimonek, Horička, Hianik, 2016). Typically, a key component in the process of assigning specific playing positions is body height, in which the tallest players near the basket are chosen as centers. Given the limited attention that has been focused on predicting performance in team sports, it is important to research, analyze and to present information on the values and interrelationships of body composition parameters and motor skills represented by the parameters of locomotor speed, specific basketball agility and explosive power. There is also a noticeable lack of previous studies that would compare the physical and speed strength qualities of basketball players of different levels of performance as well as players of different basketball positions. Therefore, the aim of this research is to compare the parameters of speed-strong qualities of young basketball players (cadets) of different individual quality and different positions in the game, who are members of teams of different levels of success in the Sarajevo Cantonal League.

WORKING METHODS

Sample of respondents

The sample of respondents consisted of a total of 41 basketball players, cadets, 19 successful and 22 less successful . In relation to the achieved placement, all the clubs and basketball players were divided into three quality groups. The first group consists of basketball players whose clubs are took 1st to 4th place, the second group consists of basketball players whose clubs took 5th to 8th place and the third group of basketball players whose clubs achieved a placement of 9.do 12 Places. All players had a basketball federation card Bosnia and Herzegovina certified by the competent Institute of Sports Medicine.

Sample of variables

Independent variables
Of the motor tests for the assessment of locomotor speed, agility and rebound power, the following tests were applied: running time of sections of 5, 10, 15, and 20m, T – agility test, Line agility test, Zigzag – Agility test, vertical reflection of the foot – hands on the side (squat jump), vertical reflection of the feet with the swing of the hands (sqaut hand free jump), vertical reflection after jumping from a height of 40cm (drop jump), 10 consecutive vertical vertical jumps (repeating vertical jumps), standing long jump.

Dependent variables
For the purpose of more detailed analyses, two dependent or grouping variables have been defined:
Position in the game-centers
The Success of Basketball Players
The Success of Basketball Players
According to this criterion, basketball players are divided into two groups:
Group 1 - The Most Successful Players
Group 2 – less successful basketball players
A player's competitive performance is determined by a scale of 1 to 5. Each basketball player was assigned a score from 1 to 5 according to two criteria (Table 1):
Team placement at the end of the competition:
All teams (12 basketball clubs)
who participated in the Cadet League of Sarajevo Canton for the 2019 season, with regard to placement, are grouped into 3 categories (1st - 4th place; 5th-8th place; 9th-12th place). The quality of the players in the team (as assessed by the coach). Each coach divided the basketball players of his team into three

quality groups *(above average* - game holders, *average* - other basketball players members of the first lineup and reserves that contribute to the quality of the game; *below* average – basketball players who very rarely or never enter the game).

Basketball players who were assigned grades 4 and 5 were classified in the group of more successful basketball players, and basketball players who were assigned grades 1, 2 and 3 were classified in the group of less successful basketball players (Grgantov et al. 2013).

Table 1. The process of categorizing the individual value of a basketball player

The team's placement in the championship	A member of the representation.	Above average player	Average player	Below average player
(1-4)	5	5	4	3
(5-8)	5	4	3	2
(9-12)	5	3	2	1

Methods for data processing

Within the positional difference and the difference, groups of successful and less successful basketball players by motor skills were checked by tests for Multivariate Analysis of Variance (Manova) with a level of significance of $p \leq 0.05$. Prior to the use of Multivariate Analysis of Variance, preliminary tests were used to test assumptions about normality, linearity, univariation and multicollinearity. mThe contributions of individual sets of analyzed variables for distinguishing groups of basketball players with different positions in the game, as well as for distinguishing groups of successful and less successful basketball players by sets of analyzed variables were determined by the F test for univariate analysis of variance with a level of significance of $p \leq 0.05$ and adequate Bonferroni adjustment taking into account the number of dependent variables. The importance (size) of the influence of the values of individual somatic variables in relation to the groups formed by position in the game and by the performance of basketball players are determined by the values of Partial Eta Squared. Multiple comparisons of the determined group mean values by sets of variables were analyzed by LSD Post Hoc tests.

RESULTS AND DISCUSSION

Two groups of basketball players who play at the center positions (19 more successful centers and 22 less successful centers) were subjected to a multivariate analysis of variance in order to determine differences in the levels and structures of sets of motor ability variables. The mean values and standard deviations of the motor ability variables of the centers classified into 2 groups according to the level of success are shown in Table 2.

