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The correlations between body posture parameters and physical fitness characteristics of male and female pupils playing the accordion and the Western concert flute

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Key words: body posture, Eurofit test

Abstract

Introduction

The boundaries of human adaptation to the load of exercise in sport, recreational and occupational activity are flexible but not unlimited.

Material, methods and research tools

393 students from randomly selected music schools were qualified for the study. In each of the schools involved in the study, the level of physical fitness was assessed using the Eurofit test and the level of body posture parameters by means of the photogrammetric method.

Summary

As regards the players of musical instruments, the most frequent correlations with the characteristics of physical fitness were observed among female pupils of class III, IV, V and male pupils of class I, moderately frequent relationships were recorded among female students of II, VI and male students of class II, III and the fewest correlations were noticed among female pupils of class I and male pupils of class IV and V. Considering the frequency of correlations among female students, the most frequent relationships were recorded in class I, V and IV, the moderately frequent ones in class II and VI and the fewest in class I (…)

Introduction

A body posture being an external human physicality presents an individual's concrete stage of posturogenesis. The analysis of the values of frontal parameters does not seem to cause any major problems, but it can be challenging indeed when it comes to physiological spinal curvatures, their correlations with pelvis parameters or physical fitness. Allegedly, the more

pro-healthy the adopted lifestyle is the larger the percentage of correct body postures and the smaller the percentage of incorrect body postures. The intensity and volume of the stressor having an impact on the number and type of environmental drivers which determine postural parameters should be more important than these parameters. While playing an instrument, the main activity of a musician includes movement and related physical work of selected muscle bands. The modern process of learning how to play a musical instrument and the related load of the skeletal, muscle, circulatory and nervous system, require considering a range of properties connected with pursued physical activity, and to understand these properties it is necessary to apply a wide range of research methods. The question thus arises how bone and muscle tissue will be modelled in the event of a permanently active stressor illustrated by the professional activity of a musician as a form of physical activity. It has been clearly demonstrated that physical activity optimally shapes the body posture and the character of these changes largely depends on the above-mentioned intensity and volume. If the system of stressors undergoes a quantitative or qualitative change, the volume of functional and anatomic parameters may change as well which is the consequence of an organism's readaptation to external stimuli. The boundaries of human adaptation to the load of exercise in sport, recreational and occupational activity are flexible but not unlimited. This is the result of the Arndt – Schultz law claiming that a too large load of the locomotor system triggers adverse adaptation signs in the vegetative system and in the organs managed by the system; weak stimuli maintain bodily functions whereas the strong ones create adaptation and training. A stimulus which, with its minimum intensity, improves fitness and induces learning of new motor functions is a physiological model of optimal load and adaptative reactions of the body [1].
The purpose of the study was to show correlations between posture parameters and physical fitness of male and female pupils playing the accordion and the Western concert flute.

Material, methods and research tools
393 individuals were recruited from randomly selected music schools.
All the students who obtained the consent of the legal guardian or parent, in case of minors, and of the direct teacher or school principal and who had been students of a music school for at least one year were allocated for the study. All subjects were divided into classes depending on the leading instrument and within a class depending on gender, age and the period of playing an instrument. Accordion students accounted for class I, Western concert flute students – class II, grand piano students – class III, guitar students – class IV, violin students – class V, and cello students – class VI. The physical fitness analysis considered completed years and months of life in accordance with the requirements established by Dobosz [2]. Eventually, 190 girls (K) and 203 boys (M) were qualified for the statistical analysis. The average age of girls was 14.25 years and the experience of playing an instrument was 7.25 years. In the group of boys, the figures were 14.44 and 7.40 respectively. The most girls practiced playing the grand piano (44 subjects) and the fewest girls played the Western concert flute (21 subjects). As for boys, the largest number of them practiced playing the guitar (42 people) whereas the Western concert flute was the least played instrument (23 subjects). Violin female students had the longest experience of playing the instrument (10.2 years) while those who played the flute demonstrated the shortest period (4.6 years). Among boys, these were respectively: the violin (10.2 years) and the Western concert flute (11.94 years).
The studies were conducted in the period from 10 September 2016 to 20 December 2016 by a team of six under the guidance of the author.

