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CHANGES IN CHILDREN'S POSTURE FROM THE FIRST TO THE THIRD GRADE OF ELEMENTARY SCHOOL

SPREMEMBE TELESNE DRŽE OTROK OD PRVEGA DO TRETJEGA RAZREDA OSNOVNE ŠOLE

Abstract

Changes in posture indicators, developing from the first grade to the third grade of elementary school, have been identified in a sample of 224 children, 114 female and 110 male pupils, all first graders. Fourteen indicators were used for body posture valuation, measured with a scoliosis meter. The results were processed using quantitative analysis of changes of one sample, measured at two age points using an SSDIF algorithm (Momirović, 1984). The obtained discriminative functions indicate the existence of significant differences between the first and the second, and between the second and the third measurings. Thirteen out of fourteen indicators revealed statistically important increases of average parameter values, thus leading to the conclusion that a child's muscular system is influenced by new and specific overloads, caused by school obligations.

Key words: posture, children, primary school, overloads

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Povzetek

Spremembe kazalnikov telesne drže, ki se razvijajo od prvega do tretjega razreda osnovne šole, smo spremljali na vzorcu 224 prvošolčkov, 114 deklic in 110 dečkov. Za ocenitev telesne drže smo uporabili štirinajst indikatorjev, ki smo jih določili s pomočjo skoliosis metra. Podatke smo obdelali s kvantitativno analizo sprememb na enem vzorcu, izmerjenem v dveh starostnih točkah v skladu s SSDIF algoritmom (Momirović, 1984). Izražene diskriminativne funkcije kažejo na značilne spremembe med prvim in drugim ter drugim in tretjim merjenjem. Statistično značilne razlike v povprečnih vrednostih so se pokazale v trinajstih izmed štirinajstih kazalnikov, glede na kar lahko sklepamo, da nova specifična bremena, povezana s šolskimi dolžnostmi, vplivajo na otrokov mišični sistem.

Ključne besede: telesna drža, otroci, osnovna šola, preobremenitev

INTRODUCTION

The regular growth and development in children is a condition for maintaining their psycho-physical health, which manifests itself in later phases of their lives. However, the pace of growth and development in children is very diverse. The complex functional transformation of a person does not occur regularly and equally in all of the different parts of the body and is marked by so-called *development crises* (Kosinac, 2002). Children present significant differences in degrees of psychophysical maturity, and all of their school obligations and other activities, which are not adjusted to their biological maturity but still a part of their every day lives, have a negative influence on regular growth and development. This becomes particularly evident during the crisis phases of development. One of the key crisis phases of growth and development is the beginning of elementary school. The beginning of schooling is as well the beginning of a period of a new, adverse load on the motion system. Being in school inhibits the free movement dynamic, which is a precondition for coherent growth and development. Changes that every schoolchild faces are long-term static loads; increased pedagogical demands, decrease of motor activity, work discipline and psycho-emotional stress. During the school year, or during the first months, many children suffer from functional and morphological changes of the body (decrease of body weight, increased restlessness, tenseness, fear, insomnia, lack of appetite, etc.), known as *school stress.* Disorders in the muscular-skeleton system, crucial for posture, result in decreased muscular function, and are a direct consequence of *school external loads* (Hong and Cheung, 2003; Hong and Brueggeman, 2000; Grimmer et al, 2002, Lai et al, 2001; Merati et al, 2002). The presence of posture deviation in children is becoming more frequent, and is evident in the following percentages. Paušić (2005) found that 51.58% of children in first grade elementary school have asymmetries of posture indicators. After a year, that percentage increased at 62.1%. Furthermore, it was found that 28.4% of children in first grade have thorax anomalies; a year later, that number increased at 51.6%. In addition, it was found that 47.3% of children in first and 60.7% of children in second grade have flat feet condition. In these studies, it is assumed that posture disorders in schoolchildren have become an important part of their health status (Hong and Brueggeman, 2000; Pascoe et al, 1997).

Primary aim of this work was to establish the present condition using the posture assessment indicators in children at the beginning of primary school, and the state of changes that occurred in a new condition, using the same indicators for the period preceding the third grade.

METHODS

Sample

The sample of examinees includes male and female pupils, first graders, coming from three different elementary schools in Split. The final sample included 224 children: 114 female and 110 male pupils. The first sample included 231 children, but the longitude type of the research required seven children to be excluded from the sample because of changing schools.

