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POSTURE DEFECTS AMONG 5TH GRADE PUPILS FROM MUSIC CLASS AT AN ELEMENTARY SCHOOL COMPLEX NO. 2 IN SZCZECIN

Pupils attending elementary music schools (1st cycle) are gifted children, often from families with long-term, multi-generation traditions, and musical passion. Music is an important aspect of their lives, and high-level music performance requires systematic, daily practice from the beginning of their music education. Due to numerous years of practicing, these children are prone to incorrect body statics and torso asymmetries. It mainly results from a forced position during practice and concerts. The aim of this study was to determine the incidence of faulty body postures amongst 11-year-old 5th-graders from music and general profile classes. A subject group consisted of 70 children aged 11 from the Elementary School Complex No. 2 in Szczecin (Poland); it included 46 (65.7%) girls and 24 (34.3%) boys; children attended 5th grade with either a music or general profile. The subjects were measured twice: at the beginning and at the end of the school year. The first measurement took place in September, while the second one in June of the following year. In the assessment of body posture, the surface topography examination (ST) method was used, based on the technique of spatial photogrammetry. The angle of thoracic kyphosis and angle of lumbar lordosis in the sagittal plane were analyzed. The signs of correct posture in the sagittal plane were found in 62% of girls in the music class and 73% in the control group. Among boys, the results were 71% and 75%, respectively. 31% of girls from music class had round back, while only 14% in the control group; among boys, the results were 25% and 16%, respectively. Flat backs were found in 6% of girls in the music class and 12% in the control group, while for boys it was 4% and 13%, respectively. Based on the conducted research, the following conclusions were drawn: The physiological spine curvatures of pupils from the music class were deepened, compared to their peers in the control group. Posture defects (with the exception of flat back) were more common among girls from the music class. The incidence of postural defects among boys from the music and control classes was similar. The curriculum of physical education classes in music-specialized groups should be modified to include exercises which increase the mobility range of the shoulder and pelvic girdle.

Keywords: *posture defects, maladies in musicians, musician health and safety, pupils, children.*

Introduction

Pupils attending music schools are gifted children, often from families with long-term, multi-generational traditions and musical passion. Music is an important aspect of their lives, and high-level music performance requires systematic, daily practice from the beginning of their music education. These children are prone to incorrect body statics and torso asymmetries (Kluszczyńska, 2003; Kaneko, 2005). It mainly results from forced position during practice and concerts (Foxman, Burgel, 2006).

Bubka and Poznańska (2000), and Gołąb at all (2003) showed that postural defects and lateral curvature of the spine occur much more often in pupils from music schools than in their peers from general schools. Thus, early diagnosis and prevention are very important, as the treatment of posture defects is not always fully effective.

Goals and tasks

The aim of the study was to determine incidence of incorrect body posture in the sagittal plane in the torso of 11-year old 5th-graders who attended music and general profile classes at Elementary School Complex No. 2 in Szczecin (Poland).

Materials and methods

The subject group consisted of 70 children aged 11 from the Elementary School Complex No. 2 in Szczecin; it included 46 (65.7%) girls and 24 (34.3%) boys; children attended 5th grade with either a music or general profile (Table 1).

Table 1.

Total of Subjects

Children's age	Girls		Boys		Total	
	n	%	n	%	n	%
11	46	65.7	24	34.3	70	100

Due to the need to compare children from parallel 5th grades (music and general profiles), the division of subjects was made: 'M' (5th grade, music profile) and 'C' (5th grade, control group – general profile). M and C groups included individuals who - on the day of the study – attended the fifth grade and were between 10 years, 6 months and 1 day old and 11 years and 6 months (Lewandowski, 2006). Individuals who on the day of the first measurement were in the fifth grade but did not meet the age range, were eliminated from the observations.

In the music class, 40 children were examined, including 28 (70.0%) girls and 12 (30.0%) boys. In the comparative (control) class, 30 children were examined, including 18 (60.0%) girls and 12 (40.0%) boys (Table 2).

Table 2.

Number of Children in M and C Classes

Grade	Profile											
	Music						General (control)					
	Girls		Boys		Total		Girls		Boys		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
5th	28	70	12	30	40	100	18	60	12	40	30	100

The most numerous group was children in the piano class, followed by: violin, guitar, flute, clarinet, cello, and percussion (Table 3).

Table 3.

