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DIFFERENCES IN BODY POSTURE AND BALANCE IN CHILDREN OF CLASSROOM TEACHING ATTENDING AND NOT ATTENDING EXTENDED STAY

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(Original scientific paper)

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Abstract

Proper postural child development depends on good structural and functional development of the body. Children have already affected their development and their posture in a negative way by reducing their movements and by increasing their weight at the same time. When observing the sagittal posture, the gravity line passes through these points: mid skull, mid shoulder, hip, knee, and slightly in front of the malleolus lateralis.The main objective of this paper is to determine the differences in indicators of posture in children attending extended and those children who do not attend an extended stay. The sample in this study included the students from 1st to 3rd grade of elementary school with a total number of 134. Subsamples of respondents are arranged within the first, second and third grade and subsamples of children attending an extended stay and those who do not attend it. Four variables were taken to determine the postural stability: anterior or posterior tilt of the body in relation to the gravity line, percentage of CG distributed anteriorly and posteriorly to the point of the projection of the center of the body on the surface of the palm of respondents and distance travelled point of the projection of the center of the body in the area of support expressed in millimeters. Measuring of the indicators of posture were exercised by one surveyor who set markers at specific points of the body in the sagittal examination, another surveyor carried out the shooting, and the third one did the analysis on the force platform recording within 3 seconds by setting a foot parallel to the platform in a calm and relaxed attitude. Based on the results the main hypothesis was confirmed: subsamples of respondents (children attending and those not attending extended stay) were significantly different in all postural parameters.

***Key Words**: foot pressure distribution, elementary school children*

Introduction

The standard posture (Latin - positura - position) is the correct relation of different parts of the body which maintains a balance between supporting structures. The spine must have a normal curvature and lower extremities must be in an ideal position to maintain balance. When observing the sagittal posture, it is clear that gravity line passes through these points: auditory opening, acromion, and hip, slightly anterior to the epicondyle knees and slightly anterior to the lateral malleolus. Derogation from any point of the correct body posture will try to compensate for posture, and eventually will become improper posture. It is important to recognize the body points that indicate postural deviations in the growth of the individual. In recent times there is increasing dispute about the problem of overweight children's schoolbags and risks to children's health, the muscle and spinal discomfort and numbness in hands and fingers, fatigue and cervical spinal musculature which is associated with improper posture. In some European countries, the law prescribes that the weight of school bags must not exceed 10 % of the body weight of the child (Fošnarić, 2007).

The younger the child, the lower acceptable load; for children who are between 6 and 7, it should not exceed 5-10 % of their body weight. If a child carries heavy burden, it will be difficult to walk faster and they will get tired easily. Conditions unwittingly exacerbate if a child carries a bag on one shoulder, in one hand or over their back all the way to their thigh. Child weakens stat - dynamics of their musculoskeletal system; there is a failure in occurrence of postural muscle which promotes the formation of inadequate posture. Hunched posture will harm the natural curvature of the spine in the long run. Postural tilt implies a movement of the head, shoulders and pelvis. The head and pelvis can tilt the