Observation and monitoring of posture indicators was conducted using the three age points. In the first point, children had to be more than seven years old (± 3 months), in the second more than eight years old (± 3 months), and in the third more than nine years old (± 3 months).

Variables

Fourteen indicators were applied for assessment of children's posture, which were estimated using the symmetric body parts assessment method (Palmer and Epler, 1998) with the help of a scoliosis meter (a Plexiglas board with engraved centimetre net – a measure instrument presented a good reliability (Paušić, 2005; Amendt and Ause-Eluaskl, 1990)). The plantography method, which determines the flatness of a foot, estimated indicators of foot status. Plantograms were processed using a Modified method of Russian authors (Bala, 1972), which evaluated foot status as zero if an examinee had a normal foot, as one if he/she had a *pes planus,* two in case of a *planovalgus,* three in case of a *pes planus.*

The posture assessment indicators presented the following shoulder posture indicators:

- SRGL – measures the longitude difference between *angulus superiora* of the left and the right shoulder in relation to the spine (cm);
- SVGL – measures the altitude difference between *angulus superiora* of the left and right shoulder (cm);
- SRDL – measures longitude difference between *angulus inferior* of the left and the right shoulder in relation to the spine (cm);
- SVDL – measures the altitude difference between *angulus inferior* of left and right shoulder (cm);
- SVRA – measures the altitude difference between the left and right acromion (cm);
- SRPA – measures the longitude difference between the left and the right papillae in relation to sternum (cm);
- SVPA – measures the altitude difference between left and right papillae (cm);
- SRSI – measures the longitude difference between left and right *spine iliac, anterior superior* in relation to the body axis (cm);
- SVSI – measures the altitude difference between left and right *spine iliac anterior superior* (cm);
- SSTOP – indicator measured by pedometer, its plantograms are measured with a modified method of Russian authors (Bala, 1972), a measure indicates the level of foot flatness (number ration 0-3);
- SPCAR – indicator evaluated by visual method on frontal level, indicating the existence of convex chests *(pectum carinatum),* measure is marked down as zero for non-existence of deformation, as one for minor deformation, as two for major deformation;
- SPEXC – indicator evaluated using a visual method in front-on level, indicating the existence of concave chests *(pectum excavatum).* Measure is marked down as zero for non-existence of deformation, as one for minor deformation, as two for major deformation.

Data processing

Results were processed using quantitative analysis of changes in one sample, measured at two age points on which the set of quantitative multivariate normally distributed variables were applied (Momirović, 1984). This method was developed in 1974 in the form of SSDIF made for the FORTAN software. Later, Dizdar (2002) reprogrammed it for the STATISTICAL 5 software, and it was used for the purpose of this study. Mahalanobisov's distances of vector centroids for the first and the second set of measures were calculated, and statistically important differences were determined. Univariate differences between the measurements were estimated and the structure of discriminative function was obtained, as well as correlations of certain variables with the discriminative function.

RESULTS AND DISCUSSION

The objective was to establish whether the changes in posture status occurred and whether those changes had statistical relevance, using quantitative analysis of posture changes indicators, in the period starting from the first grade of the elementary school to the third grade. The results of the first measurements at the beginning of the first grade, and the results of the second measurements, at the beginning of the second grade reveal a change in posture (Table 1).

Table 1: Quantitative analysis of differences between first and second measurement

Variables	$Mean_2$	$Mean_3$	$Mean_3$-$Mean_2$	DF b	DF r	F	p
SRGL	.39	.58	.19	-.73	.24	29,21	**,00**
SVGL	.32	.82	.50	1.64	.48	111,51	**,00**
SRDL	.56	.65	.09	-.20	.13	7,98	**,01**
SVDL	.54	.80	.26	.05	.26	34,16	**,00**
SVRA	.47	.80	.33	.98	.35	59,64	**,00**
SRPA	.35	.38	.02	-1.04	.04	,71	,40
SVPA	.39	.69	.29	-.48	.36	63,26	**,00**
SRSI	.11	.17	.06	.80	.17	13,74	**,00**
SVSI	.15	.44	.29	.70	.40	80,67	**,00**
SUKZ	.00	.41	.41	.61	.24	27,34	**,00**
SSTOP	.70	1.02	.32	1.77	.34	55,58	**,00**
SPEXC	.34	.24	-.10	-.67	-.13	8,68	**,00**
SPCAR	.13	.05	-.08	-2.87	-.19	18,31	**,00**
MD d^2	**df_1**	**df_2**	**F**	**p**			
2.20	13	211	35.87	**0.00**			