In each of the schools involved in the study, tests of physical fitness were carried out by means of the Eurofit test following the order described by Mucha [3], Table 1. The measurement of body posture parameters was conducted using the photogrammetric method in accordance with the rules described by Mrozkowiak [4], Table 2.

Table 1. Type and order of Eurofit tests

Order of tests	Category	Factor
1	Balance	Balance of the whole body
2	Flexibility	Flexibility
3	Strength	Explosive strength
4		Static strength
5	Endurance	Strength of body trunk
6		Functional strength
7	Speed	Agility run
8		Speed of upper limb movements
9	Cardiorespiratory efficiency	Cardiorespiratory efficiency

Source: Mucha [3]

Table 2. The list of recorded body posture parameters

No.	Symbol	Parameters		
		Unit	Name	Description
Sagittal plane				
1	Alpha	degrees	Inclination of lumbo-sacral region	
2	Beta	degree	Inclination of thoracolumbar region	
3	Gamma	degree	Inclination of upper thoracic region	
4	Delta	degree	Sum of the values of partial angles	Delta = Alpha + Beta + Gamma
5	DCK	mm	Total length of the spine	Distance between C_7 and S_1, measured in vertical axis
6	KPT	degree	Angle of trunk extension	Defined as a deviation of the C_7-S_1 line from vertical position (backwards)
7	KPT -	degree	Angle of body bend	Defined as a deviation of the C_7-S_1 line from vertical position (forwards)
8	DKP	mm	Thoracic kyphosis length	Distance between LL and C_7
9	KKP	degrees	Thoracic kyphosis angle	KKP = 180 – (Beta+Gamma)
10	RKP	mm	Thoracic kyphosis height	Distance between points C_7 and PL
11	GKP	mm	Thoracic kyphosis depth	Distance measured horizontally between the vertical lines passing through points PL and KP
12	DLL	mm	Lumbar lordosis length	Distance measured between points S_1 and KP
13	KLL	degree	Angle of lumbar lordosis	KLL = 180 – (Alpa + Beta)

14	RLL	mm	Lumbar lordosis height	Distance between points S_1 and PL
15	GLL -	mm	Lumbar lordosis depth	Distance measured horizontally between the vertical lines passing through points PL and LL
Frontal plane				
16	KNT -	degree	Angle of body bend to the side	Defined as deviation of the C_7-S_1 line from the vertical axis to the left
17	KNT	degree		Defined as deviation of the C_7-S_1 line from the vertical axis to the right
18	LBW -	mm	Right shoulder up	Distance measured vertically between horizontal lines passing through points B2 and B4
19	LBW	mm	Left shoulder higher	
20	KLB	degree	Shoulder line angle, right shoulder up	Angle between the horizontal line and the straight line passing through points B_2 and B_4
21	KLB –	degree	Shoulder line angle, left shoulder up	
22	LŁW	mm	Left scapula up	Distance measured vertically between horizontal lines passing through points Ł1 and Łp
23	LŁW	mm	Right scapula up	
24	UL	degree	Angle of scapula line, right scapula up	Angle between the horizontal line and the straight line passing through points Ł1 and Łp
25	UL -	degree	Angle of scapula line, left scapula up	
26	OL	mm	Lower angle of left scapula more distant	Difference of the distance of lower angles of the scapula from the line of spinous processes measured horizontally along the lines passing through points Ł1 and Łp
27	OL -	mm	Lower angle of right scapula more distant	
28	TT –	mm	Left waist triangle up	Difference of the distance measured vertically between points T_1 and T_2, T_3 and T_4.
29	TT –	mm	Right waist triangle up	
30	TS	mm	Left waist triangle wider	Difference of the distance measured horizontally between straight lines passing through points T_1 and T_2, T_3 and T_4
31	TS -	mm	Right waist triangle wider	
32	KNM	degree	Pelvis tilt, right ilium up	Angle between the horizontal line and the straight line passing through points M1 and Mp
33	KNM -	degree	Pelvis tilt, left ilium up	

