PREVALENCE OF SPINE DEFORMITIES AND RELATIONSHIP WITH BODY COMPOSITION IN ELEVEN AND TWELVE YEAR OLD STUDENTS

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ABSTRACT: On the sample of 110 students aged 11 and 12, a study was carried out to determine the prevalence of spine deformity and relationship with the body composition. Two methods for determining bodily deformities were applied. The method of Wolanski and the method on the CONTEMPLAS and Tanitu apparatus for body composition. In two variables Sag. Distance cervical spine sacrum results represent the distance of the cervical spine from the projection of the vertical line of sacrum, and the distance of the lumbar spine from the projection of the vertical line of the sacrum show that 85 and 99 subjects had this body posture deformity. These subjects have increased flexion in cervical spine. In one variable Sag. Distance of the cervical spine sacrum, the results in 47 subjects were negative. The result indicates an enlarged extension of the chest part of the spinal column. These results were reflected in the scoliotic posture measured by the Wolanski method. The predictive value of the variables that define the body composition measured by Tanita scale with respect to the criterion defining the variables of scoliotic posture by the Wolanski method, multiple correlation is .440.
The complete predictor system has given a statistically significant contribution to the explanation of the criterion variable of scoliotics at a significance level of 0.01%. The largest single contribution was given by the fatproc variable (mass percentage and fat mass. (total weight of fat) There are results in all variables that significantly deviate from the normal body posture and are considered a poor body posture. In some variables, as many as 80-90% of students deviate from good posture. Based on the results, we can conclude that bodily deformities and bad postures are very pronounced in 11 and 12 year olds.

Keywords: *incidence, body deformities, scoliotic posture, body composition*

INTRODUCTION

Physical posture implies proper alignment of body segments and their balance, which is achieved with the investment of minimum strength with maximum mechanical efficiency (Garrison and Read, 1980). So far, many studies have addressed the problem of assessing posture, selecting the best indicators, and assessing the reliability of these procedures (Adar, B.Z. 2004, Stefanović i suradnici, 1972; Tribastone, 1994; Watson, Mac Donncha, 2000; Skender, 2001; Skender, Kendić, 2002; Paušić, 2005; McEvoy i Grimmer, 2005; Demeši, Č. 2007). All these studies were conducted with the aim of detecting irregularities in the posture of children and adults. Lack of movement reduces the ability to regulate the vegetative system, on which largely depends the ability to adapt, resistance and health. (Kosinac, 1994). Sedentary lifestyle leads to an increase in various diseases, especially spinal deformities, which are related to reduced physical activity. Hypokinesia is an insufficient amount of physical activities that the body needs to function normally.

The population of students of all ages is affected by hypokinesia regardless of the place of residence, resulting from a sedentary lifestyle, which, with abundant food most often unconfirmed origins and increased intellectual and emotional activity (Nagyová & Ramacsay, 1999), is a multiplied problem. Today's population of children and young people is burdened by nervous tension, locomotor system disorders and diseases of the cardiovascular and respiratory systems. There is a growing disproportion between meeting biotic needs and the so-called civilisational needs or, more precisely, genetically conditioned and civilisationally imposed demands, and this, of course, to the detriment of the former (Prskalo, I., et.al. 2010., Kurtović, N. et al 2020).

AIM AND METHODS

The aim of this paper is to determine the frequency of physical deformities in students aged 11 and 12 years and their relationship with the structure and composition of the body.

The aim of this paper is to determine the frequency (prevalence) of spine deformities by students 11 and 12 year olds and relationships with the composition and body structure.

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, who are clinically healthy. 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 the professor of physical education and health, the frequency of spinal deformities and the sudden increase in obese children in this population.

Sample variables

The sample of variables for the assessment of physical deformities (Skender, 2001; Skender, 2004; Skender er al. 2018., Wolanski, 2005) The entire assessment procedure VODRGL - head posture, VORGK - chest posture, VDRLO - shoulder blades posture, VOSKO - scoliotic posture, VODRTR - front abdominal wall posture, and VOBO - leg posture. Evaluation of posture according to the method of Napoleon Wolanski. In order to obtain some assessment of body posture or assessment of

posture for one component, the following 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, i.e., 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 characterised 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 spine deformities. 0 POINTS - excellent posture. 1-4 POINTS - very good posture, 5-8 POINTS - good posture, 9-12 POINTS - poor posture, and 13-16 POINTS - very poor posture.
The second group of variables for the assessment of physical deformities of the back using the measuring instrument Contemplast, professional motion analysis software, (Kovač & al., 2014), a modern tool for the diagnosis of postural disorders. We used a total of 11 variables in this study.

