INFLUENCE OF MORPHOLOGICAL CHARACTERISTICS ON THE FREQUENCY OF BODY DEFORMITIES IN CHILDREN AGED 11 AND 12

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ABSTRACT: The main aim of this study was to determine the relationship between spinal deformities and morphological characteristics in students aged 11 and 12 years. In the area of morphological characteristics, seven variables were used to measure body volume and circumference, and in the assessment of body posture, the standard method for measuring body deformities according to Napoleon Wolanski was applied, where the assessment is performed by visual method. They performed the assessment by three evaluators. We determined the connection of the entire predictor set with individual variables of criteria. The results showed that within the intercorrelation matrix there is a large correlation between the entire morphological space and three body posture variables, namely the scoliotic posture variable (WAXWORK), the abdominal posture variable (VODRTR) and the leg shape variable (VOOBN). By regression analysis, we determined a significant influence of the predictor system on two body posture variables. We see the influence of morphological characteristics on the variable scoliotic posture through a multiple correlation of 427, and a coefficient of determination of 182, and the statistical significance of the entire system is 0.013, which indicates a significant influence of the entire system on this variable. We did not have a single impact of any variable on the system criterion system. The same is the case with the variable abdominal posture where the multiple correlation was, 419 and the coefficient of determination, 176, which ultimately resulted in a significance level of 0, 018. Based on these results, we confirmed that there is a statistically significant correlation and influence of morphological characteristics as a predictor system with the frequency and level of poor posture and body deformities in the two variables, namely scoliotic posture and abdominal posture.

Keywords: *morphological characteristics, scoliotic posture, abdominal posture*

INTRODUCTION

The growth and development of a child is well biologically programmed, regulated and directed towards genetic potential. The individual differences encountered during development are mainly genetic but also numerous external factors that affect the characteristics of individuals. Body posture implies balanced static and dynamic behavior of the body in space (Čolakhodžić, Vuk, Habul, Tanović and Vujica, 2017). Proper posture implies a relaxed upright posture when walking. Such a posture of the body is actually an appropriate position of the head with a view forward and straight, a slight pull of the shoulders backwards, the chest is pointed forward and the arms are stretched out along the body. The abdomen is retracted, the knees are stretched and the pelvis is set at an angle of 60 degrees. Poor posture is the initial breakdown of the biomechanical balance of the spine. Muscle groups that keep the spine in an upright position due to symmetrical or asymmetrical sagging cause curvature of the spine of the scoliotic or kyphotic type. This is the phase when there are no pronounced changes in the bony parts, so muscle weakness can be strengthened by appropriate exercises and brought to a state of muscle sufficiency with normal physiological curves of the spine (Kosinac, 1992, Skender, 2001.). The sedentary way of life is present in western countries and is spreading to developing countries. As a result, an increase in various diseases has been observed, which are associated with reduced physical activity. Decreased physical activity and immobility lead to hypokinesia. Hypokinesia is an insufficient amount of physical activities that the body needs for normal functioning (Kurtović, 2017). This phenomenon affects the population of children in the period of growth and development. Disorders and diseases of today - overweight and nervous tension, are increasingly present in young people, and free time of children and adolescents is increasingly used for activities that require almost no muscular effort (Prskalo et all., 2010, Kurtović et all. 2017). The population of students of all ages is affected by hypokinesia regardless of place of residence, resulting from a sedentary lifestyle, which with abundant food most often unconfirmed origins and increased intellectual and emotional activity (Nagyová and Ramacsay, 1999) is a multiplied problem. Morphological characteristics represent the process of growth and ontogenetic development. Nešić, Šabić and Skender (2020) state in their research that the consequence of this is inappropriate attitude towards physical exercise as a measure of prevention from the occurrence of painful states of lumbar syndrome are noticeable. In light of these findings, it can be concluded that is a keyword (which can trigger positive shifts in terms of lifestyle change and thus prevention of LBP) refers to knowledge. That is, continuing education and informing about healthy lifestyles, especially active lifestyles. Morphological characteristics include:

- longitudinal dimensions of the skeleton - growth of bones in length
- transverse dimensionality of bone growth in width
- body weight and volume - total body weight and circumference

• subcutaneous fat - the total amount of fat in the body

Morphological status is determined by anthropometric measurements. Morphological anthropometry is a method that includes measuring the human body and processing and studying the obtained measures. It is applied in many areas: in sports and sports medicine, pediatrics and school medicine for monitoring the growth of children and youth, ergonomics and industry, within standard procedures in practice, for assessing nutritional status, for scientific research of body morphological characteristics during growth and development, correlation of body dimensions with other anthropological characteristics and in the analysis of population structure (Čolakhodžić, Rađo and Alić, 2016). The problem of assessing posture, selecting the best indicators, and assessing the reliability of these procedures has been addressed by many scientists with the aim of detecting irregularities in the posture of children and adults. (Tribastone, 1994; Palmer and Epler, 1998; Watson and Mac Donncha, 2000; Paušić, Skender, 2002; Skender at all, 2018; McEvoy and Grimmer, 2005). Abalkhail (2002) published a study on the incidence of obesity in girls and boys in Saudi Arabia, measured in 1994 on a sample of 2708 subjects and in 2000 on a sample of 2542 subjects. Measurements of morphological characteristics were assessed by measures of body height and body weight, and the BMI value was calculated from the obtained results. Between the two measurements in both sexes, there was an increase in BMI in percentages from 85 to 95 percent. The trend of increase in boys shows the largest increase between the ages of ten and sixteen. The sample of girls showed the smallest increase between the ages of fourteen and sixteen. Abalkhail believes that it would be very important to prepare preventive measures to reduce obesity in this population.

RESEARCH METHODOLOGY

Sample of respondents

The sample of respondents in this study is 110 female and male students aged 11 and 12, citizens of Bosnia and Herzegovina. These are the students of the Elementary School "Gornje Prekounje" in Bihać. The main reason for choosing this population is contained in the observation of physical education and health professors about the frequency of spinal deformities and the sudden increase in obese children in that population.

Sample variables

A sample of variables to assess morphological characteristics AOBGRU-chest circumference, AOBNAD-upper arm circumference, AOBTRB-abdominal circumference, AOBNAT-upper leg circumference, ANABTR-abdominal fold, ANABNAD-upper arm fold, ANABLE-back skin fold

Sample of variables for the assessment of physical deformities (N. Wolanski assessment) The entire assessment procedure (Skender, 2001) VODRGL - holding the head, VORGK - holding the chest, VDRLO - holding the shoulder blades, VOSKO - scoliotic holding, VODRTR - holding the front wall of the abdomen and VOBO - shape of the legs. Assessment of posture according to the method of Napoleon Wolanski.

In order to obtain some assessment of body posture or assessment of posture of one component, scoring is performed.

0 POINTS - if the component is within the given criteria and such condition is considered normal.

1 POINT - the first degree of impaired posture deformity is observed.

2 POINTS - second degree, ie marked deviation.

This system is good because it gives us the opportunity for a more detailed assessment of certain minor deviations in individual posture elements. It is also possible to evaluate the posture of the body as a whole based on the sum of negative points. Based on these indicators, we determined the prevalence of poor posture and spinal deformities. We formed two groups so that subjects who had up to 8 points were treated as the first group and we characterized them as subjects with good posture, and subjects who had 9 to 16 points were treated as the second group who had poor posture and spinal deformities.

0 POINTS - excellent posture
1-4 POINTS - very good posture
5-8 POINTS - good posture
9-12 POINTS - poor posture
13-16 POINTS - very poor posture

DATA PROCESSING METHODS

Data processing was realized in the software package SPSS 18. Manifest variables applied in this experiment were processed by standard descriptive procedures to determine their distribution and basic function parameters, as well as the differences between actually obtained and expected relevant cumulative frequencies.
In this way, it is possible to test hypotheses that the distribution of the obtained results is normal, which was done - tested by Kolomogorov - Smirnov procedure. The following parameters were calculated for the obtained results:

Arithmetic mean - Mean, Standard error - Error, Standard deviation-St. dev., Variance-Variance, Minimum value-Min, Maximum value - Max, Range, Rank, Coefficient of curvature-Skewness, Elongation coefficient - Kurtosis, Total - Sum.