34	UK	mm	Maximum inclination of the spinous process to the right	Maximal deviation of the spinous process from the line from S_1. The distance is measured in horizontal line.
35	UK -	mm	Maximum inclination of the spinous process to the left.	
36	NK	_	Number of the vertebra maximally distanced to the left or to the right	Number of the vertebra most distanced to the left or to the right in the asymmetric line of the spinous process, counting as 1 the first cervical vertebra (C1). If the arithmetic mean takes the value e.g. from 12.0 to 12.5, it is Th_5, if from 12.6 to 12.9 it is Th_6.
37	NK	_	Number of the vertebra maximally distanced to the right	
Transverse plane				
38	ŁB -	mm	Lower angle of the right scapula more convex	Difference of the distance of lower scapula angles from the surface of the back
39	ŁB	mm	Lower angle of the scapula more convex	
40	UB –	degree	Angle of projection line of lower scapula angles, the left one more convex	Difference in the angles $UB_1 – UB_2$. Angle UB_2 between: the line passing through point Łl and at the same time perpendicular to the camera axis and the straight line passing through points Łl and Łp. Angle UB_1 between the line passing through point Łp and perpendicular to the camera axis and the straight line passing through points Łp and Łl.
41	UB	degree	Angle of projection line of lower scapula angles, the right one more convex	
42	KSM	degree	Pelvis rotated to the right	Angle between the line passing through point M1 and perpendicular to the camera axis and the straight line passing through points M1 and MP
43	KSM -	degree	Pelvis rotated to the left	Angle between the line passing through point Mp and perpendicular to the camera axis and the straight line passing through points Ml and MP

Source: author's own research

Test results

The statistical analysis of the achieved results was intended to study the correlations of body posture parameters with physical fitness of the research subjects.

Legend for Table 3-15.

Very significant correlation – red, (***)

Moderately significant correlation – blue, (**)

Insignificant correlation – green, (*)

No correlation – white

KKG – upper limbs

As regards female accordion players, significant correlations of body posture parameters and physical fitness characteristics were observed between the speed of upper limbs, cardiovascular efficiency and the angle of inclination of the lumbosacral region, between agility run results, speed of upper limbs and cardiovascular efficiency and the height of thoracic kyphosis, between balance test results and the value of asymmetric spinous process with right-sided protrusion.

Table 3. Correlations of body posture parameters with selected physical fitness characteristics of girls in class I

Girls in class I (Accordion)									
Parameter	Balance	Agility	Explosive strength	Static strength	Endurance of body trunk	Functional endurance	Agility run	KKG speed	Cardiovascular efficiency
Sagittal plane									
Alpha				0.50037 pv=0.01085 *			-0.050222 0.01052 *	-0.67098 0.00024 ***	0.76801 0 ***
Beta	0.45103 0.02364 *					0.41146 0.041 *			
DKP				0.57592 0.00259 **			-0.64852 0.00045 ***	-0.7742 0.00001 ***	0.7447 0.00002 ***
RKP						0.39644 0.04976 *	-0.53349 0.00603 **	-0.42612 0.03367 *	0.64419 0.00051 ***
KLL									-0.48252 0.01457 *
GLL		0.5305 0.00637 **							-0.39694 0.04945 *
Frontal plane									
KNT–			–0.42182 0.03571 *						
OL–			–0.5698 0.00295 **						
UK	0.62128 0.00092 ***	–0.6056 0.00134 **	–0.60173 0.00146 **		–0.55656 0.00386 **				
Transverse plane									
KSM					–0.52248				

					0.00738 **					
ŁB–				0.42387 0.03472 *						
UB							0.43775 0.02863 *		–0.50353 0.01029 *

Source: author's own research studies

Table 4. Correlations of body posture parameters with selected characteristics of physical fitness in boys from class I

Men/ Accordion									
Parameter	Balance	Flexibility	Explosive strength	Static strength	Trunk endurance	Functional endurance	Agility run	KKG speed	Cardiovascular endurance
Sagittal plane									
KPT								–0.34962 0.03952 *	
DKP		0.47497 0.00394 **	0.34502 0.04237 *					–0.43194 0.00957 **	
GKP				–0.44788 0.00698 **			0.48806 0.00294 **		–0.35807 0.03468 *
DLL				0.34416 0.04292 *		0.47242 0.00416 **		–0.3362 0.04831 *	0.3419 0.0444 *
Frontal plane									
KNT	–0.39763 0.01801 *	0.56688 0.00038 ***	0.51321 0.00162 **						
KNT–	0.46186 0.00522 **	-0.55441 0.00055 ***	–0.5938 0.00017 ***						
KLB	0.43016	-0.54235	–0.51508						