anterior or posterior to the coronal plane. The anterior tilt of the head will result in flexion of the cervical spine and posterior slope will result in the extension. The posterior pelvic tilt results in flexion of the lumbar spine and anterior pelvic tilt results in the extension of the lumbar spine. The head and pelvis can tilt laterally; from the neutral position, shoulder blade can attain anterior slope rather than posterior slope, unless the posterior slope means the blades moving back to theneutral positionof theanteriortilt. There is an increasing number of children with incorrect posture and the research has shown that in Croatian schools in children between 6-9 years, this percentage ranges from 51-62%, (Paušić, 2005) and in boys 10-13 years, from 10 to 22% (Paušić, 2007). Paušić and Kujundžić (2008) conducted a study whose objective was to determine the percentage of the weight of school bags in relation to the weight of students in some schools in Split-DalmatianCounty and therefore warn all of those concerned, that there is a problem of too heavy bags in early childhood. The weight study was carried out on a sample of 348 students attending years 1-4 and two values were established : body weight and the weight of school bags, as well as the average weight of bags in relation to body weight. The data indicated that in all years, the percentage of overweight bags in relation to students' body weight is 10% higher, reaching up to 12.5-13.8%. Paušić et al. (2009) have conducted this research on 252 students attending years 1-4. The aim of the study was to determine the percentage of overweight schoolbags in relation to body weight students and to determine whether there were differences between the students of the first, second, third and fourth years. The next objective was to answer the question of whether there is a connection established by the percentage of weight of school bags in relation to body weight and intensity of pain reported by carrying schoolbags and differences between students of different years in the variable of intensity of pain. The interview with the students was conducted immediately after the measurement of body weight and weight bags and the researcher talked with all the students involved. It was concluded that the primary factor that made the bags so heavy was carrying unnecessary didactic material; the timetable was always defined, but its implementation was not always to the plan. Ultimately, we always have to think about the future growth and development of our children. Pau et al. (2010) analyzed the foot pressure in 359 children attending primary school (6-10 years of age) in a static upright posture, in order to assess the size and features that impact stemming from the relationship between the load and the foot of the substrate. The data collected showed that the school bag had a significant increase in the total reliance on the surface (10%) and that the pressure was greater on the front of the foot (20-30%). A significant shift in the average position of the feet from the pressure centre towards the front of the foot was an indication of where the body tried to compensate for its stability at an excessive load. These results suggest that heavy burden increases the risk of foot deformities and acts as an important factor in the occurrence of changes in the structure of the foot. Kellis (2001) conducted a study where the aim was to examine the pressure distribution of the body weight on the foot in preschool boys with upright posture, during lowering and walking. Fourteen healthy boys performed five activities (standing on one leg, standing on both feet, landing in a squat on one and both legs and walking) on the platform of Musgrave system. Eight points of view were considered in analyzing the results taken: analysis of variance (ANOVA) shows that, in total, the pressure of the foot during the descent was significantly higher compared to the total pressure developed during standing on one leg or both legs and the contact during walking ($p<0.05$). Multivariate analysis of variance showed that the foot pressures were significantly greater during the descent on the other point of view and walking compared with pressures while standing on both legs ($p<0.05$). Standing and walking phases were not entirely important positions in this observation.

The aim of this study was to determine whether there were differences in body posture in children attending an extended stay (breakfast club and after school club) and those children who do not, but go to school and carry their bag every day, in order to highlight the problem and assist in their healthy growth and development .

Material & methods

The study included 134 students in years 1-3. The respondents were observed within the first, second and third year, those attending an extended stay and those who did not. The first class included 45 children, 26 of whom were attending an extended stay and 19 who did not. The second class included 42, 18 of which attended an extended stay and 24 did not. The third class included 47 children, 34 of them attended an extended stay and 13 who did not attend. Subsample of children attending an extended stay within each class were not wearing school bags and had daily physical activity within the 2 hours of afternoon rest. The students needed their parents' approval for participating in this study and signed

agreement was needed for performing further measurements as well as their approval for their children's photographs to be taken and used in this study. In order to determine the postural stability four variables had to be considered. Variable BODTIL shows the anterior or posterior tilt of the body in relation to gravity line which is estimated by taking pictures of posture and angle of inclination of the line, using computer program PostureZone Analyser Version 2.0.63 (Phillip Geary DC , MSc). The following three variables were estimated by tensiometric platform Footscan(RsScan , Inc., UK):

ANT% - the percentage of body gravity is distributed anterior to the point of projection of the body center of gravity on the surface of the support of the respondents. The value is expressed in percentages and the total percentage is 100%; it refers to the sum of the values of two variables ANT% and POS%.

