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Relations of the Morphological Characteristic Latent Structure and Body Posture Indicators in Children Aged Seven to Nine Years

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A B S T R A C T

With the aim of determining the connection between the indicators of body posture and latent structure of morphological variables in children aged 7 and 8 years, first and second grade of primary school, a set of 17 morphological measures and 12 body posture indicators were longitudinally applied to a sample of 110 boys and 114 girls. The latent structure of morphological variables in both sexes was defined by three factors but at a different order of significance: in boys, the order was longitudinal dimensionality, voluminosity, mass and subcutaneous fat tissue and transverse dimensionality, whereas in girls the order was voluminosity, mass and subcutaneous fat tissue, longitudinal dimensionality and transverse dimensionality. The latent structure of torax body posture indicator was defined by two factors, the status of body posture of the rear part of the thorax, and status of the body posture of the front part of the thorax. The results obtained by canonical correlation analysis between predictive variables, morphological latent structure and criterion variables, latent structure of thorax body posture indicators with two posture indicators of the chest and one of the foot status, showed two important pairs of canonical roots on each measurement, suggesting a significant association between these two sets of parameters.

Key words: *body posture, scoliosometer, morphological status*

Introduction

Many factor studies have determined the structure of latent dimensions of a group of manifest morphological variables. The majority of these studies were performed in older children, children in the end stage of development, or children whose growth and development had been completed. Relatively reliable indicators of the final morphological structure and dimension relations that can be considered final or permanent were thus obtained (Szirovicza et al., 1980; Hofman and Hošek, 1985)[1–2]. These results show that four morphological dimensions can generally be identified in adult individuals: longitudinal dimensionality of the skeleton, transverse dimensionality of the skeleton, voluminosity and body mass, and subcutaneous fat tissue. A two-dimensional model is found in children (Bala, 1977; Katić et al., 1994; Katić, 2003)[3–5].

A study by Bala (1977)[3] is best comparable in terms of specific age. In this study, 11 anthropometric variables were measured in a specimen of 1,750 female subjects aged 6–10, and demonstrated that there were only two morphological dimensions both in boys and girls: dimensionality of the skeleton, voluminosity of the body with subcutaneous fat tissue. Isolated dimensions were similar in both sexes, although the structure obtained was much better expressed in boys.

The general developmental tendencies reflect on all other body subsystems, which are inter-related and require a multisegment and multidisciplinary approach whenever possible (Katić et al., 1994; Katić, 2003; Katić et al., 2004)[4–6]. Developmental processes lead to the formation of a general morphological factor defined as ecto-mesomorph and two general mechanisms responsible for motor efficiency in the form of strength regulation and speed regulation[6].

There are studies in the area of anthropometric characteristics and development of certain deformities, in which the relations between the growth and development of the spine and its deformities, mostly scoliosis, were assessed. Lončar-Dušek et al.[7] observed subjects

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over a 3-year period in their longitudinal study including 698 children aged 9–12, measuring their body height and recording the development of secondary sex characteristics every six months. The data obtained showed faster growth and secondary sex characteristic development in children with idiopathic scoliosis. Furthermore, in the second part of the study[8], an important association was established between the development of scoliosis in puberty and growth, recorded in 8.9% of the study subjects, i.e. in those that developed scoliosis during puberty, while initially exhibiting normal body posture. Other researchers report on a connection between the evolution of idiopathic scoliosis and spinal growth, i.e. the process of growth[9].

The specificity of the age of the study subjects, 7–9 years, was not taken into consideration in the area of morphologic characteristics and their relation to some body posture indicators. Therefore, it is important to start with some studies that are not directly connected with this paper, in order to establish the basic morphological characteristics and relations to body posture in a specimen of this age. Children aged 7–9 are in an important and very specific period of growth and development. Any abnormal external influence may impair proper growth and development of a child and prevent the child from growing and developing properly later in life[10]. It is therefore important to determine all possible relations mentioned above to be able to act quickly and appropriately to prevent possible deviations.

