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An attempt to assess physical performance of male and female pupils who play selected musical instruments as compared to reference values of the Eurofit test battery provided by Dobosz

Mateusz Apanowicz

FizjoMedica, Poniatowskiego 1/4, 86-300 Grudziądz

Abstract

Introduction. The modern techniques of musical performance and occupational loading related to them require a comprehensive approach to the physical performance of players, their typical illnesses, physiotherapy and prophylaxis.

Material and methods. 393 students from randomly selected music schools were qualified for the study. The level of physical fitness was assessed using the Eurofit test in each of the schools and the obtained test results were compared with the reference values provided by Dobosz.

Summary

The physical performance of female pupils of music schools was slightly higher than of male students. The physical performance at the age of 13, 14 and 18 was at a higher level than at the age of 11, 12, 15, 16 and 17 years. It was also significantly higher than the level represented by the peers in the area of flexibility, explosive and static strength, endurance of trunk muscles, agility and cardio-respiratory efficiency, but significantly higher within balance, functional endurance and the speed of upper limbs. As regards both girls and boys,

the fittest pupils were among grand piano, violin and cello players, whereas accordion players turned out to be less fit and guitar players were even more unfit. 17-year-old violin players, 16-year-old guitar players and 12-year-old accordion players were reported to be the most unfit students. Among girls, the fittest pupils were observed in the group of accordion, grand piano, violin and cello players, while the most unfit individuals were 16-year-old guitar players and 17-year-old violin players. As regards boys, the fittest pupils were violin, grand piano and cello players and the most unfit ones were 12-year-old accordion players, 16-year-old guitar and cello players as well as 17-year-old violin players.

Key words: physical performance, musical performance, Eurofit test

Introduction

The modern techniques of musical performance and occupational loading related to them require a comprehensive approach to the physical performance of players, their typical illnesses, physiotherapy and prophylaxis. The broadly comprehended physical fitness constitutes the basis for the technique of playing musical instruments. An important role is played here by all motor skills accounting for the widely interpreted motor activity and intellectual efficiency [1, 2].

Physical activity is an indispensable attribute of human life ensuing from the inborn needs of the body. A properly chosen activity is conducive to the development, promotion and maintenance of health. Additionally, it improves the muscle system, positively influences the height and shape of bones, develops the cardio-respiratory system, enhances physical performance and efficiency. A sedentary lifestyle, on the contrary, significantly reduces the efficiency of all human systems. In order to ensure that physical activity brings desired effects, it should be systematic and the volume and intensity of physical activity should be well chosen. The physical confidence in own abilities affects confidence in general. The excitability threshold has a higher value and so it increases anti-stress condition.

Assuming that the first contact with an instrument, learning to play and subsequent permanent improvement of the play begins at the age of 6-7 years, and the minimum time spent on the work with an instrument as 30-45 minutes, the forced body posture and “the school shock” result in the morning statics disorders to a great extent. The need to master increasingly more extensive musical works, the need to improve the playing technique and the freedom of

coordination of fingers during the play, extend the duration of practicing and the time of the body posture assumed and forced by an instrument. The achievement of the first degree of music school requires a 120-150-minute practice of a chosen instrument and the second degree means a 4-5-hour training. Assuming that after twelve years of education and having achieved the second degree, the pupil decides to undertake the profession of a musician and thus agrees to have a 6-hour training every day. The motor skills of the student and the adaptability of his or her body may not satisfy the technical requirements of the play. Yet another aspect of the pupil's effort is the work with a music teacher who spends 60 minutes twice a week for an individual work during which the teacher constantly corrects the pupil's body posture. When the student returns home, he or she usually practices the teacher's tips. Consequently, the adopted routine means that the time of playing an instrument without the teacher is longer. In this part, the pupil realizes the adopted tasks auto-controlling the play technique, body posture, physical and emotional loading.

The purpose of the research was to assess the physical fitness of the players of selected musical instruments as compared to the reference values provided by Dobosz using the Eurofit test.

Materials, methods and research tools

393 individuals were recruited from randomly selected music schools. All the students 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 fitness analysis considered completed years and months of life in accordance with the requirements specified by Dobosz [3]. 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 least 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. The research was performed in each of the schools involved in the study using the Eurofit test according to the adopted order [4], Table 1. Following a 5-7-minute warmup under the guidance of a member of the research team, each of the subjects started the first test. The break between tests was not longer than 3 minutes.