	0.0099 **	0.00076 ***	0.00154 **						
KLB–	–0.38315 0.02309 *	0.57186 0.00033 ***	0.52705 0.00114 **						
UL		-0.40512 0.01577 *	–0.46764 0.00462 **						
UL–	–0.36953 0.02891 *	0.57644 0.00029 ***	0.58698 0.00021 ***						
OL	–0.3882 0.0212 *	0.55742 0.0005 ***	0.52507 0.0012 **						
OL–		-0.49875 0.00229 **	–0.47399 0.00402 **						
TT–	–0.37416 0.02681 *	0.58448 0.00023 ***	0.59632 0.00016 ***						
TS	0.38788 0.02131 *	-0.52128 0.00132 **	–0.46392 0.005 **		–0.34149 0.04467 *				
TS–	–0.38022 0.02425 *	0.55442 0.00055 ***	0.51508 0.00154 **		0.34248 0.04402 *				
KNM	–0.36815 0.02956 *	0.58437 0.00023 ***	0.58922 0.0002 ***						
KNM–	0.3933 0.01942 *	-0.46407 0.00498 **	–0.5274 0.00113 **						
UK	0.69777 0 ***	-0.79447 0 ***	–0.82245 0 ***		–0.43824 0.00846 **				
UK–	–0.3348 0.04931 *	0.56716 0.00038 ***	0.54248 0.00076 ***						

Transverse plane									
KSM			–0.34943 0.03963						
KSM–	–0.36724 0.02999 *	0.57967 0.00026 ***	0.60225 0.00013 ***						
ŁB			–0.38339 0.023 *						
ŁB–	–0.3742 0.02679 *	0.57186 0.00033 ***	0.56338 0.00043 ***						
UB	0.45724 0.00575 **	-0.60106 0.00013 ***	–0.55165 0.00059 ***						
UB–	–0.38951 0.02073 *	0.59059 0.00019 ***	0.58313 0.00024 ***						

Source: Author's own study

Moderately significant correlations existed between the value of static strength and the length of thoracic kyphosis, between flexibility of the depth of lumbar lordosis and the level of asymmetric spinous process with right-sided protrusion, between the results of explosive strength and asymmetry of the distance between lower scapula angles with the right angle more distant and the value of asymmetric spinous process with right-sided protrusion and between the level of body trunk endurance and asymmetric spinous process with right-sided protrusion. Insignificant relationships were noticed between the results of the balance test and the angle of inclination of the thoracolumbar region, the value of explosive strength and the angle of body bend to the left, between static strength and the inclination angle of the lumbosacral region and asymmetry of protrusion of lower scapula angles with the right angle more convex, between the results of the functional endurance test and the angle of the inclination of the thoracolumbar region and the height of thoracic kyphosis, the results obtained in the agility run and the inclination angle of the lumbosacral region and the asymmetry of the protrusion of lower scapula angles with the left angle being more convex, the results of the speed of upper limb and the height of thoracic kyphosis, between the level of cardiovascular endurance and the depth and angle of lumbar lordosis and the asymmetry of the protrusion of lower scapula angles with the left angle more convex, Table 3.

Among male accordion players, very significant correlations of body posture parameters with the parameters of physical fitness characteristics were observed between the results of the balance test and the asymmetric spinous process with right-sided protrusion. Likewise, very significant correlations were reported between the results of the flexibility test and the angle of the right-sided or left-sided bend of the body trunk, the angle of the shoulders line with the left or right shoulder up, the angle of the line of lower scapula angles with the angle of the left scapula up, the asymmetry of the distance between the lower angles of scapulas from the spinous process with the angle of the left scapula more distant, the asymmetry of the height and width of waist triangles with the right triangle being higher and wider, the value of the angle of the left-sided pelvic inclination, the value of the asymmetric spinous process with the left- or right-sided protrusion, the angle of the left-sided pelvis tilt, the asymmetry of the protrusion of lower scapula angles with the angle of the right scapula more convex, the angle of the protrusion of lower scapula angles with the left or right angle being more convex. The same correlations existed between the results of the explosive strength test and the angle of the left-sided trunk bend, the angle of the line of low scapula angles with the left angle up, the asymmetry of the height of waist triangles with the right one up, the value of the angle of the left-sided pelvis inclination, the asymmetry of the spinous process with the left- or right-sided protrusion, the angle of the left-sided pelvic tilt, the asymmetry of the protrusion of low scapula angles with the angle of the right scapula being more convex, the angle of the protrusion line of low scapula angles with the left or right angle being more protruding. Moderately significant relationships were existed between the results achieved in the balance test and the angle of the trunk inclination to the left and the angle of the shoulders line with the right shoulder up. The same correlations were reported between flexibility test results and the length of thoracic kyphosis, the asymmetry of the distance of the lower angles of scapulas from the spinous process line with the right scapula angle being more distant and the asymmetry of the width of waist triangles with the left triangle being wider and the angle of the right-sided pelvic inclination. As regards the explosive strength test results, moderately significant correlations were observed with the angle of the right-sided body trunk bend, the angle of the shoulders line with the left or right shoulder up, the angle of the line of lower scapula angles with the angle of the right scapula up, the asymmetry of the distance of the lower angles of scapulas from the spinous process line with the left or right scapula angle being more distant and the asymmetry of the width of waist triangles with the right or left triangle being wider and the angle of the right-sided pelvic inclination, the value of the