The aim of this study was to determine the association between the indicators of body posture and latent structure of morphologic space in children aged 7 (first grade of primary school) and 8 (second grade of primary school).

Material and Methods

Sample

Study sample included 110 boys and 114 girls, pupils of three Split primary schools (Pojišan, Dobri and Skalice). The longitudinal study was carried out at two points: at age 7 years (±3 months) and at age 8 years (±3 months). Inclusion criteria were freedom from malformation and regular class attendance.

Variables

A set of 17 morphological variables were chosen, according to the International Biological Protocol (IBP) standards. All measures were taken on the left side of the body. The latent morphological structure with four different latent dimensions was taken from a previous study[1,2]: longitudinal dimensionality, transverse dimensionality, voluminosity and body weight, and subcutaneous fat tissue; body height (BH), sitting height (SH), leg length (LL), hand length (HL), knee diameter (KD), hand diameter (HD), bicristal diameter (BCD), bisacromial diameter (BAD), chest diameter (CD), chest depth (CDE), body weight (BW), chest circumference (CC), forearm circumference (FC), calf circumference (CAC), subscapular skinfold (SS), abdominal skinfold (AS), and triceps skinfold (TS). All measures were taken three times on the left side of the body. Final results were obtained by Burt method of summation.

A set of 12 body posture indicators were used. Eleven parameters were obtained by the method of symmetric body parts using a scoliososmeter[11–13] (a measuring instrument with a plexiglass board with a centimeter grid). The indicators of foot status were estimated by the four-grade plantography method (0, normal foot; 1, pes valgus; 2, pes planovalgus; and 3, pes planus).

Body posture indicators were: SCDIFF1 – difference in distance from the scapular upper edge to the spine (cm); SCALT1 – difference between the scapular upper edge highs (cm); SCDIFF2 – difference in distance from the scapular lower edge to the spine (cm); SCALT2 – difference between the scapular lower edge highs (cm); SHOALT – difference between shoulder highs (cm); PAPDIF – difference in distance between the nipples (cm); PAPALT – difference between nipple highs (cm); SIDIFF – difference in crista suprailiaca superior anterior (cm); SIALT – difference between highs of crista suprailiaca superior anterior (cm); FOST – foot status; PECEXC – pectus excavatum (0 – normal, 1 – deformity 1°, 2 – deformity 2°); and PECCAR – pectus carinatum (0 – normal, 1 – deformity 1°, 2 – deformity 2°).

Data processing methods

Latent structure of the morphological variables and thorax body posture indicators (9 variables) were calculated by factor analysis, with the principle component method and varimax rotation. For the extraction criterion of significant components, Guttman-Kaiser criterion[14] was chosen: factor correlations, λ – eigenvalues.

Determinants of relations between predictive variables, morphological latent structure and criterion variables, latent structure of thorax body posture indicators with two posture indicators of the chest and one of the foot status were calculated by canonical correlation analysis: correlations with canonical roots, Can R – canonical correlation, Can R^2 – canonical determination, χ^2 – Chi square, df – degrees of freedom.

Results and Discussion

General examination of body posture in first-grade children showed incorrect thorax posture in 41.1% and incorrect foot status in 47.3% (Figure 1). On second examination (second grade), posture examination revealed an increase in the percentage of incorrect thorax posture (42.2%) and incorrect foot status (60.7%) (Figure 1). Ostojić et al.[15] report on incorrect thorax posture in 28.3% of first-graders and 28.9% of third-graders. Thus, both this and the present study showed the rate of incorrect posture to be on an increase.