Number of Children in Specific Instrument Classes

Instrument	Girls		Boys		Total	
	n	%	n	%	n	%
Piano	12	43	4	33	16	40
Violin	7	25	3	25	10	25
Guitar	3	11	2	17	5	13
Flute	2	7	1	8	3	8
Clarinet	2	7	1	8	3	8
Cello	1	4	0	-	1	3
Percussion	1	4	1	8	2	5
Total	28	100	12	100	40	100

Participation of pupils in the research was based on the consent of their parents and school management. Based on school health records and conversations with parents, children from dispensary groups and with documented irregularities in the construction within the musculoskeletal system were excluded from the study. On the day when the measurements started, the children were generally healthy, according to the doctor's opinion. The measurements were carried out twice: at the beginning and at the end of the school year. The first measurement took place in September, while the second one was carried out in June of the following year. All students were measured in the same conditions and in the same order:

- measurements of height and body weight,
- measurements of body posture.

The school's management and parents of the children gave written consent for the participation of their children in the research. Parents and pupils were notified about the purpose of the research, the method and the right to resign at any time without any consequences. The program of the study received a positive opinion of the Bioethical Commission of the Pomeranian Medical University in Szczecin (Resolution No. BN-001/133/07).

The examination of somatic features included measurements of body height with an accuracy of 0.1 cm using a Martin-type anthropometer, and measurements of body weight with an accuracy of 0.1 kg, using a medical weight (Jopkiewicz, Suliga, 2011).

In the assessment of body posture, the surface topography examination (ST) method was used. Computer equipment was used, produced by CQ Elektronik System

from Wrocław (Poland) (Świerc, 2005). The device used a non-invasive photogrammetric technique (Moiré's phenomenon) (Tokarczyk, Mazur, 2006). The method used in the study was based on taking a photograph of subjects' back with a video camera, and a computer analysis of the obtained photograph – a photogram (Hackenberg, Hierholzer, Pötzl, Götze, Liljenqvist, 2003; Chowańska, Kotwicki, Krzyżaniak, Szulc, 2009; Mrozkowiak, 2010). The results of the measurements were evaluated by a physician – head of the Department of Rehabilitation and Sports Traumatology at the Institute of Physical Culture WNP of the University of Szczecin (currently the Department of Physical Culture and Health Promotion of the University of Szczecin).

Two angular parameters describing the posture of the examined children in the sagittal plane were analyzed (Table 4).

Table 4.

Torso Parameters of 5th Graders from M and C Classes in the Sagittal Plane

No.	Parameters			
	Symbol	Unit of measurement	Name	Explanation
1	TKA	degrees	Thoracic kyphosis angle	TKA = 180 - (BETA + GAMMA)
2	LLA	degrees	Lumbar lordosis angle	LLA = 180 - (ALFA + BETA)

ALFA – inclination of the lumbosacral segment, BETA – inclination of the thoracolumbar segment, GAMMA – inclination of the upper thoracic segment

To date, no standards have been published describing the body posture based on the body surface topography method for the population of children from the city of Szczecin and the Zachodniopomorskie voivodship. Therefore, the measurement results were compared to normative ranges developed by Mrozkowiak (2010) for the population of children from the Warmian-Masurian voivodship.

Body posture with a thoracic kyphosis angle within the normative range according to Mrozkowiak (2010) was classified as a correct posture, above the upper limit – as posture with flat back, and below the bottom limit – as round back. Similarly, body posture with lumbar lordosis angle within the normative range was classified as correct posture, above its upper limit – as flat back, and below the bottom limit – as concave back.

Statistical analysis was carried out using a statistical program Statistica PL, v. 7, and MS Excel 7.0 spreadsheet.

The distribution of quantitative variables was made (Stanisz, 2000):

- For discrete and continuous variables, the following were given: group size (n), the minimum value (min), the maximum value (max), the median, the arithmetic mean ($\overline{X}$) and standard deviation (SD).
- Interquartile ranges (Q1 – Q3; Q1 – first quartile, Q3 – third quart) were not given in the characteristics of variable distributions due to small group sizes (n <30, n – group size).
- For continuous variables, despite small groups, compliance with the normal distribution was checked, using the Shapiro-Wilk test (the significance levels are not specified in the tables).
- In order to determine the significance of differences between the two groups of independent variables with normalized distributions, Student's t-test or Cochran-Cox test were applied. For variables with a non-normal distribution, in at least one of the groups, the Mann-Whitney U test was used.
- In order to determine the significance of differences between the two groups of dependent variables with normalized distributions, Student's t-test was applied. For variables with a non-normal distribution, in at least one of the groups, the Wilcoxon signed-rank test was used.

The admissible probability of the type 1 error (test significance level) was assumed to be 0.05.

Results

The level of somatic development of the examined children corresponded to the standards developed for the population of children from Szczecin; the measurement results did not reveal statistically significant differences.