asymmetric spinous process line with the right- or left-sided protrusion. However, the results of the static strength test and the agility run test revealed such correlations only with the depth of thoracic kyphosis and the results of the trunk muscle endurance with the value of the asymmetric spinous process with right-sided protrusion, the results of the functional endurance with the length of lumbar lordosis and the speed of upper limbs with the length of thoracic kyphosis. Insignificant relationships were noticed between the results of the balance test and the angle of the right-sided body trunk bend, the angle of the shoulders line with the left shoulder up, between the angle of the lower scapula angles with the angle of the left scapula up, between the asymmetry of the distance of the lower angles of scapulas from the spinous process line with the left scapula angle being more distant and the asymmetry of the height and width of waist triangles with the left triangle up and the left or right one wider, the angle of the right- or left-sided pelvic inclination, the asymmetric spinous process line with the left-sided protrusion, the angle of the left-sided pelvic tilt, the asymmetry of the protrusion of lower scapula angles with the angle of the right scapula being more convex, the angle of the protrusion line of lower scapula angles with the left angle being more convex. As far as the results of the flexibility test are concerned, such correlations were observed only with the angle of the scapulas line with the right scapula up and with the value of static strength and the length of lumbar lordosis. Yet, the results of the explosive strength test revealed insignificant correlations with the length of thoracic kyphosis and the asymmetry of the distance
of lower angles of scapulas with the right scapula angle being more distant, the trunk muscle endurance and the width of the left or right waist triangle, the results of the lower limbs speed with the angle of trunk extension and the length of lumbar lordosis, and the results of cardiovascular efficiency with the depth of thoracic kyphosis and the length of lumbar lordosis, Table 4.

Table 5. Correlations of body posture parameters with selected characteristics of physical fitness in girls from class II

Women/ Western concert flute									
Parameter	Balance	Flexibility	Explosive strength	Static strength	Trunk endurance	Functional endurance	Agility run	KKG speed	Cardiovascular endurance
Sagittal plane									
Alpha			–0,52763 0,01681 *						
Gamma				0,52535 0,01737 *					
KPT					0,51799 0,01931 *				0,54258 0,01344 *
KPT–									–0,53222 0,01571*
DKP				0,54499 0,01296 *					
GKP							–0,47868 0,03275 *		
DLL								0,57549 0,00793 **	
KLL			–0,47267 0,03533 *						
RLL				0,51484 0,02019 *					
GLL		-0,47814 0,03297 *							
Frontal plane									

KNT					0,55477 0,01112 *				
KNT–			–0,4544 0,04414 *		–0,53133 0,01592 *				
KLB					–0,51972 0,01884 *				–0,46465 0,03901 *
KLB–					0,5565 0,01082 *				0,48737 0,02928 *
UL					–0,4635 0,03956 *				–0,49709 0,02576 *
UL–					0,47967 0,03234 *				0,51256 0,02084 *
OL					0,52004 0,01875				0,56348 0,00967 **
OL–					–0,44815 0,04752 *				
TT									–0,57936 0,00743
TT–					0,50784 0,02226 *				0,53897 0,0142 *
TS									–0,56877 0,00887 **
TS–					0,47031 0,03638*				
KNM					0,45245 0,04517 *				0,53897 0,0142 *
UK	0,70983		–0,55864		–0,75088				