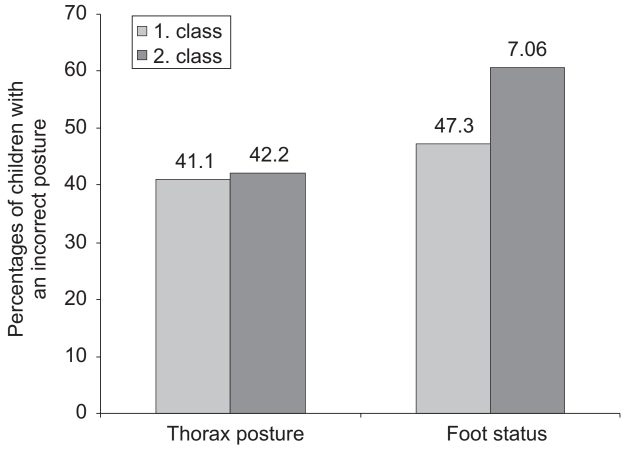

Fig. 1. Prevalence of incorrect thorax posture and foot status in first- and second-graders.

The latent structure of the morphological space in children aged 7 (first-graders) and 8 (second-graders) is explained by three significant latent dimensions.

The significant sex differences in anthropometric characteristics pointed to the need to separately estimate the latent structure of anthropometric variables. By use of factor analysis, Guttman-Kesier criterion of extraction of different components and Varimax normalized rotation, three important factors were distinguished in girls and boys. An almost identical latent structure of anthropometric space of 17 variables was obtained in all measurements. The factors obtained were named as follows (Table 1): voluminosity, mass and subcutaneous fat tissue (VSFT); longitudinal dimensionality (LD); and transverse dimensionality (TD). The factor of voluminosity, mass and subcutaneous fat tissue became apparent as most important in both sexes, and most variables were associated with this factor (8). Four parameters were connected with the second factor of longitudinal dimensionality, and three to five parameters with the third factor of transverse dimensionality.

The latent structure of anthropometric variables in girls and boys aged 7 was defined by two factors (Table 1): voluminosity, mass and subcutaneous fat tissue (VSFT), longitudinal dimensionality (LD). In girls aged 8 was defined by three factors (Table 1): voluminosity, mass and subcutaneous fat tissue (VSFT), longitudinal dimensionality (LD), and transverse dimensionality (TD). The latent structure of anthropometric variables in boys aged 8 was well defined by three factors but in different order of significance: longitudinal dimensionality, voluminosity, mass and subcutaneous fat tissue, and transverse dimensionality.

The estimate of the latent structure of body posture indicators pointed to a conclusion that body posture as the main study objective could be divided into two components (Table 2). It was decided to measure the body

TABLE 1
LATENT STRUCTURE OF MORPHOLOGICAL VARIABLES (F)

	Girls 7 years			Girls 8 years			Boys 7 years		Boys 8 years		
	F1	F2	F3	F1	F2	F3	F1	F2	F1	F2	F3
BH	0.17	0.92	0.05	0.25	0.93	0.07	0.60	0.76	0.88	0.22	0.30
SH	0.37	0.77	–0.21	0.28	0.80	0.22	0.48	0.65	0.84	0.22	0.12
LL	0.59	0.58	–0.22	0.39	0.79	0.00	0.55	0.61	0.70	0.33	0.40
HL	–0.45	0.72	0.11	–0.14	0.70	–0.10	0.41	0.57	0.85	0.09	0.03
KD	0.19	0.00	0.84	0.73	0.27	0.19	0.69	0.39	0.55	0.66	–0.09
HD	0.62	0.56	0.28	0.67	0.42	–0.14	0.55	0.39	0.66	0.46	0.07
BCD	0.33	0.24	0.81	0.60	0.35	–0.66	0.71	0.55	0.22	0.57	0.76
BAD	0.07	0.39	–0.76	0.13	0.27	0.91	–0.29	0.75	0.17	0.08	0.95
CDE	0.83	0.10	–0.08	0.78	–0.04	–0.16	0.69	0.21	0.53	0.55	0.01
CD	0.43	0.28	0.42	0.75	0.27	–0.48	0.70	0.29	–0.17	0.17	0.83
BW	0.44	0.52	0.09	0.83	0.44	0.11	0.78	0.53	0.69	0.70	0.17
CC	0.66	0.17	0.30	0.92	0.23	–0.06	0.84	0.32	0.69	0.56	0.28
FC	0.75	0.34	0.04	0.76	0.17	0.06	0.80	0.18	0.65	0.68	0.13
CAC	0.24	0.60	0.13	0.74	0.45	0.07	0.81	0.35	0.44	0.77	0.10
SS	0.83	0.11	0.16	0.86	–0.04	0.07	0.95	0.08	0.55	0.71	0.05
AS	0.80	0.06	0.08	0.88	0.07	–0.03	0.92	0.16	0.49	0.74	0.18
TS	0.81	0.11	0.29	0.69	0.19	–0.20	0.80	–0.10	0.45	0.78	0.04
λ	5.35	3.71	1.85	7.49	3.65	1.70	8.00	3.51	6.13	5.04	2.62