Shoulder rotation
Variable expressed in degrees indicates the rotation in longitudinal axis (transversal plane) of the left/right shoulder. If the results are positive it indicates a rotation of the upper body in which case the right shoulder is placed forward, while negative results indicate a rotation of the upper body in which case the left shoulder is placed forward.

Pelvic rotation
Variable expressed in degrees indicates rotation in longitudinal axis (transversal plane) of the left/right pelvic side. If the results are positive it indicates the rotation in which case the right side of the pelvis is placed forward, while in negative results the rotation of the left side of the pelvis is placed forward.

Trochanter rotation
Variable expressed in degrees indicates rotation of the left/right tronchanter in longitudinal axis (transversal plane). If the result is positive it indicates the rotation of the lower body in which case the right side of pelvis is rotated towards front, while the negative results indicate the front rotation of the left side of pelvis.

Condylus rotation
Variable expressed in degrees indicates the knee rotation in longitudinal axis (transversal plane). If the results are positive, it indicates the front rotation of lateral condylus of the right leg, while the negative results indicate the front rotation of the left lateral condylus.

Sag. Distance cervical spine – sacrum*
Variable expressed in centimetres indicates the distance of the most protruded cervical (neck) vertebra in regards to the vertical line projection of the sacrum (bone at the bottom of the spine) in the sagittal plane. Positive result indicates the increased flexion of the cer vical spine, while the negative results indicate the increased extension of the cervical spine.

Sag. Distance thoracic spine - sacrum*
Variable expressed in centimetres indicates the distance of the thoracic spine in regards to vertical line projections of the sacrum (bone at the bottom of the spine) in sagittal plane. Positive results indicate an increase of flexion in thoracic spine, while the negative results indicate an increase in other extension of the thoracic spine .
*Higher values in the positive and negative offset do not apply for the variables "Sag. dis tance cervical, thoracic, lumbar – sacrum"

Sag. Distance lumbar spine - sacrum*
Variable expressed in centimetres indicates the distance of the lumbar (lower) spine in re gards to the vertical line projection of sacrum (bone at the bottom of the spine) in sagittal plane. Positive result indicates an increase in lumbar spine flexion, while negative results indicate increase in the lumbar spine extension.

Varus/Valgus left Variable expressed in degrees indicates the Varus-Valgus alignment angle of the left leg (medial/lateral) at the knee joint.

Varus/Valgus right Variable expressed in degrees indicates the Varus/Valgus alignment angle of the right leg (medial/lateral) at the knee joint.

Flexion/Extension left
Variable expressed in degrees indicates the hyperextension and flexion of the left leg at the knee joint (sagittal plane). Positive result indicates the left leg flexion, while negative result indicates hyperextension of the left leg.

Flexion/Extension right
Variable expressed in degrees indicates the hyperextension or the flexion of the right leg at knee joint (sagittal plane). Positive result indicates the right leg flexion, while the negative result indicates the hyperextension of the right leg.

A sample of variables to assess body composition BIA was measured using a TANITA body composition parameter analyser (the model of TANITA body composition analyser BF-350) in relation to the body composition and age of the subjects. This body composition assessment set includes the following nine variables: HEIGHT - body height, WEIGHT - body mass, BMI - Body Mass Index, BMR - the value of basal metabolism, IMPEDANCE RESISTANCE - bioelectrical resistance of the body, FATPROC - percentage of fat, FATMAS - total weight of fat mass (in kg, lb) in the body, FFM - total lean body mass, TBW - the percentage of water in the body. All formulas and settings used are factory default.

(Musulin J, Baretić M, Šimegi - Đekić V. 2017, Kurtović, N. et al. 2020).

RESULTS AND DISCUSSION

Frequency of physical deformities-poor posture in students aged 11 and 12) based on the method of Napoleon Wolanski

Of the five groups of respondents, table no. 1. The first three groups of respondents who had a total of up to 8 points were treated as respondents with good posture, and respondents who had from 9 to 16 points were treated as respondents with poor posture. Based on these studies, we found that a total of 66 of the 110 respondents had poor posture. This shows us that more than 50% of respondents in this population had poor posture, which tells us about the increased number of poor posture in students aged 11 and 12 years.

This state of incidence of poor posture (scoliotic, kyphotic and lordotic posture) in primary school students indicates a condition that warns and indicates the need for systematic examinations in schools in order to take preventive measures and develop corrective exercise programs.