Table 2. Mean values and standard deviations of motor skills of CENTERS of different performance groups

Dependent Variable Group of centers by success	Mean	Std. Er
CMJ hands on hips	31.353	1.295
Less successful centers More successful centers	29.759	1.204
CMJ with swing	38.800	1.734
Less successful centers More successful centers	36.332	1.612
CMDJ40 jump	31.268	1.445
Less successful centers More successful centers	28.736	1.373
SIFNESS 10 jumps	30.157	1.186
Less successful centers More successful centers	26.648	1.102
Long jump	217.842	5.982
Less successful centers More successful centers	208.091	5.559
Running 5 m	1.123	.021
Less successful centers More successful centers	1.150	.020
Running 10 m	1.926	.033
Less successful centers More successful centers	1.960	.030
Running 15 m	2.531	.040
Less successful centers More successful centers	2.662	.037
Running 20 m	3.204	.052
Less successful centers More successful centers	3.388	.049
T-test agillity	10.604	.175
Less successful centers More successful centers	11.619	.163
Line agillity test	12.606	.199
Less successful centers More successful centers	13.631	.185
Zig-zag agillity test	5.207	.166
Less successful centers More successful centers	5.130	.154

It can be seen from Table 2 that the group of more successful centers than the less successful centers showed better results in all tests of reflective power, locomotor speed and two of the three agility tests (T-test and Line test). A group of less successful centers has a slightly better result in the Zig-Chuck agility test compared to the group more successful centers.

All multivariate tests confirm that groups of trotters of centers of different levels of success do not differ statistically significantly by a linear combination of dependently variable variables of motor skills (Table 3). The statistical significance of all tests is .066, i.e. Sig<.05, so we conclude that there is no statistically significant difference between the group of more successful and less successful centers in motor skills. However, the Univariate F test data in Table 4 indicate that the following tests in the order of significance of Partial Eta Squared have a unique statistical significance for distinguishing the groups: T – agility test (Sig= .000 with a 31.7% proportion of variance in Line Agility Test (Sig=.001 with 26.7 proportions of variance in dependent variable), 20m running (Sig=.014 with 14.6% proportion of variance in dependent variable) and 15m running (Sig=.021 with 12.8% proportion of variance in dependent variable) and CMJ Stifness 10 (Sig=.036 with 10.8% proportion of variance in dependent variable).

Table 3. Multivariate tests of motor skills of CENTERS of different levels of success

Effect Intercept	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Pillai's Trace	.999	3683.704	12.000	28.000	.000	.999
Wilk's Lambda	.001	3683.704	12.000	28.000	.000	.999
Hotelling's Trace	1578.730	3683.704	12.000	28.000	.000	.999
Roy'sLargest R	1578.730	3683.704	12.000	28.000	.000	.999
KVALGR Pillai's T	.460	1.985	12.000	28.000	.166	0.460
Wilk's Lamda	.540	1.985	12.000	28.000	.166	0.460
Hotelling's Trace	.851	1.985	12.000	28.000	.166	0.460
Roy's Largest R	.851	1.985	12.000	28.000	.166	0.460

Table 4. Univariate tests of the significance of motor skills of CENTERS of different levels of success

Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Sq.
KVALGR		1		.812		
CMJ hands on hips	25.889	1	25.889	1.087	.373	.020
CMJ with swing	62.108	1	62.108	1.648	.304	.027
CMDJ40 jump	65.364	1	65.364	4.701	.207	.041
STIFFNESS – 10 jumps	125.547	1	125.547	1.426	.036	.108
Long jump	969.412	1	969.412	.841	.240	.035
Running 5m	.007	1	.007	.597	.365	.021
Running 10 m	.012	1	.012	5.741	.444	.015
Running 15m	.176	1	.176	6.665	.021	.128
Running 20 m	.345	1	.345	18.07	.014	.146
T-test agillity	10.502	1	10.502	14.21	.000	.317
Line agillity test	10.714	1	10.714	.117	.001	.267
Zig-Zag agillity test	.061	1	.061		.734	.003

CONCLUSION

The aim of this transversal research, of a confirmatory type, is reflected in the effort to verify the existence within the positional differences of basketball cadets in relation to the level of their success in the game and motor skills with an objective, scientifically and methodologically based approach. The research was based on a sample of 41 cadet basketball players, 19 more successful and 22 less successful centers. In order to achieve this goal of the research, an analysis of the differences in dominant motor skills in relation to positions and level of success in the game was carried out as a prerequisite for a more complete explanation of the projected problems and hypotheses of the research. The variables in this study were composed of 12 motor tests. Groups of trotters of centers of different levels of success statistically do not differ significantly in a linear combination of dependently variable variables of motor skills. However, it is observed that the group of more successful centers compared to less successful centers shows better results in all tests of reflective power, locomotor speed and two out of three agility tests (T-test and Line test). The following tests in the order of significance of Partial Eta Squared have a unique statistical significance for distinguishing the groups: T-agility test (Sig=.000), Line Agility Test (Sig=.001), 20m Run (Sig=.014) and 15m Run (Sig=.021) and CMJ Stifness 10 (Sig=.036).