BH – body height, SH – sitting height, LL – leg length, HL – arm length, KD – knee diameter, HD – hand diameter, BCD – bicristal diameter, BAD – bisacromial diameter, CDE – chest depth, CD – chest diameter, BW – body weight, CC – chest circumference, FC – forearm circumference, CAC – calf circumference, SS – subscapular skinfold, AS – abdominal skinfold, TS – triceps skinfold, λ – eigenvalues

TABLE 2
LATENT STRUCTURE OF BODY POSTURE INDICATORS (F)

	Girls 7 years		Girls 8 years		Boys 7 years		Boys 8 years	
	F 1	F 2	F 1	F 2	F 1	F 2	F 1	F 2
SCDIFF1	0.87	0.11	0.88	0.08	0.88	0.07	0.87	0.05
SCALT1	0.89	0.22	0.89	0.27	0.89	0.28	0.89	0.26
SCDIFF2	0.93	0.09	0.89	0.03	0.91	0.03	0.93	0.02
SCALT2	0.86	0.38	0.88	0.27	0.85	0.36	0.86	0.37
SHOALT	0.62	0.29	0.63	0.24	0.71	0.36	0.62	0.37
PAPDIF	0.04	0.79	0.14	0.72	0.05	0.78	0.03	0.79
PAPALT	0.13	0.73	0.25	0.60	0.10	0.72	0.11	0.73
SIDIFF	0.22	0.70	0.02	0.76	0.25	0.69	0.12	0.61
SIALT	0.45	0.61	0.54	0.51	0.35	0.61	0.34	0.51
λ	3.77	2.13	4.55	1.31	3.55	2.01	3.46	2.11

SCDIFF1 – difference between distance from scapular upper edge to the spine (cm), SCALT1 – difference between highs of scapular upper edge (cm), SCDIFF2 – difference between distance from scapular lower edge to spine (cm), SCALT2 – difference between highs of scapular lower edge (cm), SHOALT – difference between highs of shoulders (cm), PAPDIF – difference between distance of nipples (cm), PAPALT – difference between highs of nipples (cm), SIDIFF – diference between crista suprailiaca superior anterior (cm), SIALT – difference between highs of crista suprailiaca superior anterior (cm), λ – eigenvalues

posture status of the rear part of the thorax (REARTHORAX) and body posture status of the front part of the thorax (FRONTTHORAX) in separate by use of a scoliosometer. Of the nine segments measured by the scoliosometer, the segments estimating the shoulder-blade and shoulder position were joined into a single component, whereas the segments estimating the papilla and crista suprailiaca anterior position were joined into another component.