The connection between the space of body deformities and morphological characteristics was examined by regression analysis.

RESULTS

Analysis of central dispersion parameters of applied variables for all subjects

Table 1. shows the central dispersive parameters of measuring instruments for all sets of variables (variables of body posture assessment and variables of morphological characteristics) in students aged 11 and 12 years. The values of minimum and maximum result, arithmetic mean, standard deviation, variance, skewness and kurtosis are presented. A good look at the table shows a good balance of descriptive statistics results. The results range within the normality of the distribution of the applied manifest variables. We can also notice this on the basis of balanced results of the median and arithmetic mean which are very close (the values are close) which tells us about the correct distribution of the results and the normality of the distribution. The applied manifest variables based on the variability parameters indicate significant variability between the variables which is estimated based on the standard deviation and the variance of the applied variables. Based on kurtosis and skewness, we can assess the balance of the results, which shows the mesocourt distribution of these results. This was quite to be expected as the sample was taken from the natural population by the method of random sampling, and the number of 110 subjects is quite sufficient for normal distribution when it comes to the applied variables that we treated within the paper.

Table 1. Analysis of central dispersion parameters of applied variables for all subjects

Variables	N	Range	Min	Max	Sum	Mean		Std. Dev	Varian	Skewness		Kurtosis	
	Stat.	Stat.	Stat.	Stat.	Stat.	Stat.	Std. Err.	Stat.	Stat.	Stat.	St. Err	Stat.	Std. Err.
AGE	110	2,30	10,70	13,00	1285,10	11,68	,06	,65	,42	,21	,23	-1,34	,45
AMASTJ	110	56,5	27,50	84,00	5076,50	46,15	1,01	10,61	112,75	,69	,23	,64	,45
AVISTJ	110	43,0	132,00	175,00	16723,70	152,03	,78	8,19	67,18	,17	,23	-,24	,45
AOBNAD	110	13,0	17,50	30,50	2522,10	22,92	,28	2,96	8,81	,24	,23	-,61	,45
AOBGRU	110	51,4	43,20	94,60	8076,70	73,42	,86	9,05	81,94	-,26	,23	,53	,45
AOBRTB	110	72,5	27,40	99,90	7766,80	70,60	,95	10,04	100,81	-,24	,23	2,47	,45
AOBNAT	110	33,1	32,30	65,40	4850,80	44,09	,55	5,81	33,77	,96	,23	2,35	,45
ANABNAD	110	4,30	,30	4,60	164,00	1,49	,08	,87	,76	1,07	,23	,76	,45
ANABLE	110	3,40	,10	3,50	122,30	1,11	,06	,63	,40	1,32	,23	1,57	,45
ANABTR	110	5,70	,10	5,80	194,30	1,76	,10	1,10	1,23	,89	,23	,56	,45
VODGL	110	3,00	,00	3,00	128,00	1,16	,07	,78	,61	-,18	,23	-1,10	,45
VODRRA	110	2,00	,00	2,00	131,00	1,19	,06	,67	,44	-,24	,23	-,77	,45
VORGK	110	2,00	,00	2,00	125,00	1,13	,05	,59	,35	-,05	,23	-,25	,45
VDRLO	110	2,00	,00	2,00	151,00	1,37	,05	,58	,34	-,31	,23	-,68	,45
VOSKO	110	2,00	,00	2,00	113,00	1,02	,05	,59	,35	-,00	,23	-,13	,45
VODRTR	110	2,00	,00	2,00	127,00	1,15	,05	,62	,38	-,11	,23	-,47	,45
VOOBNO	110	2,00	,00	2,00	102,00	,92	,06	,70	,49	,10	,23	-,93	,45
VOSVST	110	2,00	,00	2,00	140,00	1,27	,06	,72	,53	-,47	,23	-,98	,45