POS% - the percentage of body gravity is distributed posterior to the point of projection of the body center of gravity on the surface of the support of the respondents. The value is expressed in percentages and the total percentage is 100%; it refers to the sum of values of two variables %ANT and %POS. PCTT - distance travelled point projection of the center of gravity in the area of support, expressed in millimetres (mm). Data collection was carried out within one working day and 134 school children from years 1-3 took part. Children were arranged in different subcategories according to whether they attended an extended stay in school or not. It is important to note that the measurement was performed at the end of the school year when the children were already adjusted to school regime (carrying a school bag). Measuring indicators of body posture was performed by an assessor who set markers at specific points of the body in the sagittal review, another surveyor carried out picture taking and the third performed analysis using the platform of Footscan, (RsScan , Inc., UK) recording within 3 seconds, setting foot parallel to the platform in a calm and relaxed attitude . Photography was done in the sagittal examination by placing markers in order from head to toe, to very specific areas of the body, using method of photography analysis of subjects within the computer software Posture Zone Analyser Version 2.0.63 (Phillip Geary DC, MSc), which proved to be highly reliable (Paušić, 2010). After all the children had been measured and the data stored, the processing of the obtained data started. The data processing began by analyzing photos of the children within the computer software PostureZone Analyser Version 2.0.63 (Phillip Geary DC, MSc). For each photo the assessors have set lines that match the description of the variables obtained. In this way, six reference lines were detected and for this study the line that represented the deviation of body posture towards gravity line was taken as the reference (representative) line.

The results of reference lines were entered into the matrix of data, which were subsequently processed in the statistical program Statistica 7.0 (StatSoft, Inc. 2004). Then, they analyzed the data obtained on the platform of Footscan (RsScan, Inc. UK) and for each of the children were taken three data (anterior ANT and posterior POS percentage of the body mass centre distributed from the point of projection on the surface of the respondent's palm and the distance travelled from the point of projection of the body mass line within the area of support, expressed in millimetres, PCTT). The results were analyzed by descriptive statistics and the following values were obtained: AS - mean, SD - standard deviation, min. - Minimum score, max. - the maximum score and histogram display for all reference points. The Kolmogorov - Smirnov normality test was used and it showed the following parameters: d max - p - MANOVA - a test that compares the independent categorical variables and more continuous dependent variables, most often used for comparison of several groups with respect to the more continuous variables.

Results and Discussion

Kolmogorov - Smirnov test indicated the assessment of normal distribution of all measurement tests and, except in the third variable PCTT class (the distance travelled based on body mass) which were not normally distributed variables, did not deviate significantly from the normal distribution, because the greatest discrepancies between the theoretical and the cumulative proportion (D max) were lower than limits of deviation (0.23). These results indicated the relevance of the tests. The data obtained were transformed into descriptive statistics in order to obtain the basic values of the actual situation. Within the subsample of subjects in all years, the biggest difference between the subsample of children attending an extended stay and those who did not attend, was found inside PCTT variables (the distance travelled based on body mass). The position of the projection of the body mass centre, for the children in Year 1 who did not attend an extended stay, at a standstill, was 80 mm, while the children who attended the extended stay was 39 mm. The other parameters of postural stability were not significantly different. In the subsample of children attending Year 2 and subsample of children who did not attend extended stay,

average value of the projection of the body mass centre was significantly different from the subsample of children attending an extended stay. It was 91mm for the children who did not and 32mm for the children who attended an extended stay. The other three indicators were not significantly different. In the children in Year 3, statistically significant differences were also found between the subsample of children who attended and those children who did not attend an extended stay, in PCTT variables as in previous school years. The indicator value of postural stability in the subsample who attended extended stay was 38mm while in the subsample who did not attend was 73mm. All variables between the subsample of children who attended and those who did not attend an extended stay were taken as a collective assessment of postural stability. According to multivariate analysis of variance, the two subsamples were statistically different in PCTT variable, while others contributed to it (Table 1).

Table 1. Multivariate analysis of the variables indicators in postural stability in children in Year 1, within the subsample of children who attended and those who did not attend extended stay (school hours including breakfast and after school club

	Regular stay n=19				**Extended stay n=25**					
	AS	**Min**	**Max**	**SD**	**AS**	**Min**	**Max**	**SD**	**F**	**p**
PCTT	80,61	58,00	122,00	17,26	39,29	21,00	133,00	27,18	**33,531**	**0,000**
%ANT	36,53	20,00	60,00	13,02	35,92	19,00	48,00	7,95	0,321	0,574
%POS	61,37	32,00	80,00	14,69	64,08	52,00	81,00	7,95	0,003	0,956
NAGTIJ	-1,72	-3,40	-0,60	0,93	-1,56	-2,90	-0,20	0,72	0,421	0,519

Wilks'λ = 0.493 F = 9.759 DF1 = 4 df2 = 38 p = 0.000

On the basis of Table 1, subsamples of respondents (children attending and not attending an extended stay) were significantly different in all postural indicators in Year 1.