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DIFFERENCES OF PARAMETERS OF SOMATIC CHARACTERISTICS OF BACKS DIFFERENT LEVELS OF SUCCESS

Original Scientific Paper

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ABSTRACT: The main goal of this study was to determine the intra-positional differences in the somatic characteristics of cadet basketball players, taking into account their level of success in the game. The set of variables in this study was composed of 14 anthropometric measures. Although the group of more successful full-backs compared to less successful full-backs has a more pronounced body height, body mass, reaching height and arm span, a higher level of relative lean mass, relative muscle mass and total body water, a lower level of skin folds and relative fat mass, multivariate tests confirm that groups of backs with different levels of success do not have statistical significance in distinguishing according to a linear combination of dependently variable variables of somatic characteristics dependent on the variables of somatic characteristics. It is noticeable that only body height has unique statistical significance for distinguishing groups of backs formed by their level of performance (Sig=.035).). The choice of measures, tests for analysis in this paper and the results obtainedare of great importance for understanding and improving the process of detection, identification and development of young basketball players. The information and results obtained from the analyses can serve as a basis for modeling talent recognition programs inthe sport of basketball.

Keywords: *basketball, cadets, somatic characteristics, guards*

INTRODUCTION

Basketball is a collective game and belongs to the group of polystructural complex sports. Basketball (Russian: basketball; Italian-pallekanestro; German: korball) is strictly defined by its own rules. The specific structure of movement on the floor and rapid transformations in attack and defense, requires from basketball players the speed of excitatory processes in the regulation of movement and movement in order to cope with many new situations. Somatic profiles of basketball players are widely recognized as a crucial factor in the selection process and as an important predictor of performance (Ostojić, S.M.; Mazić, S.; Dikić, N. (2006); Bayios, I.A.; Bergeles, N.K.; Apostolidis, N.G.; Noutsos, K.S.; Koskolou, M.D (2006); Berri, D.J.; Brook, S.L.; Fenn, A.J. (2010). Anthropometric characteristics, such as body fat, skin thickness, body height, arm span and body circumference are determined as the main components in elite basketball players and are often considered assumptions and indicators of level and play (Vaquera, A.; Santos, S.; Villa, J.G.; Morante, J.C.; García-Tormo, V. (2015). Typically, body height is a key component in the process of assigning specific playing positions (Dežman, B.; Trninić, S.; Dizdar, D, 2004), in which the backs are shorter in stature (further away from the basket). The study of the anthropometric characteristics of basketball players of different ages, together with the characteristics of body composition, significantly contributes to their profiling as professional athletes and plays an important role in the selection process, as these characteristics can have a significant impact on performance.

SAMPLE OF VARIABLES

Independent variables

The set of variables in this study was composed of 14 anthropometric measures. Anthropometric measures of body composition type and dimensionality were measured: body height, body mass, reach height, arm span, hand span, body mass index, relative lean mass, relative fat mass, relative muscle mass, body water, abdominal skin fold, subscapular skin fold, triceps skin fold, biceps skin fold.

Dependent variables

For the purpose of more detailed analyses, two dependent or grouping variables have been defined:

1. Position in the game-full-back
2. The Success of Basketball Players

According to this criterion, basketball players are divided into two groups:

Group 1 - The Most Successful Players
Group 2 – less successful basketball players

A player's competitive performance is determined by a scale of 1 to 5. Each basketball player was assigned a score from 1 to 5 according to two criteria (Table 1):

1. Team placement at the end of the competition: All teams (12 basketball clubs) that participated in the Sarajevo Canton Cadet League for the 2019 season are grouped into 3 categories (1st - 4th place; 5th-8th place; 9th-12th place).
2. The quality of the players in the team (as assessed by the coach). Each coach shared basketball players of their teams in three quality groups *(Above average)* - game holders, *Average* – other basketball players members of the first lineups and reserves that contribute to the quality of the game; *Below the average* – basketball players who very rarely or they don't get into the game.

Basketball players who were assigned grades 4 and 5 were classified in the group of more successful basketball players, and basketball players who were assigned grades 1, 2 and 3 were classified in the group of less successful basketball players (Grgantov et al. 2013).

Table 1. The process of categorizing the individual value of a basketball player

The team's placement in the championship	A member of the representation.	Above average player	Average player	Below average player
(1-4)	5	5	4	3
(5-8)	5	4	3	2
(9-12)	5	3	2	1

Table 2. Mean values and standard deviations of somatic characteristics of backs of different performance groups