The canonical correlative analysis (Table 3) yielded two different significant pairs of canonical roots that explained the connection of the two sets of parameters in first-grade girls, and three important pairs of canonical roots that explained the connection of the two sets of parameters in second-grade girls. In 7-year-old girls, the first pair of canonical roots explained 31% of total variability. In the anthropometric space it was negatively defined by the factor of voluminosity, mass and subcutaneous fat tissue, and by the factor of transverse dimensionality. In the space of body posture parameters, this pair of canonical roots was positively defined by chest deformity (pectus excavatum). Such a structure of the first pair of

TABLE 3
RESULTS OF CANONICAL CORRELATION ANALYSIS IN GIRLS

Variable	Girls 7 years (n=114)		Variable	Girls 8 years (n=114)		
	CAN1	CAN2		CAN1	CAN2	CAN3
VSFT	–0.74	–0.42	VSFT	0.97	–0.06	0.37
LD	–0.29	0.91	LD	–0.13	–0.94	–0.84
TD	–0.60	0.07	TD	0.20	–0.33	0.39
REARTHORAX	–0.09	–0.12	REARTHORAX	0.12	0.09	–0.65
FRONTTHORAX	0.05	0.54	FRONTTHORAX	–0.33	–0.31	0.14
FOST	–0.24	0.94	FOST	0.85	–0.94	–0.33
PECEXC	0.99	–0.06	PECEXC	–0.24	0.41	–0.79
PECCAR	–0.01	0.26	PECCAR	–0.21	0.07	0.15
Can R	0.55^{a}	0.36^{a}	Can R	0.70^{b}	0.36^{b}	0.28^{a}
Can R^2	0.31^{a}	0.13^{a}	Can R^2	0.49^{b}	0.13^{b}	0.08^{a}
χ^2	61.8	22.1	χ^2	93.0	23.5	0.08
df	15	8	df	15	8	3

$^{a}p<0.05$, $^{b}p<0.01$, CAN – canonical variable, Can R – canonical correlation, Can R^2 – canonical determination, χ^2 – Chi square, df – degree of freedom, VSFT – voluminosity, mass and subcutaneous fat tissue, LD – longitudinal dimensionality, TD – transverse dimensionality, REARTHORAX – status of body posture of the rear part of the thorax, FRONTTHORAX – status of body posture of the front part of the thorax, FOST – foot status, PECEXC – pectus excavatum (0 – normal, 1 – deformity 1°, 2 – deformity 2°), PECCAR – pectus carinatum (0 – normal, 1 – deformity 1°, 2 – deformity 2°)

canonical roots indicated that chest deformity (pectus excavatum) was present in children who had a less pronounced transverse and voluminous-fat component. The second pair of canonical roots (13% of total variability) could explain the association of longitudinal dimensionality mostly with flat feet, and then with the factor of body posture of the front part of the thorax. The presence of flat feet was explained by this pair, and asymmetry of the body posture parameters of the front thorax part by the emphasized longitudinal component.

In 8-year-old girls, the first important pair of canonical roots explained 49% of total variability. It could explain the connection of the voluminous-fat component with foot status. Their relation was expressed by positive sign and very high correlations. Accordingly, this pair of canonical roots showed that there was a significant association with a higher flat foot severity in children that had a greater voluminous-fat component. The second pair of canonical roots explained 13% of total variability. In this pair there was a high negative correlation with the longitudinal component and parallel correlation with foot status. The parallel connection of these two parameters was obtained in first-graders of both sexes. There was a significant connection between body height and the length of the levers with a higher flat foot grade. The third pair of canonical roots explained 8% of total variability and showed connection of a higher transverse component with a lower rate of pectus excavatum deformity and asymmetry of body posture parameters of the rear thorax part. This connection was also recorded in first-graders.

Canonical correlative analysis (Table 4) yielded two important pairs of canonical roots that explained the connection of the two sets of parameters in first-grade and second-grade boys.