Analysis of the results of the correlation of morphological characteristics and body posture for all subjects

Table 2. shows the matrix of intercorrelations and correlations of morphological space and body posture for all subjects. A total of nine variables from morphological space and eight variables from body posture space were analyzed. Based on the results from the matrix of intercorrelations of morphological space, a very large coefficient of correlation between all variables within that space can be observed. Particularly significant are the associations of the body mass variable (AMASTJ) with the variables covering body volume. There is also a very large association with subcutaneous adipose tissue variables, and in particular the variables fold of the back (ANABLE) and fold of the abdomen (ANABTR). These correlations were to be expected because in previous studies, a great connection within the morphological space was confirmed. Within the posture space, the level of intercorrelations is much lower in both volume and intensity. The variable head posture has a very high correlation with shoulder posture at 0.01% and chest posture at 0.01%, while with abdominal posture at 0.03%. This was to be expected as in upright posture and proper posture proper shoulder posture as well as abdominal posture is crucial in head posture and in the sagittal and frontal planes. The shoulder holding variable, in addition to the explained connection with head holding, has a very high coefficient of connection with shoulder holding, as it is known that the acromion (top of the scapula) connects and enters the shoulder joint, it is inevitable that the position of the shoulder blades This tells us a very high correlation coefficient at the significance level of 0.01. Chest posture also has a high coefficient of association with the head posture variable and the abdominal posture variable. These three variables

are very important in both the frontal and sagittal levels of postural status because they form one chain in maintaining proper posture. Another characteristic variable is the posture of the abdomen, which has correlations with the posture of the head and the posture of the chest, and the correct posture of the spinal column, the muscular wall of the abdomen and back is crucial for maintaining the correct position of the spine. The analysis of the cross-correlation matrix of body posture variables and morphological characteristics showed a statistically significant correlation between the scoliotic posture variable with body mass variables, body volume variables and subcutaneous adipose tissue variables. The variable posture of the abdomen also has statistically significant correlations with the same variables as the variable shape of the legs. This indicates that at the significance levels of 0.1 and 0.5%, there was an association of these three variables with body mass space, body volume, and subcutaneous adipose tissue. Other variables have individual correlations and we will not single them out. Already at this level of research, it can be stated that there is a significant correlation between morphological space variables and body posture variables.

Within the cross-correlation table, it can be seen that there are statistically significant relationships between the variables scoliotic posture (wax), the variable posture of the abdomen (vodrtr) and the variable shape of the legs (voob) with almost all variables of morphological characteristics. These relationships are very significant, which will probably confirm the influence of these morphological characteristics on these variables of poor posture in a later analysis.

Table 2. Analysis of the results of the correlation of morphological characteristics and body posture for all subjects