	0,00046 ***		0,01046 *		0,00014 ***				
UK–					0,55697 0,01074 *				0,53125 0,01594 *
Transverse plane									
KSM					–0,52142 0,01839 *				
KSM–					0,4992 0,02504 *				0,56711 0,00912 **
ŁB					0,5337 0,01537 *				
UB			–0,50768 0,02231 *		–0,51815 0,01927 *				–0,63499 0,00263 **
UB–					0,52379 0,01777 *				0,57763 0,00765 **

Source: Author's own research studies

Table 6. Correlations of body posture parameters with selected physical fitness characteristics in boys from class II

Men/Western concerto flute									
Parameter	Balance	Flexibility	Explosive strength	Static strength	Trunk endurance	Functional endurance	Agility run	KKG speed	Cardiovascular endurance
Sagittal plane									
DCK								–0,51401 0,01211 *	
Alpha				0,82414 0 ***					
Gamma		0,45278 0,03004 *						–0,51562 0,01179 *	
KPT									0,47378 0,02239 *
DKP				0,61923 0,00163 **					
RKP				0,85667 0 ***					
DLL	0,41637 0,04812 *			0,78798 0,00001 ***					
KLL			0,42989 0,04062 *					0,43947 0,03589 *	
RLL	0,49321 0,01678 *			0,68803 0,00028 ***					
Frontal plane									
KNT									0,47798 0,02106 *

KNT–									–0,52524 0,01006 *
KLB									–0,66313 0,00056 ***
KLB–									0,4815 0,02 *
UL						0,41899 0,04659 *			
UL–									0,4815 0,02 *
OL									0,4815 0,02 *
OL–						0,62102 0,00156 **			–0,49802 0,01559 *
TT–									0,4815 0,02 *
TS						0,46599 0,02502 *			
TS–									0,4815 0,02 *
KNM									0,46605 0,025 *
UK–									0,4815 0,02 *
Transverse plane									
KSM–									0,47378

									0,02239 *
ŁB									0,4815 0,02 *
UB				0,48991 0,01765 *		0,44506 0,03333 *			
UB–									0,47378 0,02239 *

Source: Author's own research studies

Among female pupils playing the Western concert flute, significant correlations of body posture parameters with physical fitness characteristics existed between the results of the balance test and the trunk muscle endurance test and the asymmetric spinous process with the right-sided protrusion. Moderately significant relationships were observed between the speed of upper limbs and the length of lumbar lordosis, between cardiovascular efficiency and asymmetry of the distance between lower angles of scapulas from the spinous process line, where the left lower angle is more distant, between the asymmetry of the width of waist triangles, where the right triangle is wider, between the angle of the pelvic tilt to the left and the angle of the protrusion line of lower scapula angles with the left or right angle being more convex. Insignificant correlations were reported between the flexibility level and the depth of lumbar lordosis, the value of explosive strength and the trunk inclination angle in sagittal plane, between the asymmetric spinous process line with the right-sided protrusion, between the value of the protrusion line angle of lower scapula angles, where the right angle was more convex. Insignificant relationships were also between observed between the value of static strength and the angle of inclination of the upper thoracic region, the length of thoracic kyphosis and the height of lumbar lordosis. Insignificant correlations existed also between the level of trunk endurance and the angle of trunk extension in the sagittal plane and flexion to the right or to the left in the frontal plane, between the angle of the shoulders line and the angles of lower scapulas with the left or right angle up, between the asymmetry of the distance between lower angles of scapulas from the spinous process line, where the left or right one is more distant, the asymmetry of the height of waist triangles with the right or left one up, the asymmetry of the width of waist triangles with the right triangle being wider, the angle of the left-sided inclination of pelvis, the asymmetric spinous process line with left-sided protrusion, the angle of the right- or left-sided pelvic tilt, the asymmetry of protrusion of lower scapula angles, where the left angle was more protruding, the angle of the protrusion line of lower scapula angles with the left or right angle more convex. The results of the agility test revealed a significant correlation only with the depth of thoracic kyphosis. The results of the cardiovascular endurance test correlated insignificantly with the values of the trunk extension and flexion angles, the angle of the shoulders line and the angles of lower scapulas with the right or left angle up, the asymmetry of the height of waist triangles with the right triangle up, the angle of the left-sided pelvic inclination, the asymmetric spinous process with left-sided protrusion, Table 5.