Dependet Variable	Back groups	Mean	Srd. Error
Height Less successful becks	More successful backs	175.047 171.071	1.366 1.215
Body mass Less successful backs	More successful backs	62.079 59.437	2.364 2.104
Mass height index Less successful backs	More successful backs	20.158 20.242	.630 .561
Reachible height Less successful backs	More successful backs	227.937 223.779	1.862 1.657
Arm length Less successful backs	More successful backs	177.105 174.942	1.760 1.566
Hand stretch Less successful backs	More successful backs	21.521 21.804	.348 .310
Relat. non-fat mass Less successful backs	More successful backs	54.558 51.546	1.810 1.611
Relative fat mass Less successful backs	More successful backs	7.521 7.892	.824 .733
Relative muscular mass Less successful backs	More successful backs	30.411 26.642	1.107 .985
Total body water Less successful backs	More successful backs	40.121 37.913	1.325 1.179
Abdomen Less successful backs	More successful backs	12.605 15.563	1.626 1.447
Subcapularis Less successful backs	More successful backs	9.763 10.104	.823 .733
Triceos Less successful backs	More successful backs	11.079 11.450	.764 .680
Biceps Less successful backs	More successful backs	5.550 6.250	.430 .383

Table 3. Multivariate tests of somatic characteristics of BEKs of different levels of success

Effect Intercept	**Value**	**F**	**Hypothesis df**	**Error df**	**Sig.**	**Partial Eta Squared**
Pillai's Trace	1.000	264034.798	13.000	29.000	.000	1.000
Wilk's Lambda	.000	264034.798	13.000	29.000	.000	1.000
Hotelling's Trace	118360.426	264034.798	13.000	29.000	.000	1.000
Roy's Largest Root	118360.426	264034.798	13.000	29.000	.000	1.000
KVALGR Pillai's Trace	.406	1.527	13.000	29.000	.167	0.406
Wilk's Lamda	.594	1.527	13.000	29.000	.167	0.406
Hotelling's Trace	.685	1.527	13.000	29.000	.167	0.406
Roy's Largest Root	.685	1.527	13.000	29.000	.167	0.406

Table 4. Univariate tests of the significance of somatic characteristics of backs of different levels of success

Source Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
KVALGR	167.690	1	167.690	4.730	.035	.103
Body height	73.991	1	73.991	.697	.409	.017
Body mass	.074	1	.074	.010	.409	.000
Fat height index	183.315	1	183.315	2.781	.103	.064
Reachible height	49.642	1	49.642	.844	.364	.020
Arm stretch	.850	1	.850	.369	.547	.009
Hand stretch	96.211	1	96.211	1.545	.221	.036
Relat. Nonfat mass	1.457	1	1.457	.113	.738	.003
Relative fat mass	33.181	1	33.181	1.426	.239	.034
Relative muscle mass	51.726	1	51.726	1.551	.220	.036
Total body water	92.740	1	92.740	1.846	.182	.043
Abdomen	1.233	1	1.233	.096	.759	.002
Subcapularis	1.460	1	1.460	.132	.719	.003
Triceps	5.196	1	5.196	1.479	.231	.035
Biceps						

Methods for data processing

Within the positional difference and the difference, groups of successful and less successful basketball players by somatic parameters were checked by tests for Multivariate Analysis of Variance (Manova) with a level of significance of $p \leq 0.05$.

Prior to the use of Multivariate Analysis of Variance, preliminary tests were used to test assumptions about normality, linearity, univariation and multicollinearity.

The contributions of individual sets of analyzed variables for distinguishing groups of basketball players with different positions in the game, as well as for distinguishing groups of successful and less successful basketball players by sets of analyzed variables were determined by the F test for univariate analysis of variance with a level of significance of $p \leq 0.05$ and adequate Bonferroni adjustment taking into account the number of dependent variables.

The importance (size) of the influence of the values of individual somatic variables in relation to the groups formed by position in the game and by the performance of basketball players are determined by the values of *Partial Eta Squared.*

Multiple comparisons of the determined group mean values by sets of variables were analyzed by LSD Post Hoc tests.

RESULTS AND DISCUSSION

Two groups of basketball players playing at the point guard position (a more successful group of basketball players with 19 and a less successful group of basketball players with 24 subjects) were subjected to a multivariate analysis of variance in order to determine differences in the levels and structures of sets of somatic characteristic variables. The mean values and standard deviations of the variables of the somatic characteristics of backs classified into 2 groups according to the level of success are shown in Table 2.

It is noticeable from Table 2 that the group of more successful backs has a more pronounced body height, body mass, reaching height and arm span compared to less successful backs. Also, the successful quarterbacks have a higher level of relative lean mass, relative muscle mass, and total body water. Less successful backs are more dominant in all measures of skin folds and relative fat mass. All multivariate tests *confirm that* groups of backs with different levels of performance do not have statistical significance in differentiating by a linear combination of dependently variable variables of somatic characteristics (Table 3). The statistical significance of all tests is .167, i.e. Sig>.05, so we conclude that there is no statistically significant difference between the group of more successful and less successful quarterbacks in somatic characteristics.

It is noticeable that only body height has unique statistical significance for

Differentiation of groups of backs formed by their level of success (Sig=.035). All other variables have no taxonomic significance for classifying full-backs into groups according to their level of performance (Sig>.05).