Legend: **$Mean_2$** – mean of second measurement; **$Mean_3$** – mean of third measurement; **$Mean_3$-$Mean_2$** – difference between two means; **DF b** – structure of discriminative function; **DF r** – coefficient of correlation with discriminative function; **F** – values F; **p** – signification level; **MD d^2** – Mahalanobis distances; **df_1** and **df_2** – degrees of freedom; **SRGL** – measures the longitude difference between *angulus superiora* of left and right shoulder in relation to spine (cm); **SVGL** – measures the altitude difference between *angulus superiora* of left and right shoulder (cm); **SRDL** – measures longitude difference between *angulus inferior* of left and right shoulder in relation to spine (cm); **SVDL** – measures altitude difference between *angulus inferior* of left and right shoulder (cm); **SVRA** – measures the altitude difference between left and right acromion (cm); **SRPA** – measures the longitude difference between left and right papillae in relation to sternum (cm); **SVPA** – measures the altitude difference between left and right papillae (cm); **SRSI** – measures the longitude difference between left and right *spine iliac, anterior superior* in relation to body axis (cm); **SVSI** – measures the altitude difference between left and right *spine iliac, anterior superior* (cm); **SSTOP** – indicator, measured by pedometer and of which plantogram are measured with modificated method of Russian authors, a measure indicates the level of foot flatness (number ration 0-3); **SPCAR** – indicator evaluated by visual method in front-on level, but indicating the existence of convex chests (pectum carinatum),measure is evaluated as zero for non-existence of deformation, as one for minor deformation, as two for major deformation; **SPEXC** – indicator evaluated by visual method in front-on level, indicating the existence of concave chests (pectum excavatum).

The differences between other two age points, beginning of the second and beginning of the third grade, were also established (Table 2).

Table 2: Quantitative analysis of differences between second and third measurement

Variables	$Mean_2$	$Mean_3$	$Mean_3$-$Mean_2$	DF b	DF r	F	p
SRGL	.58	.64	.06	2.17	.26	5.26	**.02**
SVGL	.82	.82	-.00	-1.22	-.00	.00	1.00
SRDL	.65	.71	.05	-1.33	.24	4.30	**.04**
SVDL	.80	.85	.04	1.37	.24	4.23	**.04**
SVRA	.80	.84	.04	-.10	.19	2.63	.11
SVPA	.69	.62	-.07	-1.35	-.48	17.15	**.00**
SRSI	.17	.17	.00	.60	-.00	.00	1.00
SVSI	.44	.42	-.01	-1.94	-.20	3.03	.08
SUKZ	.41	.43	.02	.37	.13	1.34	.25
SUNZ	.04	.05	.02	-.02	.23	4.05	.06
SSTOP	1.02	1.02	.00	-.09	.00	.00	1.00
SPEXC	.24	.29	.05	1.33	.39	11.52	**.00**
SPCAR	.05	.07	.02	1.33	.23	4.05	.06

MD d^2	df_1	df_2	F	p
0.34	13	211	5.53	0.00

Legend: **$Mean_2$** – mean of second measurement; **$Mean_3$** – mean of third measurement; **$Mean_3$-$Mean_2$** – difference between two means; **DF b** – structure of discriminative function; **DF r** – coefficient of correlation with discriminative function; **F** – values F; **p** – signification level; **MD d^2** – Mahalanobis distances; **df_1** and **df_2** – degrees of freedom; **SRGL** – measures the longitude difference between *angulus superiora* of left and right shoulder in relation to spine (cm); **SVGL** – measures the altitude difference between *angulus superiora* of left and right shoulder (cm); **SRDL** – measures longitude difference between *angulus inferior* of left and right shoulder in relation to spine (cm); **SVDL** – measures altitude difference between *angulus inferior* of left and right shoulder (cm); **SVRA** – measures the altitude difference between left and right acromion (cm); **SRPA** – measures the longitude difference between left and right papillae in relation to sternum (cm); **SVPA** – measures the altitude difference between left and right papillae (cm); **SRSI** – measures the longitude difference between left and right *spine iliac, anterior superior* in relation to body axis (cm); **SVSI** – measures the altitude difference between left and right *spine iliac, anterior superior* (cm); **SSTOP** – indicator, measured by pedometer and of which plantogram are measured with modificated method of Russian authors, a measure indicates the level of foot flatness (number ration 0-3); **SPCAR** – indicator evaluated by visual method in front-on level, but indicating the existence of convex chests (pectum carinatum),measure is evaluated as zero for non-existence of deformation, as one for minor deformation, as two for major deformation; **SPEXC** – indicator evaluated by visual method in front-on level, indicating the existence of concave chests (pectum excavatum).