Table 1. Frequency of body deformities divided into two groups

Ordinal number	Number of points	Posture	No	groups	total	
1.	0 points	excellent posture	2	1	44	40%
2.	1-4 points	very good posture	10	1		
3.	5-8 points	good posture	32	1		
4.	9-12 points	poor posture	43	2	66	60%
5.	13-16 points	very poor posture	23	2		
Total:			110		110	

Frequency of physical deformities - poor posture in students aged 11 and 12 years) based on the device Contemplast

By applying the most modern equipment, the measuring instrument Contemplast (professional motion analysis software), we obtained significant descriptive and numerical indicators in the deviation from the correct posture. We have applied the logic based on previous research that when it comes to rotation in variables measured degrees above + 5 and below - 5 is considered poor posture and when it comes to variables where deplacement deviation from good posture is considered above + 2 and below -2. The following Table 2 shows the results of a study of the prevalence of poor posture scores for all variables.

Table 2. Incidence of poor posture and spinal deformities

R.Br.	Name of variable	u +	u-
1.	Shoulder rotation	29	14
2.	Pelvic rotation	15	18
3.	Trochanter rotation	7	27
4.	Condylus rotation	14	6
5.	Sag.Distance cervical spine sacrum	85	0
6.	Sag.Distance lumber spine sacrum	14	47
7.	Sag.Distance cervical spine sacrum	99	0
8.	Varus/Valgus lef	10	2
9.	Varus/Valgus right	10	5
10.	Flexion/extension left	57	3
11.	Flexion/extension right	11	38

Analyzing the above table, we see that in almost all variables there is an increasing number of deviations from proper posture. In the first variable Shoulder rotation where the result is expressed in degrees, and gives us information about the rotation along the longitudinal axis of the left and right shoulder, we found that 29 subjects rotated the upper torso where the right shoulder is moved forward, and 14 the subject is also a rotation of the upper torso where the left shoulder is facing forward. Therefore, only in

this variable there is a pronounced deviation in 43 subjects. The second variable we analyzed was Pelvic rotation. The results we obtained also tell us about the rotation along the longitudinal axis of the pelvis, a positive result tells about the rotation of the right side of the pelvis, and a negative result about the rotation of the left side of the pelvis forward. A total of 15 subjects had a rotation of the right side forward, and 18 subjects had a deviation of the rotation of the left side of the pelvis forward, which totals 33 subjects.

The third variable analyzed in this study is Trochanter rotation which gives us information about the rotation of the left / right femoral rotator along the longitudinal axis in the transverse plane. In a total of 7 subjects, the rotation of the right side of the pelvis forward was determined, and in 27 subjects it was a rotation of the left side forward.

Analysis of the first variable Sag.Distance cervical spine sacrum which gives us information about the distance of the most protruding cervical (cervical) vertebra from the projection of the vertical line of the sacrum (sacral) bone seen in the sagittal plane, and expressed in centimeters 85 subjects had increased flexion in the cervical spine. Analysis of the second variable Sag.Distance cervical spine sacrum which tells us about the distance of the thoracic (thoracic) spine from the projection of the vertical line of the sacrum observed in the sagittal plane from the results shows that increased flexion in the thoracic spine was obtained in 14 subjects, while enlarged extension thoracic spine we have in 47 subjects. Further analysis of the third variable Sag.Distance cervical spine sacrum which tells us about the distance of the lumbar spine from the projection of the vertical line of the sacrum seen in the sagittal plane indicating increased flexion in the lumbar spine was observed in 99 subjects.

The next variable we analyzed is Flexion / extension left which speaks of hyperextension of the left leg and knee joint in the sagittal plane. A positive result indicates left leg flexion while a negative result indicates left leg hyperextension. In a total of 57 subjects, deviation from normal posture was noted. In the variable Flexsion / extension of the right leg, hyperextension of the right leg was noted in 38 subjects, while flexion of the right leg was noted in 11 subjects.

The results of the research show that one of the causes of kyphotic poor posture is probably poor posture (bending the head towards the sternum) (Simov et al., 2011), and one of the growing problems of our time is excessive computer work. Some research suggests that increased sitting time at the computer leads to an increase in cases of lumbar lordosis, and the reason is improper sitting and looking up, which leads to stretching the torso to keep the view towards the monitor straight (Straker, O'Sullivan, Smith and Perry, 2007). Inactivity leads to weakening and loss of muscle tone, and thus the strength of the back muscles, which causes improper sitting, which can lead to spinal deformities, or the appearance of poor posture. (Kovač, at al 2014,)

From the above results we can conclude that almost all variables have results that deviate significantly from normal body posture, and as such in this paper are considered as poor posture. In some variables, as many as 80-90% of students have a pronounced disagreement with good posture. Analyzing the results of both methods of determining physical deformities, we can say with certainty that the frequency of physical deformities in students aged 11 and 12 years is expressed in a very large volume. Since this is the age where students reach puberty, which is a sensitive period in the development of children and a sensitive period for the emergence of poor posture due to the rapid growth and development that occurs in this period, which we have proven with this paper. The main reason for poor posture is immobility and poor physical activity, which are one of the main external causes of deformities.