	VODGL	VODRRA	VORGK	VDRLO	VOSKO	VODRTR	VOOBNO	VOSVST	AMASTJ	AVISTJ	AOBNAD	AOBGRU	AOBRTB	AOBNAT	ANABNAD	ANABLE	ANABTR
VODGL	1	,673**	,559**	,543**	,460**	,529**	,323**	,323**	,054	,047	,039	-,020	,068	,129	,048	,128	,048
VODRRA	,67**	1	,415**	,609**	,376**	,390**	,343**	,249**	,090	,175	,077	,009	,080	,160	-,067	,044	-,057
VORGK	,559**	,415**	1	,454**	,349**	,386**	,221*	,251**	,087	,120	,061	,032	,076	,141	,041	,058	,004
VDRLO	,543**	,609**	,454**	1	,415**	,417**	,311**	,210*	,110	,088	,095	,034	,058	,010	-,061	,059	-,028
VOSKO	,460**	,376**	,349**	,415**	1	,407**	,443**	,299**	,268**	,127	,162	,100	,154	,235*	,281**	,336**	,208*
VODRTR	,529**	,390**	,386**	,417**	,407**	1	,257**	,129	,177	-,149	,237*	,129	,238*	,194*	,288**	,300**	,260**
VOOBNO	,323**	,343**	,221*	,311**	,443**	,257**	1	,507**	,212*	,066	,170	,206*	,068	,133	,250**	,321**	,269**
VOSVST	,323**	,249**	,251**	,210*	,299**	,129	,507**	1	,128	,067	,155	,126	,061	,204*	,156	,123	,145
AMASTJ	,054	,090	,087	,110	,268**	,177	,212*	,128	1	,587**	,825**	,766**	,739**	,669**	,490**	,667**	,651**
AVISTJ	,047	,175	,120	,088	,127	-,149	,066	,067	,587**	1	,328**	,406**	,379**	,341**	-,099	,089	,035
AOBNAD	,039	,077	,061	,095	,162	,237*	,170	,155	,825**	,328**	1	,657**	,669**	,662**	,524**	,612**	,645**
AOBGRU	-,020	,009	,032	,034	,100	,129	,206*	,126	,766**	,406**	,657**	1	,658**	,505**	,350**	,510**	,483**
AOBRTB	,068	,080	,076	,058	,154	,238*	,068	,061	,739**	,379**	,669**	,658**	1	,496**	,262**	,417**	,443**
AOBNAT	,129	,160	,141	,010	,235*	,194*	,133	,204*	,669**	,341**	,662**	,505**	,496**	1	,454**	,524**	,551**
ANABNAD	,048	-,067	,041	-,061	,281**	,288**	,250**	,156	,490**	-,099	,524**	,350**	,262**	,454**	1	,845**	,747**
ANABLE	,128	,044	,058	,059	,336**	,300**	,321**	,123	,667**	,089	,612**	,510**	,417**	,524**	,845**	1	,814**
ANABTR	,048	-,057	,004	-,028	,208*	,260**	,269**	,145	,651**	,035	,645**	,483**	,443**	,551**	,747**	,814**	1

Regression analysis of morphological characteristics and scoliotic posture (VOSKO)

Table 3 shows the results of regression analysis in which the relationship of one continuous dependent variable in this case scoliotic posture with a set of predictor variables in the area of morphological characteristics is shown. This regression analysis is based on the correlation processed in Table 2, but allows us to more accurately determine the interrelationships of a set of variables. In this case, it tells us how well a certain set of variables (morphological characteristics) predicts a concrete outcome. Given the size of the sample on which the research was conducted, we can talk about the ability to generalize, which means that the results obtained on this sample can be obtained on other samples. Since the two variables VOSKO and VODTR show a high correlation, the conditions for the continuation of the multiple regression procedure have been met. The analysis showed that the relationship between the predictor set of variables and the criterion set of variables (VOSKO) was statistically significant. The prediction of the whole system of morphological characteristics with the variable scolitic posture reflected through the multiple correlation coefficient is of medium height and is .427 which tells us how much of the variance of the dependent variable is explained by the model. This means that our model explains 43% of the variance of the scoliotic posture criterion variable. The model in this example reaches a statistical significance of .013 which is significant at the sig level. 0.03. The results of this table show that the overall model of predictor variables has a statistically significant effect on the criterion variable scoliotic posture.

Table 3. Regression analysis of morphological characteristics and scoliotic posture

Model		R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	1	,427	,182	,109	,56407	
		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7,101	9	,789	2,480	,013
	Residual	31,818	100	,318		
	Total	38,918	109			
		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	
		B	Std. Error	Beta	B	Std. Erc
	(Constant)	1,424	1,680		,848	,399
	AMASTJ	,023	,017	,416	1,402	,164
	AVISTJ	-,001	,011	-,013	-,085	,933
	AOBNAD	-,049	,036	-,242	-1,349	,180
	AOBGRU	-,017	,010	-,252	-1,738	,085
	AOBRTB	,003	,009	,047	,323	,747
	AOBNAT	,013	,013	,123	,955	,342
	ANABNAD	,056	,127	,083	,442	,660
	ANABLE	,361	,203	,385	1,776	,079
	ANABTR	-,134	,095	-,248	-1,405	,163