CONCLUSION

The aim of this transversal research, of a confirmatory type, is reflected in the effort to verify the existence within the positional differences of cadet basketball players with an objective, scientifically and methodologically based approach. This approach should provide information relevant to the processes of identifying, developing and selecting young basketball talents. The achievement of this goal enables an approach in which the planning and programming of the training process will emphasize the development of abilities and skills most important for success in the game of basketball and which can be effectively influenced by adequate practice.

In order to achieve this goal of the research, an analysis of the differences in dominant somatic characteristics in relation to positions in the game and the level of success in the game was performed. It is based on the assumption that the achieved approach enables the confirmation or correction of the current procedures in the process of selection of young basketball players. Although the group of more successful full-backs compared to less successful full-backs has a more

pronounced body height, body mass, reaching height and arm span, higher levels of relative lean mass, relative muscle mass and total body water, lower levels of skin folds and relative fat mass, multivariate tests *confirm that* groups of full-backs with different levels of success are more successful.

They have no statistical significance in distinguishing by a linear combination of dependently variable variables of somatic characteristics. It is noticeable that only body height has unique statistical significance for distinguishing groups of full-backs formed by their level of performance (Sig=.035).

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CLASSIFICATION OF THE INTERNAL STRUCTURE OF SPORTS ORGANIZATIONS IN THE AREA OF THE COUNTY OF WEST HERZEGOVINA

Original Scientific Paper

Dženan Šuta, Damir Đedović, Ekrem Čolakhodžić, Skoko Stjepan

ABSTRACT: This research was carried out as a transversal study with the aim of determining the structure of the classification of sports managers from the area of West Herzegovina County, in relation to professional and management competences within sports organizations. On a sample of 250 respondents, the internal and external organization of sports clubs on all three management level from the area of West Herzegovina County. Using taxonomic analysis, we obtained 23 phases with the lowest possible connection distance. Based on the cluster analysis of 250 respondents, all three management levels of sports organizations were taxonimized into three homogenous groups in the area of the organization of sports associations. Based on the analysis of central and dispersion parameters, taxonomic analysis in the area of SWOT analysis, it was concluded that statistical differences were shown in the characteristics of human resource management as an element of the organizational structure, and that there was a significant connection in the levels of human resource management in sports organizations in the area of this county.

Keywords: *classification, human resources, sports organizations*

INTRODUCTION

The structure of a sports organization as a system means its physical elements and information links that produce its behavior (Adižes, 2004). It is the way in which the building elements of the system are organized or interdependent. In real sports systems - organizations, the structure consists of several physical elements and a complex network of information connections (Tomić, 2007; Đedović, 2011, Skoko, 2023). Knowledge of this network of elements and information connections enables the management of a sports organization as a dynamic (time-changing) system. Identifying the structure of a sports organization begins with the analysis of the entity's flow and the distribution of human resources to different physical elements-organizational blocks and activities/operational facilities that its founders envisioned to achieve the projected goals.

Preparation for managing a sports organization requires examining (Đedović, Popo, Talović, 2015):

- informal sociological structure,
- structure from the point of view of system dynamics.

Formal structures are prescribed by the management, but in the real functioning of the sports system there is always an informal structure made up of related groups that have a strong influence on the behavior of athletes and the staff who belong to them. These are unplanned structures that arise due to the spontaneous interaction of people. Informal structures are formed by connecting/ socializing people in groups that have the function of preserving the group culture, maintaining the communication system, establishing intra-group and external control as well as the social life of the members of such an informal group. Management that does not take these informal structures into account encounters difficulties in managing its formal organization. From the point of view of system dynamics, the discovery of feedback cause-and-effect relationships in the sports system has a far-reaching significance.

SUBJECT AND OBJECTIVE OF THE RESEARCH

The subject of this research is the classification of sports managers from the area of West Herzegovina County, in relation to professional and management competencies within sports organizations.

The aim of this research is to determine the structure of the classifications of sports managers from the area of the West Herzegovina County, in relation to professional and managerial competencies within sports organizations.

WORKING METHODS

For the purposes of this paper, the respondents were sports managers with different functional powers in clubs and sports institutions. The examination was carried out in sports clubs, sports associations, municipal sports departments and sports associations from the area of West Herzegovina County, which are in any way in the regular competition system or are part of the management structures in sports institutions, i.e. in government structures in the area of West Herzegovina County Herzegovina (N=250). All three levels of management participated in the survey, top management (N=186), functional management (N=41), operational management (N=23). In accordance with the problem of the research, a systematic methodical-methodological approach was realized, using appropriate logical, mathematical, statistical methods and procedures at the univariate and multivariate level. For the purposes of this work, analyzes were applied that included elementary statistical parameters and factor analysis. When selecting the variables, the results of previous research were used. A questionnaire for "managers" was used to collect data in the research (Bajraktarević, 2008, modified in 2010). The selected variables are

suitable for the category of respondents, with a defined subject, problems and goal of the research. The selected variables in this research hypothetically cover the following space:

- SWOT analysis – 43 particles, of which;
  - (Sports and business functions of the club - 30 units)
  - (Sports and business functions of branches of federations and sports institutions – 13 particles).