In 7-year-old boys, the first pair of canonical roots explained the connection of longitudinal and transverse dimensionality factors with most of all chest deformities (pectus excavatum), body posture factor of the rear thorax part, and foot status. This pair explained 40% of total variability. This pair explained a similar connection as in girls. In boys who had a pronounced longitudinal and transverse component, chest deformities were less present (negative correlation of the parameter with this root), therefore there was a higher rate of foot deformities in the children thus morphologically defined. The second pair of canonical roots explained 27% of total variability and connected the factors of dimensionality with the body posture factor of the front thorax part and foot status. In this pair of canonical roots, there was positive connection of body dimensionality with a higher rate of flat foot as well. This pair of canonical roots explained the positive connection of dimensionality factors with more emphasized asymmetry of the body posture parameters of the front thorax part.

In boys, the connection of longitudinal dimensionality with foot status was best explained (it was present in both pairs of canonical roots). This connection was positively defined, which could be explained by the greater longitudinal dimensionality of the skeleton being connected with a higher rate of flat foot in boys, which was also observed in first-grade girls. The second important connection that was observed in both sexes was the connection of the less expressed transverse component with the presence of pectus excavatum deformity. One of the important parameters explaining the transverse component was the width of the chest cavity, which influenced

TABLE 4
RESULTS OF CANONICAL CORRELATION ANALYSIS IN BOYS

	Boys 7 years (n=110)			Boys 8 years (n=110)	
Variable	CAN1	CAN2	Variable	CAN1	CAN2
VSFT	0.64	0.70	LD	0.85	–0.38
LD	0.21	0.23	VSFT	0.14	–0.52
			TD	–0.51	–0.77
REARTHORAX	–0.52	0.18	REARTHORAX	0.09	–0.44
FRONTTHORAX	–0.16	0.65	FRONTTHORAX	–0.10	–0.57
FOST	0.57	0.48	FOST	0.57	–0.75
PECEXC	–0.72	–0.22	PECEXC	–0.40	0.30
PECCAR	–0.02	0.20	PECCAR	–0.19	0.42
Can R	0.63[a]	0.52[a]	Can R	0.46[b]	0.36[a]
Can R^2	0.40[a]	0.27[a]	Can R^2	0.21[b]	0.13[a]
χ^2	89.8	36.1	χ^2	15.5	10.8
df	15	8	df	15	8

[a]$p<0.05$, [b]$p<0.01$, CAN – canonical variable, Can R – canonical correlation, Can R^2 – canonical determination, χ^2 – Chi square, df – degree of freedom, VSFT – voluminosity, mass and subcutaneous fat tissue, LD – longitudinal dimensionality, TD – transverse dimensionality, REARTHORAX – status of body posture of the rear part of the thorax, FRONTTHORAX – status of body posture of the front part of the thorax, FOST – foot status, PECEXC – pectus excavatum (0 – normal, 1 – deformity 1°, 2 – deformity 2°), PECCAR – pectus carinatum (0 – normal, 1 – deformity 1°, 2 – deformity 2°)

this connection. The depth of the chest cavity was mostly related to the factor of voluminosity, mass and subcutaneous fat tissue. In girls, this factor was closely connected with the deformity of pectus excavatum. Lower values of the chest cavity depth explained the higher rate of pectus excavatum, as indicated by the signs observed. Two significant pairs of canonical roots were obtained 8-year-old boys, together explaining 34% of total variability. The structure of these canonical roots was more vaguely defined. The first pair of canonical roots (21% of total variability) explained the parallel connection of the voluminous-fat component with the pectus excavatum deformity. The second pair of canonical roots ($CanR^2$= 13%) explained the connection of the dimensionality factor with foot status and asymmetry of the body posture parameters of the front and rear thorax parts. This connection was defined by the same direction, indicating that deformities such as flat foot and asymmetry of body posture parameters would occur at a higher rate in children with a more pronounced body dimensionality.