In girls from the 'M' 5th grade, there was a statistically significant worsening of thoracic kyphosis during measurement 1, compared to classmates from the 'C' class. In the second measurement, no statistically significant differences were found between all 5th-grade students (Table 5).

In measurements 1 and 2, the average TKA in boys from the 'M' and 'C' classes were similar and no statistically significant differences were found. In the second measurement of boys from the 'M' class, a statistically significant increase in TKA was found, in comparison to measurement 1 (Table 6).

Girls from the 'M' class displayed deepened lordosis in measurements 1 and 2, compared to girls from the 'C' class, but a statistically significant difference was found in both studies only between the 'M' and 'C' classes. In measurement 2, the average LLA of girls from the 'M' 5th grade decreased, while LLA of girls from the 'C' 5th grade increased (compared to measurement 1), but the differences were statistically insignificant (Table 7).

Boys from 'M' and 'C' classes obtained mean values of LLA at a similar level in both measurements, and no statistically significant differences were found, neither between 5th grade classes in measurements 1 and 2, nor in the same classes across both measurements (Table 8).

Signs of correct posture in the sagittal plane were found in 62% of girls in the 'M' class and 73% in the 'C' class. Among boys, the values were 71% in 'M' and 75% in 'C' class. 31% of girls from the 'M' class had round back, while only 14% in the 'C' group; among boys, the results were 25% and 16%, respectively 'M' and 'C'. Flat backs were found in 6% of girls in the 'M' class and 12% in the 'C' class, while for boys it was 4% and 13%, respectively. The above data indicate that postural defects, with the exception of flat back, were more frequent among children from the musical class, and less frequent in boys than in girls (Tables 9 and 10).

Table 5.

TKA [°] of 5th Grade Girls

Characteristics of distribution		Measurement 1		Measurement 2		Measurement 1 vs measurement 2	
		M	C	M	C	M	C
n		28	18	28	18		
min-max		143 .5 - 162 .7	152 .6 - 168 .3	140 .9 - 165 .1	140 .4 - 173 .7		
median		154 .0	156 .5	151 .0	152 .1		
$\overline{X}$ (SD)		153.3 (5.0)	159.2 (5.4)	151.4 (6.7)	154.4 (9.8)		
M vs C	p	0 .007		0 .35		0 .59	0 .20

Class: M - music, C - control

min - the minimum value (min), max - the maximum value, $\overline{X}$ the arithmetic mean, SD - standard deviation, p - significance level

Table 6.

TKA [°] of 5th Grade Boys

Characteristics of distribution		Measurement 1		Measurement 2		Measurement 1 *vs* measurement 2	
		M	C	M	C	M	C
n		12	12	12	12		
min-max		142 .6 - 170 .1	147 .3 - 169 .6	145 .7 - 161 .6	140 .8 - 165 .3		
median		150 .1	156 .2	151 .3	148 .5		
$\overline{X}$ (SD)		152.3 (9.60)	157.0 (5.66)	152.2 (5.22)	150.2 (6.92)		
M *vs* C	p	0 .19		0 .52		1 .0	0 .07

Class: M - music, C - control

min - the minimum value (min), max - the maximum value, $\overline{X}$ the arithmetic mean, SD - standard deviation, p - significance level

Table 7.

LLA [°] of 5th Grade Girls

Characteristics of distribution		Measurement 1		Measurement 2		Measurement 1 *vs* measurement 2	
		M	C	M	C	M	C
n		28	18	28	18		
min-max		141 .7 - 170 .9	149 .8 - 170 .0	137 .7 - 174 .3	142 .9 - 229 .8		
median		158 .9	162 .6	156 .4	165 .6		
$\overline{X}$ (SD)		157.2 (10.6)	162.1 (5.2)	155.4 (11.6)	169.0 (24.5)		
M *vs* C	p	0 .156		0 .11		0 .48	0 .80

Class: M - music, C - control

min - the minimum value (min), max - the maximum value, $\overline{X}$ the arithmetic mean, SD - standard deviation, p - significance level

Table 8.

LLA [°] of 5th Grade Boys

Characteristics of distribution		Measurement 1		Measurement 2		Measurement 1 *vs* measurement 2	
		M	C	M	C	M	C
n		12	12	12	12		
min-max		146 .0 - 162 .9	153 .3 - 170 .5	144 .5 - 181 .0	143 .2 - 168 .8		
median		160 .3	159 .6	158 .7	156 .2		
$\overline{X}$ (SD)		157.0 (7.5)	160 ..5 (6.2)	158.7 (12.0)	155.8 (7.8)		
M *vs* C	p	0 .84		0 .53		1 .0	0 .14

Class: M - music, C - control

min - the minimum value (min), max - the maximum value, $\overline{X}$ the arithmetic mean, SD - standard deviation, p - significance level

Table 9.