For the purposes of this research, the software package SPSS 26. for Windows was used. The following mathematical and statistical procedures were used in the processing of data obtained from this research (Čolakhodžić, Rađo, 2011; Čolakhodžić, 2021):

- ANOVA – univariate analysis of variance for analyzing differences in arithmetic means.
- Taxonomic analysis – for determining the relationship between isolated groups of taxa

RESULTS AND DISCUSSION

Taxonomic analysis belongs to the class of exploratory rather than confirmatory analysis and there is no strictly defined criterion on the basis of which we can determine the right number of groups. We make such a decision in the area of the internal organization of sports associations based on the analysis of the dendogram, which represents the hierarchical grouping of respondents. Based on the analysis of the dendogram, three groups were distinguished and this is most likely the right solution in terms of the choice of joining technique and the distance between the respondents. Table 2 shows the results of the variance analysis, which shows us whether there are differences in the variability between the obtained groups and the variability within the obtained groups.

The significance of the difference between between-group and within-group variance was checked using the F test. The values of the F test show us that our respondents differ statistically significantly in almost all variables of the internal organization of sports associations at the level of significance $p < .01$. Respondents do not differ statistically regarding the variables "our club has a clear strategic direction" and "interpersonal relations in the club are bad"

In the Agglomeration schedule table (the so-called Agglomeration particles) we see a report on solving the problem. The connection of individual objects is shown, which are connected into larger and larger clusters. With "agglomerative" methods, each object is treated as a separate cluster at the first step. Then the two closest objects are combined into the first cluster. In the third step, either an individual object is added to that cluster or two individual objects are connected to another cluster. At each subsequent step, either individual objects are combined into new clusters or already existing clusters are interconnected. It is important to point out that in the first phase, respondents 226 and 235 are connected because their distance is the smallest. The group created by their merger appears again in stage 177, as indicated by the last column of the table (Next Stage). In phase 177, the cluster created in phase 1 is merged with the new object. In the table with a large number of respondents, it is interesting to mention that we often come to the case of a large number of connections with small distances between them. In this table, we got 23 phases with the lowest possible distance. Objects that are repeated several times in the mentioned 23 phases are interesting. Thus, in phase 5 we have the merging of objects 215 and 216, and their re-merging of objects 214 and 215 in phase 6. We have the same case in phase 8 where objects 173 and 190 are at the smallest possible distance, and their merging with phase 10, this time objects 172 and 173.

Table 1. Dendogram of the area of internal and external organization of sports associations from the area of Wast Herzegovina County

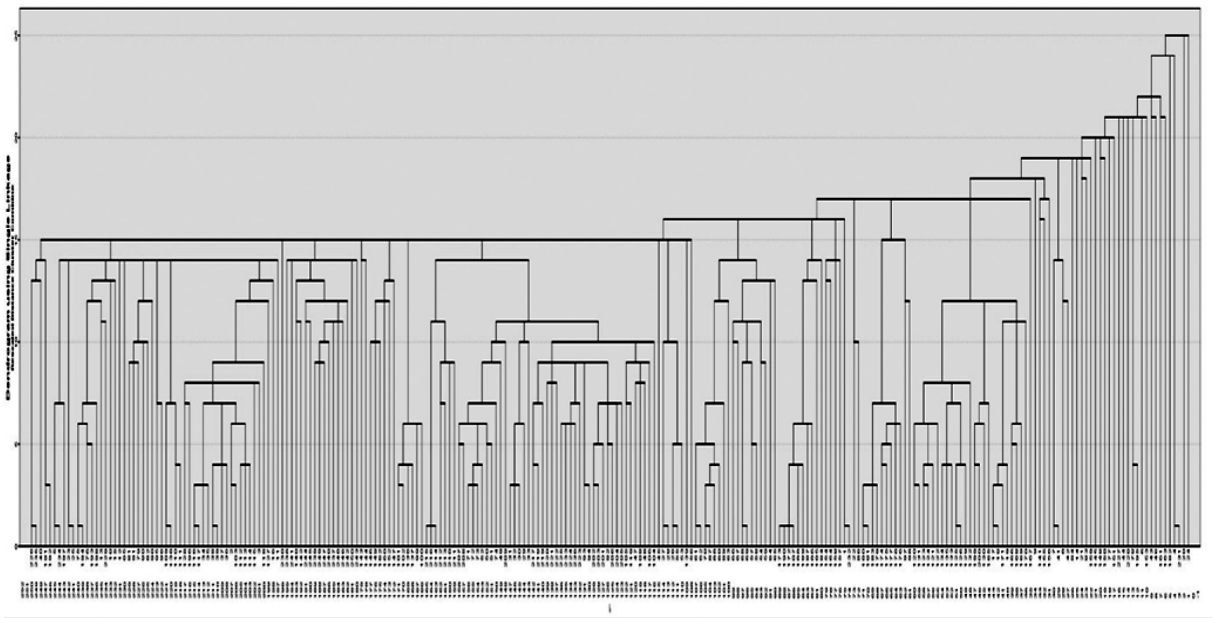

Table 2. Univariate analysis of variance in the area of internal organization of sports associations