Influence of body composition on scoliotic posture (VOSKO)

By regression analysis, we wanted to determine the predictive value of variables that define body composition in relation to the criterion that defines the variable scoliotic posture. By analyzing the table number 3, which shows the regression analysis with the criterion of scoliotic posture, we can conclude that the multiple correlation is high and amounts to .440 and the coefficient of determination .194. The complete predictor system made a statistically significant contribution to the explanation of the criterion variable scoliotic posture at a significance level of 0.01%. Further analysis of the same table shows the individual contribution of each predictor variable to the explanation of the criterion variable scoliotic posture in our subjects.

Table 3. Regression analysis of body composition and scoliotic posture (anova, coefficients)

Model		R	R Square	Adjusted R Square	Std. Error of the Estimate	
1		,440(a)	,194	,138	,55470	
		Sum of Squares	df	Mean Square	F	Sig.
	Regression	Regressi	7,533	7	1,0768	3,498
	Residual	Residual	31,385	102	,308	
	Total	Total	38,918	109		
		Unstandardized Coefficients	Standardized Coefficients	t	Sig.	
		B	Std. Error	Beta	B	Std. Err
	(Constant)	-,841	2,440		-,345	,731
	bmi	,028	,077	,171	,367	,714
	fatproc	-,084	,028	-1,279	-2,978	,004
	fatmas	-,118	,040	-1,344	2,951	,004
	ffmas	-,353	,199	-2,991	-1,772	,079
	tbw	,451	,267	2,804	1,691	,094
	totpor	,003	,002	,270	1,124	,264
	bmr	,000	,000	,239	1,070	,287

Dependent variable: vosko
Predictor variables: bmi, fatproc, fatmas, ffmas, tbw, , totpor, bmi,

The largest single contribution was made by the variable fatproc and fat mass. Fatmass has some significance, but not statistical significance in the explanation of this our model. It is quite understandable that the variable percentage of fat and fat mass is a ballast and an aggravating factor for normal functioning in children. An increase in these two parameters inevitably affected scoliotic posture. All this speaks in favor of the structure of the body, especially from the point of view of fat deposits that accumulate for several reasons, and the most important factor is inactivity and improper diet. Based on these results, we can conclude that obesity affects poor posture in children and especially scoliotic poor posture. (Kurtović, N. et al. 2020). It is very important that in the period of growth and development of physical activity we influence the reduction of subcutaneous fat, which has been proven in this paper as a very important factor in the occurrence of poor posture and deformities.

CONCLUSION

We conclude there are results in all variables that significantly deviate from the normal body posture and are considered a poor body posture. In some variables, as many as 80-90% of students deviate from good posture. Based on the results, we can conclude that bodily deformities and bad postures are very pronounced in 11 and 12 year olds.

The complete predictor system has given a statistically significant contribution to the explanation of the criterion variable of scoliotics at a significance level of 0.01%. The largest single contribution was given by the fatproc variable mass percentage and fat mass. (total weight of fat).

REFRENCES:

1. Adar, B.Z. (2004). Risk Factors of Prolonged Sitting and Lack of Physical Activity in Relate to Postural Deformities, Muscles Tension and Backache Among Israeli Children. A clinical cross sectional research. Doctoral Thesis, Semmelweis University Budapest.
2. Demeši, Č. (2007). Anti-gravity muscles in postural status of children aged 7 and 13. Master's thesis. Novi Sad: Faculty of Medicine, Novi Sad.
3. Garrison, L., A.K. Read (1980). Fitness for every body. Palo Alto, Calif Mayfield Publishing. yournal of Obesity. advance online publication, doi:10.1038/sj.ijo.0802735.
4. Kendić, S., Skender, N. (2004). Analysis of the relationship between physical deformities and ventilation of the lungs in students aged 15 to 16 years. Homosporticus, No. 1 p. 44-47
5. Kosinac, Z. (1994): Morphological and motor characteristics of girls with varying degrees of scoliosis. Kinesiology, Vol., 26. 1 - 2, Zagreb.
6. Kovač, S., Kajmović, H., Rađo, I., & Manić, G. (2014). Trend Projections of Body Deformities Occurrence between the ages of 5 and 12, Metrically Objectified and Estimated by 3D Postural Status Screening. Homosporticus, 16(2), 5-13.
7. Kurtović, N., Skender, N. Selimovi, N., Šabić, E., Palić, A. (2020). An analysis of the relationship between body structure and body deformities in children 11 and 12. Sportscience. Vol. 14. ISSUE 1; 58-67.
8. McEvoy, M.P., K. Grimmer (2005). Reliability of upright posture measurements in primary school children. BMC Musculoskeletal Disorders 2005, 6:35 .
9. Musulin J, Baretić M, Šimegi - Đekić V. (2017). Procjena sastava tijela u bolesnika s tipom 1 šećerne bolesti metodom bioelektrične impedancije.