Regression analysis of morphological characteristics and abdominal posture (VODTR)

Analysis of table number 4, which shows the results of multiple correlations, shows that the correlation is medium high and amounts to 0.419. The coefficient of determination is 0.17 and tells us how much of the variance of the dependent variable posture of the abdomen explains the model. The model in this example reaches a statistical significance of .018 which is significant at the sig level. 0.03. The results of this table show that the overall model of predictor variables has a statistically significant effect on the criterion variable abdominal posture. Further analysis of the evaluation of each independent variable did not yield any statistically significant coefficient at the level of 0.05 of any single variable, although the variables body height and abdominal circumference are very close, but not statistically significant. This suggests that all variables as a group had a contribution in creating an impact on this criterion, but that none of the variables made an individual contribution.

Table 4. Regression analysis of morphological characteristics and abdominal posture

Model		R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	1	,419	,176	,102	,59098	
		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7,447	9	,827	2,369	,018
	Residual	34,926	100	,349		
	Total	42,373	109			
		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	
		B	Std. Error	Beta	B	Std. Err
	(Constant)	2,951	1,760		1,677	,097
	AMASTJ	,002	,017	,038	,129	,898
	AVISTJ	-,022	,011	-,286	-1,8949	,061
	AOBNAD	,013	,038	,063	,344	,728
	AOBGRU	-,007	,010	-,108	-,745	,458
	AOBRTB	,016	,0094	,251	1,735	,086
	AOBNAT	,008	,014	,078	,604	,547
	ANABNAD	,017	,133	,023	,124	,901
	ANABLE	,239	,213	,244	1,122	,265
	ANABTR	-,064	,100	-,114	-,641	,523

DISCUSSION

The main aim and purpose of this research is the influence of morphological characteristics on the frequency of deformities that occur for various reasons and their connection with morphological characteristics. The results obtained on a sample of 110 respondents, students of the Elementary School "Gornje Prekounje" in Bihać, aged 11 and 12, were analyzed. The main reason for choosing this population is contained in previous research conducted in the wider region as well as empirical research and observations of school physicians as well as the observations of physical education teachers, the frequency of poor posture and spinal deformities and a sudden increase in obese children in that population. In the space of morphological characteristics, seven variables were applied, intended for measuring body volume and circumference. The basic central and dispersive parameters of the distribution of the achieved results of the applied tests, with an error of the level of 0.05%, enable the confirmation of the hypothesis about the existence of normal distribution of the expressed values.

Based on the results from the matrix of intercorrelations of the morphological space, we noticed a very large coefficient of correlation between all variables within that space. Particularly significant are the associations of the body mass variable (AMASTJ) with the variables covering body volume. There is also a very large association with subcutaneous adipose tissue variables, and in particular the variables fold of the back (ANABLE) and fold of the abdomen (ANABTR). These correlations were to be expected because in previous studies, a great connection within the morphological space was confirmed. There are very characteristic and significant connections between the predictor and criterion system in the intercorrelation. A large and significant correlation was found between almost all variables of circumference and subcutaneous adipose tissue with the variables scoliotic Posture, Abdominal Posture and leg shape. Within the regression analysis, a positive relationship and influence of the entire predictor system (morphological characteristics on two body posture variables, namely scoliotic Posture and Abdominal Posture variable were determined. Since abdominal muscles are very important in maintaining proper posture and overall posture). In this period of growth and development of children, it is especially important to influence the improvement of morphological characteristics and especially the posture of the abdomen, because the abdominal muscles are very important in maintaining the complete posture of the body.

CONCLUSION

These results showed that morphological characteristics affected poor posture because in students who had increased measures in morphological characteristics in most cases there were certain anomalies in posture as in this case. Based on this research, we can conclude that the morphological characteristics of the team of body circumference, subcutaneous adipose tissue and body weight significantly influenced the development of poor posture and body deformities. It is proposed that schools develop physical skills as well as nutrition education through physical education and health education, which would significantly affect a

better approach to monitoring morphological characteristics.

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