The Incidence of Normal and Abnormal Postures in the Sagittal Plane of 5th Grade Girls in Measurement 1

Round-concave back		Flat back		Round back		Concave back		Correct posture	
M	C	M	C	M	C	M	C	M	C
-	2%	6%	11%	20%	15%	6%	2%	68%	70%

Class: M - music, C - control

Table 10.

The Incidence of Normal and Abnormal Postures in the Sagittal Plane of 5th Grade Boys in Measurement 1

Round-concave back		Flat back		Round back		Concave back		Correct posture	
M	C	M	C	M	C	M	C	M	C
-	-	2%	8%	18%	13%	7%	0%	71%	75%

Class: M - music, C - control

Discussion

Incorrect posture in schoolchildren results in the development of degenerative spine changes, functional disorders, reduced motor fitness and – ultimately – lower quality of life. Incorrect posture may be largely influenced by various external conditions, such as limited physical activity, long-term sitting in maladjusted school benches, and long hours of practice in forced positions. These factors contribute to the occurrence of spinal pain syndromes in young people (Drozda, Lewandowski, 2011; Nowotny et.al., 2011).

Although the issue of physical development of children, their motor, physical and body performance has been described in detail, there is a lack of research on these issues in children from music schools. The few reports related to fitness and posture of children from music schools mainly concern the population in Poland. This topic was raised by, among others, Bittner-Czapińska and Janiszewski (2004), Janiszewski at all (2002), Jankowicz-Szymańska (2009). It was, however, not possible to find in the available literature any research of foreign authors on postural defects or motor skills of children from music classes at the initial stage of education. Therefore, comparing the results of authors' own research with research of others was quite difficult. The limited foreign literature concerns mainly adults, students and professional musicians (Burkholder, Brandfonbrener, 2004; Fidyk, 2009; Wilke, et.al., 2011).

An important element of the study on children from music and general classes was the assessment of their body posture. There were several attempts to determine the normative ranges of physiological curvatures of the spine, characteristic of particular populations of Polish children (Dziewulski, Szymanik, 2003; Zeyland–Malawka, 2003). Due to the variety of measurement techniques used in the cited publications, the results of our own research may not be fully comparable with the results of other authors.

However, normative physiological spine curvatures of children from Szczecin have not been yet developed on the basis of body surface topography and photogrammetric technique. Therefore, the results of our own research were referred to normative ranges developed by Mrozkowiak (2010) using the above-mentioned method – a study of 2.361 children from the Warmian-Masurian voivodeship. As setting precise boundaries between cor-

rect and incorrect posture in the sagittal plane is impossible, the above normative ranges constitute the area of variability of values that occur most frequently (in 66.66%) and allow for only approximate assessment (Mrozkowiak, 2010).

The author of this work in the studies of 7-year-old girls and boys from 1st and 2nd grade music and general classes (a separate publication) did not find significant differences in the frequency of incorrect values, perhaps due to the fact that children at the initial stage of study spend little time on practicing a musical instrument. In junior classes (1st-3rd grade), there were two instrument classes per week, 30 minutes each, while in higher grades (4th and above), there were two classes of 45 minutes per week. At home, younger children practice for approx. 30-60 minutes a day with breaks for rest, while the older ones spend usually 60-120 minutes for practice – which is significantly longer (Wilk, 2013). A similar time of instrument practice was recorded among pupils of the Comprehensive Elementary Music School in Tarnów (Jankowicz-Szymańska, Pałucka, Mikołajczyk, 2009). Over the course of a year, older children spend approx. 600 hours playing the instrument at home and at school, which can significantly burden their musculoskeletal system.

Faulty posture, reduced physical fitness, overweight, and numerous pain complaints in musicians playing various instruments start to gain importance both in the medical environment and among people involved in physical education, music education and prevention. These issues are addressed by numerous researchers, who also stress the great role of prevention through exercises that might counteract these problems at every stage of music education (Wilczyński, 2007; Steinmetz, Seidel, Muche, 2010; Storm, 2006). These increasingly popular observations become important in the absence of studies on school-aged children who begin their music education. No published sets of preventive exercises for children of music classes at an early stage of education were found, which might help them with the development of a better technique of playing an instrument. Kava at all's research (2010) conducted in the US among students of the Instrument Department showed that the introduction of exercises based on the above assumptions and the Pilates method had a positive impact on the effectiveness of playing musical instruments.