Among male pupils playing the Western concert flute, significant correlations of body posture parameters with the characteristics of physical fitness existed between the results of the static strength test and the angle of lumbosacral region inclination, the height of thoracic kyphosis, the length and height of lumbar lordosis and the values of cardiovascular endurance and the angle of the shoulders line with the right angle up. Moderately significant relationships were observed only between this parameter and the length of thoracic kyphosis and between functional endurance and the asymmetry of the distance between lowers scapula angles from the spinous process, where the right angle was more distant. Yet, Insignificant correlations were noticed between the results of the balance test and the length and the angle of lumbar lordosis, flexibility and the inclination angle of the upper thoracic region, between explosive strength and the angle of lumbar lordosis as well as static strength and the angle of the protrusion line of lower scapulas, where the lower angle of the right scapula was more protruding. The same correlations were observed between the results of the functional endurance test and the asymmetry of the height of scapulas with the lower angle of the right scapula up, the value of width of the left triangle being higher, the angle of the protrusion line of lower scapula angles with the lower angle of the right scapula more convex. The same relationships were observed between the results of the speed of upper limbs and total length of the spine, the angle of lumbosacral spine inclination and the angle lumbar lordosis. Relevant

correlations were also noticed between the results of the cardiovascular test and the angle of trunk extension and flexion to the right or to the left, the angle of the shoulders line with the left shoulder up and the line of scapulas with the left scapula, asymmetry of the distance of lower scapula angles from the spinous process line with the left or right angle being more distant, the height and width of the right waist triangle, the left-sided pelvis inclination and tilt, the asymmetric spinous process with left-sided protrusion, asymmetry of protrusion of lower scapula angles and the angle of the scapulas line with the left angle being more protruding, table 6.

Summary

Among musical instrument players involved in the study, the most significant correlations with the characteristics of physical fitness were observed among female pupils of class III, IV, V and male pupils of class I, moderately significant relationships were reported among female students of class II, VI and male pupils of class II, III, whereas insignificant correlations were noticed among female pupils of class I and male pupils of class IV and V. Considering the correlations among female subjects, significant relationships were observed in class I, V, IV, moderately significant correlations in class II and VI and insignificant correlations in class I. By far, the largest number of significant correlations existed in class III, definitely less significant ones were observed in class II, I and V while insignificant relationships were reported in class II, IV and VI. A considerable number of moderately significant correlations was observed in class II, III and IV, fewer in class V and VI and the fewest in class I. Insignificant correlations were most common in class II, III, IV, V and VI, and definitely fewer of them were in class I. Analysing the frequency of relationships among male pupils, significant correlations were undeniably the most frequent in class I and definitely less frequent in other classes. The largest number of significant correlations existed in class I whereas the remaining classes revealed such correlations much less often. A small number of moderately significant correlations was noticed in class I and still fewer in other classes. Similar levels of insignificant relationships were observed in all other classes. Considering the frequency of correlations among male pupils, they were reported in class I most often and definitely less frequently in the remaining classes. The largest number of very and moderately significant correlations was observed in class I and other classes revealed such correlations much less frequently. A similar number of insignificant relationships was observed in all classes. Analysing the frequency of significant correlations of the results achieved in the tests of physical fitness and of body posture parameters in the frontal, sagittal and transverse planes among girls and boys, it can be concluded that in class I and II they were infrequently observed only among girls in the transverse plane. Even fewer correlations were reported in the remaining planes. The frequency of significant relationships was sporadic in all planes among boys. A moderate frequency of correlations concerning the results of physical fitness tests and body posture parameters in all three planes was observed among female pupils of class III. As regards the boys of this class, the incidence of these correlations was even scarce. In class IV and V, male pupils were reported to have a moderate frequency of correlations between the results of the Eurofit tests and the values of parameters in the frontal plane. Other planes revealed still fewer correlations. As far as boys are concerned. The frequency of significant correlations was sporadic in all planes among boys. Among the female students of class VI, a small frequency of correlations between the results of fitness tests and postural parameters was observed only in the sagittal and frontal plane. The incidence of these relationships was scarce among the boys of this class.

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