There was also a statistically significant difference (p) variables within PCTT subsample of children in Year 2 in those who attended and the ones who did not attend extended stay, while within the variable ANT%, POS% and BODTIL, there was no statistically significant difference. Subsamples of respondents (the children attending and not attending an extended stay) were statistically, significantly different in all postural indicators in Year 2 (Table 2).

Table 2. Multivariate analysis of the variables indicate postural stability in children in Year 2, within the subsample of children who attended and those who did not attend extended stay (school hours including breakfast and after school club).

	Regular stayn=24				**Extended stay n=18**				**F**	**p**
	AS	**Min**	**Max**	**SD**	**AS**	**Min**	**Max**	**SD**		
PCTT	91,75	73,00	128,00	14,71	32,44	20,00	64,00	11,61	**199,07**	**0,000**
%ANT	36,29	19,00	60,00	11,58	39,33	11,00	55,00	11,18	0,731	0,397
%POS	63,71	40,00	81,00	11,58	60,67	45,00	89,00	11,18	0,732	0,398
NAGTIJ	-2,30	-4,90	0,90	1,32	-2,28	-7,80	-0,20	1,68	0,011	0,974

Wilks'λ=0,159 F=66,57 df1=3 df2=38 **p=0,000**

Table 3 also confirmed the same significant difference within the subsample of children in Year 3 between the children who attend and those who do not attend extended stay in PCTT variables. Subsamples of respondents (children attending and not attending an extended stay) are statistically significantly different in all postural indicators in Year 3.

Table 3. Multivariate analysis of the variables indicate postural stability in children in Year 3, within the subsample of children who attended and those who did not attend extended stay (school hours including breakfast and after school club).

	Regular stayn=13				Extended stay n=33				F	p
	AS	Min	Max	SD	AS	Min	Max	SD		
PCTT	73,58	61,00	90,00	10,07	38,28	22,00	111,00	23,65	**5,280**	**0,026**
%ANT	44,62	21,00	69,00	14,96	42,52	22,00	73,00	11,85	0,252	0,617
%POS	55,38	31,00	79,00	14,96	57,48	27,00	78,00	11,85	0,252	0,617
NAGTIJ	-2,31	-4,00	0,20	1,19	-2,54	-6,20	-0,20	1,24	0,323	0,572

Wilks'λ=0,502 F=13,2 df1=3 df2=40 **p=0,000**

Through the subsample of children who attend all the three years, the same crucial statistical indicator of postural stability (PCTT) appears. All children after Year 3, cease to be entitled to the extended stay in Croatia. The research was performed in Year 4 in the same school, but is not taken as a direct sub sample in this study. It is interesting to note that the average value of the projection center of the body mass, as a common value of the children attending and those not attending an extended stay was 79. From this, stems the conclusion that in children who have not entered the system of extended stays in school, this parameter is weaker. It should longitudinally follow and record children who start the system, in order to assess the speed of weakening their postural stability. The results of descriptive statistics showed dominantly better postural stability in a group of extended stay, because they were not subject to the additional load (carrying a school bag). Subsamples of respondents (children who attended and those who did not attend extended stay) were statistically significantly different in all postural parameters.

Conclusions

Children who were in the system of extended stay had better postural stability. School bags present quite a heavy load, in addition to carrying unnecessary didactic material, which first weakens postural stability and later on, causes bigger deformities. In Croatia, the children from the extended stay after Year 3 join the regular school system. This study showed statistically significant differences in the subsample of children who attend school, but do not attend an extended stay, in the variable projection of the center of body mass (for Year 1 and 2-100% and in Year 3-98%). The conclusion is that there is a great need for the continuation of extended stay in our system of education even after Year 3, which would lead to improving the health status and functional problems in children.

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