Table 1 shows the results of quantitative analysis of differences between the first and second measurement of posture indicators. In this analysis, the variable of the foot ankle longitude (SUNZ) was left out from the variable assessment posture system, because none of the examinees had an open ankle, which indicated the existence of an "x" foot deformation. The values of arithmetic means of the first and the second measurement revealed that the average values of the second measurement were higher than the first. Univariate analysis of the differences between arithmetic means of these two measurements caused important changes in every variable, except in the assessment of asymmetrical space of the papillae variable.

The received discriminative function, tested using the Mahalanobisov's significance test for quantitative longitude between centroids of the first and the second measurement, indicates that certain result changes occurred in the second measurement in relation to the first (p=0,00). As mentioned before, certain positive changes occurred in relation to parameter values of the first measurement. According to the received results, children's posture significantly deteriorated in relation to the prior situation after beginning the first grade. The explanation for that could be found in the assumptions made in the introduction. For accurate elaboration of significant changes in children's posture, it is important to analyse the data obtained in this study.

Table 2 shows the results of quantitative analysis of differences between second and third measurement of posture indicators. In this analysis, the variable of asymmetric papillae (SRPA) was excluded from the variable system for posture assessment, because changes between measurements were not detected; this disrupted the properly conducted analysis. Descriptive indicators, values of arithmetic means of the second and third measurements indicated the average values of third measurement in some variables being higher than those of the second.

Univariate analysis of the differences between the arithmetic means of these two measurements showed a significant change in a fewer number of variables than predicted. Positive significant changes between the second and the third measurement occurred in three shoulder status assessment variables (SRGL, SRDL, SVDL), as well in the concave chest status assessment variable (SPEXC). In these variables, the arithmetic means of the third measurement are significantly higher than the means of the second measurement, which indicates deterioration of shoulder posture and a higher number of concave chests among the children in third grade. In the assessment of asymmetric longitude of papillae variable (SVPA), an important change in arithmetic means occurred, but in a reverse direction. A significant decrease of irregularity occurred in this parameter. The obtained discriminative function, tested using Mahalanobisov's significance test for the distance between centroids in the second and the third measurement, indicates that certain changes in results occurred in the third measurement in relation to the second (p=0,00). However, it is important to emphasise that not every variable experienced an increase of arithmetic mean. In fact, a fewer number of variables experienced significant change compared to the changes found at the end of the first grade. At the end of the first grade, significant changes occurred in body posture status, which can be a consequence of starting school as well as inadequate preparation of a child's body for harmful influences of the school regime. Significant body posture changes also occurred at the end of second grade, but they were not found in all of the body posture indicators and not in all of the positive direction indicators. That kind of outcome can be explained as an adaptation of a child's body to school regime overloads.

CONCLUSION

The aim was to establish the genesis of changes in body posture status after the ending of first grade, and special analysis after the ending of second grade of the elementary school using quantitative analysis of changes and Momirović's 1984 SSDIF algorithm. The received discriminative functions indicated the existence of significant changes between the first and second, and the second and third measurements. According to the descriptive data, the status of body posture in children significantly deteriorated after the ending of the first grade. Thirteen out of fourteen indicators showed statistically important increases of average parameter values. The conclusion is that the musculocutaneous system of a child's body experienced new and specific overloads, originating from school obligations. As mentioned in the introduction, the child's way of life and rhythm suddenly changed. A lack of dynamic motion caused the diminishing of postural muscles, responsible for maintaining normal body posture. The univariate test difference between measurements presents a lower grade structure than the one obtained after first measurement. Significant changes between the second and third measurement were obtained only in four variables. Here we are able to conclude that a moderate adaptation of a child's body to the school system occurred, and all of the related loads and obligations are no longer new.

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