Most of available publications generally stated that the introduction of preventive exercises and increasing physical activity during classes have an impact on improving the incorrect posture and reducing pain. It is therefore recommended to take 10-15-minute breaks after each hour of practice. The few authors dealing with health problems of musicians confirm posture defects in cellists, accordionists, musicians playing string instruments, wind instruments and percussion instruments. Studies usually only apply to students and adults. Research carried out by Bittner-Czepińska and Janiszewski (2004) found that abnormal posture and lateral spinal curvature of the accordionists was much more frequent – which required corrective exercises during music studies.

According to Dupuis (1993), musculoskeletal disorders in the form of tendonitis, dystonia, carpal tunnel syndrome or thoracic outlet syndrome, are the result of over-straining muscles and ligaments. Spinal pain ('back pain') is the result of long-lasting overstrain in a forced body position during practice and concerts. Baadjou at all (2011) and Krapac (2001) are of similar opinion. Steinmetz at all (2007) found that 93% of the musicians had postural stabilization disorders, with 85% of the changes affecting the shoulder area, 71% – the lumbar and pelvic area, and 57% the so-called 'upper-crossed syndrome', as a manifestation of muscular dystonia; a significantly higher incidence was observed in women. Among the subjects, there were musicians playing string instruments, wind instruments and keyboard, who suffered from musculoskeletal pain. The author also stressed the great importance of proper prevention, treatment and rehabilitation of musicians.

Baadjou at all (2011) noted that musicians playing wind instruments in a forced sedentary position had postural disorders and their energy expenditure whilst playing was greater due to this fact. In his research, Krapac (2001) focused on non-physiological body posture, especially the cervical segment, shoulder girdle, forearms and wrists of musicians; he noticed changes in the shoulder and elbow joints, which were symptoms of overstrain.

Conclusions

1. The physiological spine curvatures of pupils from the music class were deepened, compared to their peers in the control group.
2. Posture defects (with the exception of flat back) were more common among girls from the music class versus the control group.
3. The incidence of postural defects among boys from the music and control classes was similar.
4. The curriculum of physical education classes in music-specialized groups should be modified to include exercises which increase the mobility range of the spine and shoulder and pelvic girdle.

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ДОСЛІДЖЕННЯ ДЕФЕКТІВ ПОСТАВИ УЧНІВ П'ЯТИХ КЛАСІВ ПОЧАТКОВОЇ МУЗИЧНОЇ ШКОЛИ

Учні, які відвідують початкову музичну школу – це зазвичай обдаровані діти, часто з сімей, які мають багаторічні традиції, та передають пристрасть до музики із покоління до покоління. Музика є важливим аспектом їхнього життя, і високий рівень музичної виконавчої майстерності вимагає систематичної, повсякденної практики. Через численні заняття з музичними інструментами ці діти схильні до неправильної постави та асиметрії тулуба. В основному це зумовлено статичним положенням тіла під час практики та концертів. Мета статті – представити результати дослідження дефектів постави в 11-річних учнів 5-х класів музичних і загальних профілів. Вибірка складалася із 70 дітей віком 11 років з початкової школи № 2 в Щечині (Польща); до неї входили 46 (65,7%) дівчаток та 24 (34,3%) хлопчиків; діти відвідували 5 клас із музичним або загальним профілем. Дітей було обстежено двічі: на початку та наприкінці навчального року. Перше обстеження відбулося у вересні, а друге – у червні наступного року. При оцінці положення тіла використовувався метод топографії поверхні, який базується на техніці просторової фотограмметрії. Проаналізовано кут токального (грудного) кіфозу та кут поперекового лордозу в сагітальній площині. Ознаки правильної постави в сагітальній площині були виявлені в 62% учениць музичного профілю та 73% учениць контрольної групи. Серед хлопчиків результати склали 71% і 75%, відповідно. 31% дівчат з музичного класу мали сутулість, тоді як у контрольній групі – 14%; серед хлопців результати склали 25% і 16%, відповідно. Симптоми плоскої спини були зафіксовані в 6% дівчат у музичному класі та 12% у контрольній групі, тоді як для хлопчиків – ці показники склали 4% та 13%, відповідно. На підставі проведених досліджень були зроблені такі висновки: фізіологічні дефекти хребта учнів з музичного класу є більш виразними порівняно з однолітками контрольної групи. Дефекти постави (за винятком симптомів плоскої спини) були більш поширені серед дівчат з музичного класу. Частота дефектів постави у хлопчиків з музичних і контрольних класів була схожою. Навчальний план з фізичного виховання в музично-спеціалізованих групах повинен включати вправи, які збільшують діапазон рухливості плечового та тазового поясів.

Ключові слова: дефекти постави, музиканти, здоров'я та безпека музикантів, учні, діти.

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