Assessment of body composition of patients with type 1 diabetes. Liječ Vjesn.139(9- 10):280-285.
10. Nagyová, L., & Ramacsay, L. (1999). The occurrence of the risk factors and healt problems of people. In D. Milanović (Ed.) Proceedings Book of the 2nd International Scientific Conference „Kinesiology for the 21 stCentury"(pp. 349-351). Zagreb: Faculty of PE, University of Zagreb
11. Paušić, J. (2005). Procjene promjene tjelesnog držanja u djece životne dobi od sedam do devet godina. Magistarski rad. Kineziološki fakultet Sveučilišta u Zagrebu, Zagreb.
12. Paušić, J. (2007). Konstrukcija i vrednovanje mjernih postupaka za procjenu tjelesnog držanja u dječaka dobi od 10 do 13 godina. Doktorska disertacija. Kineziološki fakultet Sveučilišta u Zagrebu. [Construction and evaluation of measurement procedures for the assessment of body posture in boys aged 10 to 13 years. Doctoral dissertation. Faculty of Kinesiology, University of Zagreb.] In Croatian
13. Prskalo, I., Barić, A., Badrić, M. (2010). Kineziološki sadržaji i slobodno vrijeme mladih, U: Andrijašević, M. (ur.): Kineziološki sadržaji i društveni život mladih, Zagreb, Kineziološki fakultet Sveučilišta u Zagrebu; str. 65-71.
14. Simov, S. B., Milinić, S. M., & Stojanović, D. O. (2011). Učestalost pojave lošeg držanja tela i ravnih stopala kod dece predškolskog uzrasta. Apollinem Medicum et Aesculapium, 9(2), 5-8. [The incidence of bad posture and flat feet in children of preschool age. Apollini medicum et Aesculapium, 9 (2), 5-8.] In Serbian
15. Skender, N. (2001) : Relacije tjelesnih deformiteta i motoričkih sposobnosti učenika uzrasta 15 i 16 godina. (Magistarski rad). Sarajevo
16. Skender, N. (2001): The frequency of bodily deformities among students aged 15 and 16 years. Homosporticus, vol. 3; 59-63.
17. Skender, N., Kendić, S. (2002) : Tjelesni i zdravstveni odgoj u funkciji korekcije deformiteta lokomotornog sistema. Pedagoški zavod. Bihać.
18. Skender, N., Kurtović, N., Čolakhodzić, E., Djedović, D. (2018). Objektivnost procjene deformiteta kralježnice kod učenika nižih razreda osnovne škole. 8 th International Conference on "Sports Science and Health" At: Banja Luka; Bosna i Hercegovina
19. Stefanović, D., N. Finogenov, N. Tasić, M. Rašić, D. Nikolić, S. Jovanović, Đ. Kolarić, Lj. Ikonić, D. Milutinović i D. Stanisavljević (1972). Učestalost telesnih deformacija i lošeg telesnog držanja školske dece na području SR Srbije. Zbornik radova I. kongresa liječnika školske medicine Hrvatske, Split-Trogir: 351-357.
20. Straker, L. M., O'Sullivan, P. B., Smith, A., & Perry, M. (2007). Computer use and habitual spinal posture in Australian adolescents. Public health reports, 122(5), 634.
21. Tribastone, R. (1994). Compendio Ginnastica Correttiva. Società Stampa Sportiva, Roma.
22. Watson, A.W.S., C. Mac Donncha(2000). A reliable method for the assessment of posture. Journal of Sports Medicine and Physical Fitness, 40:260-270.
23. Wolanski.N. (2005). Biological Development of Men. Podstory anksiologi, gerontologi i promciji zdravia. PWN. ISBN 830114422X, Varszawa, Poland. 49-67.

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