In second-graders, the structure of the connection obtained in first-graders was confirmed. The most obvious connection was recorded between foot status and voluminous-fat component, and longitudinal component. In both cases the connection was parallel, as expected. The children greater body weight, and thus with greater body height were demonstrated to have a higher rate of flat foot. It is well known that the foot arch structure deteriorates under higher pressure, as in this case. The second important connection, which was not so well explained, was the connection of dimensionality components with the body posture indicators. The children with emphasized longitudinal and transverse component were more prone to weaker postural muscles that are in charge of correct body posture.

The results obtained in this study and those from the studies that served as a hypothesis show that there is a connection between these two sets of parameters. Bižaca and Kučić[16] report on the connection between body weight and flat foot in primary school first- to fourth-graders. Another study[17] performed in a specimen of primary school fifth- and sixth-graders demonstrated the chest deformity (pectus excavatum) to be largely connected with anthropometric characteristics, depth and width of the chest cavity. Lončar-Dušek et al.[7] correlated body growth with a higher rate of spine distortion. All these studies show that there is a connection of anthropometric characteristics with some indicators of body posture; however, none was carried out using the same methodological approach. It could be stated that the connection between body posture parameters and anthropometric latent structure has been successfully explained in primary school first- and second-graders. Rather high canonical coefficients of correlation (0.28 to 0.70) have been reported, suggesting a significant connection between the given parameters.

Conclusion

The aim was to establish the connection of anthropometric measures with the body posture indicators. Two important pairs of canonical roots were obtained on each measurement. Rather high canonical coefficients of correlation show that there are significant relations between anthropometric measures and body posture measures. The most important connection was established between a higher rate of flat foot and pronounced voluminous-fat component and longitudinal component. The foot arch structure is under a great strain in children that have bigger longitudinal and voluminous-fat component, so the arches of their feet deteriorate, entailing a higher rate of flat foot. The second obvious connection, which has been demonstrated in many measurements, was the connection of transverse dimensionality with pectus excavatum chest deformity. The parameter of chest cavity depth is connected with transverse dimensionality. The body posture factors are connected to longitudinal and transverse dimensionality. In children with pronounced body dimensionality factors, greater thorax asymmetries were observed. On all measurements, the voluminosity, mass and subcutaneous fat tissue factor had opposite value in relation to the thorax posture factors. Therefore, asymmetries of the thorax posture parameter were not as observable in children with the pronounced voluminous-fat component.

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ODNOSI LATENTNE STRUKTURE MORFOLOŠKIH ZNAČAJKA I POKAZATELJA TJELESNOG DRŽANJA U DJECE U DOBI OD 7 DO 9 GODINA

S A Ž E T A K

Na uzorku od 110 dječaka i 114 djevojčica u dobi od 7 i 8 godina primijenjeno je 17 morfoloških i 12 mjera za procjenu tjelesnog držanja kako bi se utvrdili odnosi između ovih dvaju nizova pokazatelja. Pokazatelji tjelesnog držanja sastavljeni su od devet pokazatelja držanja trupa, pokazatelja spuštenosti stopala i dva pokazatelja prsnih deformiteta. Latentna struktura morfoloških varijabla u oba spola definirana je trima čimbenicima, ali drukčijim redoslijedom važnosti čimbenika: longitudinalna dimenzionalnost, voluminoznost i potkožno mason tkivo, te transverzalna dimenzionalnost. Latentna struktura pokazatelja tjelesnog držanja trupa je definirana dvama čimbenicima, statusom tjelesnog držanja prednje strane trupa i statusom tjelesnog držanja stražnje strane trupa. Kanoničkom korelacijskom analizom između latentnih morfoloških varijabli kao prediktorskog skupa i kriterijskog skupa od: dvije latentne varijable tjelesnog držanja trupa, dviju varijabli prsnih deformiteta, i varijable spuštenosti stopala, dobivena su po dva para značajnih kanoničkih korijena u svakom mjerenju, te je glavni zaključak kako postoji statistički značajna povezanost između ovih dvaju nizova pokazatelja.