ANOVA						
Indicators	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
1. Our club needs reorganization	42.454	2	1.495	247	28.405	.000
2. Our club has a clear strategic direction	.355	2	1.585	247	.224	**.799**
3. People in the management system of the club are not professional enough	24.849	2	1.318	247	18.850	.000
4. The selection of quality athletes and talents in the club is good	36.187	2	.782	247	46.273	.000
5. There is a sufficient number of sponsors for the smooth operation of the club	19.948	2	1.972	247	10.115	.000
6. Professional people are in important positions in the club	30.216	2	1.392	247	21.704	.000
7. A larger number of people and volunteers is needed for the better work of the club	8.071	2	1.168	247	6.909	.001
8. Managerial policy in the club is good	18.762	2	1.232	247	15.235	.000
9. In our club, great attention is paid to working with younger ages	52.141	2	1.322	247	39.432	.000
10. Clear goals and quality plans and programs have been set in the club	30.375	2	1.189	247	25.537	.000
11. Club policy is destructive	77.454	2	.888	247	87.211	.000
12. Interpersonal relations in the club are bad	3.805	2	1.277	247	2.979	**.053**
13. Sufficient work is done on club promotion and marketing	56.394	2	1.028	247	54.869	.000
14. In our club, everyone does the work they are responsible for	27.039	2	1.052	247	25.699	.000
15. Massiveness is our goal	25.365	2	1.523	247	16.654	.000
16. Quality and top results in the club are long-term goals	7.592	2	1.582	247	4.800	.009
17. We have excellent communication with the environment	82.485	2	.818	247	100.897	.000
18. The club's communication with schools is as effective as possible	16.976	2	1.145	247	14.827	.000
19. The club's communication at the international level is excellent	24.323	2	1.000	247	24.312	.000
20. The culture of management and athletes is at an enviable new level	13.892	2	1.417	247	9.803	.000
21. All set goals are realistic and achievable	61.684	2	.864	247	71.401	.000
22. The club works exclusively according to plan and program	12.923	2	1.104	247	11.709	.000
23. The statutes and rules of conduct in the club are followed by everyone	71.200	2	.635	247	112.205	.000
24. Stakeholders (interests of individuals and groups) in the club are clear enough	11.471	2	1.117	247	10.273	.000
25. Everyone in the club is one team and that's how we work	81.161	2	.686	247	118.246	.000
26. The goals of the club are not the same for everyone and are not clear to everyone	31.522	2	1.317	247	23.938	.000
27. The organization of work and tasks in the club is good	33.782	2	.789	247	42.822	.000
28. There are long-term, medium-term and short-term plans and goals of the club	9.425	2	1.292	247	7.296	.001
29. Our state Federation is a stable financial institution	13.553	2	1.475	247	9.191	.000
30. Our state association represents the basis of the development and initiation of football	29.974	2	1.343	247	22.323	.000
31. The advantages of the club are the maximum help from city structures	25.199	2	1.298	247	19.414	.000
32. Own infrastructure is a great advantage for the club	13.597	2	1.765	247	7.704	.001
33. The financial assistance of the club is defined by the regulation on financing	24.155	2	1.259	247	19.190	.000
34. Financial support from higher levels of the state towards the club should be better	26.664	2	1.203	247	22.159	.000
35. Competent and high-quality human resources work in key positions in our State Association	30.671	2	1.091	247	28.105	.000
36. Our state federation functions on the basis of legal regulations and laws	24.326	2	.990	247	24.563	.000
37. The plan and program provide funds for quality training existing staff in the club	14.143	2	1.060	247	13.340	.000
38. Our national federation has all the necessary infrastructure for the development of sports	34.780	2	1.273	247	27.312	.000
39. Our state association has excellent cooperation with clubs	6.103	2	1.191	247	5.123	.007
40. The relationship between businessmen and our club is on an enviable new footing	9.622	2	1.189	247	8.093	.000
41. The political environment contributes to the development of sports	57.528	2	1.529	247	37.620	.000
42. The organization of football clubs in the county is at an enviable new level	12.704	2	1.136	247	11.187	.000
43. All government structures in the city/county have recognized the importance of top sport	34.449	2	1.295	247	26.593	.000

Table 3. Table of successive cluster creation and distance coefficients between clusters

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	226	235	.000	0	0	177
2	5	234	.000	0	0	106
3	1	232	.000	0	0	217
4	4	231	.000	0	0	247
5	215	216	.000	0	0	6
6	214	215	.000	0	5	154
7	75	194	.000	0	0	73
8	173	190	.000	0	0	10
9	180	181	.000	0	0	24
10	172	173	.000	0	8	11
177	40	226	5.605	0	1	197

From table 4 to table 6, the mean values of variables by groups, Euclidean distance and group membership are shown.

	Cluster		
	1	2	3
1. Our club needs reorganization	3	2	2
2. Our club has a clear strategic direction	3	3	3
3. People in the management system of the club are not professional enough	4	3	3
4. The selection of quality athletes and talents in the club is good	2	4	3
5. There is a sufficient number of sponsors for the smooth operation of the club	3	2	3
6. Professional people are in important positions in the club	2	4	3
7. A larger number of people and volunteers is needed for the better work of the club	2	1	3
8. Managerial policy in the club is good	2	4	3
9. In our club, great attention is paid to working with younger ages	2	1	4
10. Clear goals and quality plans and programs have been set in the club	2	4	2
11. Club policy is destructive	4	2	2
12. Interpersonal relations in the club are bad	4	5	4
13. Sufficient work is done on club promotion and marketing	2	1	4
14. In our club, everyone does the work they are responsible for	3	5	3
15. Massiveness is our goal	3	1	3
16. Quality and top results in the club are long-term goals	2	1	2
17. We have excellent communication with the environment	2	4	4
18. The club's communication with schools is as effective as possible	3	1	3
19. The club's communication at the international level is excellent	3	5	3
20. The culture of management and athletes is at an enviable new level	2	1	3
21. All set goals are realistic and achievable	2	4	4
22. The club works exclusively according to plan and program	3	1	3
23. The statutes and rules of conduct in the club are followed by everyone	2	5	4
24. Stakeholders (interests of individuals and groups) in the club are clear enough	3	1	3
25. Everyone in the club is one team and that's how we work	2	4	3
26. The goals of the club are not the same for everyone and are not clear to everyone	4	1	3
27. The organization of work and tasks in the club is good	2	4	3
28. There are long-term, medium-term and short-term plans and goals of the club	3	1	3
29. Our state Federation is a stable financial institution	4	5	3
30. Our state association represents the basis of the development and initiation of football	4	1	3
31. The advantages of the club are the maximum help from city structures	3	5	3
32. Own infrastructure is a great advantage for the club	3	1	2
33. The financial assistance of the club is defined by the regulation on financing	3	5	3
34. Financial support from higher levels of the state towards the club should be better	2	1	3
35. Competent and high-quality human resources work in key positions in our State Association	3	5	5
36. Our state federation functions on the basis of legal regulations and laws	3	2	3
37. The plan and program provide funds for quality training existing staff in the club	3	5	4
38. Our national federation has all the necessary infrastructure for the development of sports	4	2	3
39. Our state association has excellent cooperation with clubs	3	5	3
40. The relationship between businessmen and our club is on an enviable new footing	3	2	3
41. The political environment contributes to the development of sports	2	5	4
42. The organization of football clubs in the county is at an enviable new level	3	2	3
43. All government structures in the city/county have recognized the importance of top sport	3	5	4

CONLUSION

Based on the cluster analysis of 250 respondents, all three management levels of sports organizations were taxonimized into three homogenous groups in the area of the organization of sports associations. Analyzing the obtained tables, we see that the first group consists of 204 respondents, the second 12 and the third 34 respondents. Analysis of variance shows that the groups differ statistically significantly in almost all variables at the 99% level. In 2 of the 43 variables used, no statistically significant difference was achieved, namely in the variables "Our club has a clear strategic direction", "interpersonal relations in the club are bad". Except for the first highlighted variable "our club has a clear strategic direction" in which all three groups have the same values (central value 3, which means that they answered when our club has a clear strategic direction), for the second variable "interpersonal relations in taxonomic analysis, we obtained 23 phases with the lowest possible connection distance. Based on the cluster analysis of 250 respondents, all three levels of management of sports organizations were taxonimized into three homogeneous groups in the area of the organization of sports associations. Analyzing the obtained tables, we see that the first group consists of 204 respondents, the second 12 and the third 34 respondents. Based on the analysis of central and dispersion parameters, taxonomic analysis in the area of SWOT analysis, we can conclude that statistical differences have been shown in the characteristics of human resource management as an element of the organizational structure in sports organizations in the area of West Herzegovina County, and that a significant connection has been achieved in the levels of human resource management of resources in sports organizations in the area of West Herzegovina County.

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