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 [4]

Test results

Legend for Table 2-9.

Red (***) high significance of differences

Blue (**) medium significance of differences

Green (*) very low significance of differences

White – insignificant difference

The analysis of the results tended to reveal the level of the physical performance of the pupils within the classes and age ranges. To this end, it was attempted to determine the level of significance of the differences between the mean test results and the standard reference values in each class, age and gender category.

Among 11-year-old female pupils who played the accordion and the flute, the differences between the reference values and the mean results of each test were of little significance and in case of flexibility they were insignificant. Among the boys, all differences of medium significance, Table 2.

Table 2. The significance of the differences between references and mean results of each Eurofit test at the age of 11, within gender range, class I and II (n) K=15, M=20

Age	11 years			
	K		M	
Parameter	Accordion	Western concert flute	Accordion	Western concert flute
Balance	0.0206 *	0.01368 *	0.00545 **	0.0019 **
Flexibility	0.46145	0.01028 *	0.00355 **	0.00686 **
Explosive strength	0.01563 *	0.01415 *	0.00583 **	0.00586 **
Static strength	0.02178 *	0.01154 *	0.00479 **	0.00482 **
Endurance of trunk muscles	0.02154 *	0.01415 *	0.00485 **	0.00563 **
Functional endurance	0.02225 *	0.01403 *	0.00573 **	0.00586 **
Agility run	0.02225 *	0.01403 *	0.00573 **	0.01234 **
Speed of upper limbs	0.02154 *	0.01368 *	0.00583 **	0.00583 **
Cardiorespiratory efficiency	0.0206 *	0.02201 *	0.00514 **	0.00885 **

Source: author's own research

Among 12-year-old girls and boys playing the accordion the differences regarding references and mean results of each test were highly significant and between the flute and grand piano players they were moderately significant, Table 3.

Tab. 3. The significance of the differences between references and mean results of each Eurofit test at the age of 12, within gender range, class I, II and III (n) K=40, M=40

Age	12 years					
Gender	K			M		
Parameter	Accordion	Western concert flute	Accordion	Western concert flute	Accordion	Western concert flute
Balance	0.00066 ***	0.00245 **	0.00151 **	0.00027 ***	0.00105 **	0.00473 **
Flexibility	0.00204 **	0.00216 **	0.0655	0.00026 ***	0.00473 **	0.005 **
Explosive strength	0.00072 ***	0.0025 **	0.00158 **	0.00031 ***	0.0016 **	0.00573 **
Static strength	0.00064 ***	0.00216 **	0.00145 **	$3 \cdot 10^{-4}$ ***	0.00141 **	0.00514 **
Endurance of trunk muscles	$7 \cdot 10^{-4}$ ***	0.00244 **	0.00135 **	0.00031 ***	0.00154 **	0.00563 **
Functional endurance	0.00071 ***	0.00251 **	0.00163 **	0.00036 ***	0.00163 **	0.00579 **
Agility run	0.00072 ***	0.00241 **	0.00157 **	0.00029 ***	0.00159 **	0.00573 **
Speed of upper limbs	0.00072 ***	0.0024 **	0.00161 **	$3 \cdot 10^{-4}$ ***	0.00159 **	0.00576 **
Cardiorespiratory efficiency	$6 \cdot 10^{-4}$ ***	0.00243 **	0.00145 **	0.00023 ***	0.00158 **	0.00536 **

Source: author's own research

Among 13-year-old girls playing the accordion, the differences between references and mean results of each test were insignificant. The differences between grand piano female players and accordion male players were of little significance. Yet, as regards the girls the difference in the cardio-respiratory efficiency test was insignificant, whereas among the boys it was moderately significant in the functional endurance test, Table 4.

Table 4. Significance of the differences between references and mean results of each Eurofit test at the age of 13 years, within gender, class I and III (n) K=9, M=8

Gender	13 years		
		K	M
Parameter	Accordion	Grand piano	Accordion
Balance	0.25	0.03103 *	0.01187 *
Flexibility	0.25	0.03401 *	0.01356 *
Explosive strength	0.25	0.03552 *	0.01403 *
Static strength	0.17357	0.03401 *	0.01198 *
Endurance of trunk muscles	0.25	0.03401 *	0.01379 *
Functional endurance	0.17357	0.03552 *	0.00781 **
Agility run	0.25	0.03552 *	0.01379 *
Speed of upper limbs	0.25	0.03552 *	0.01403 *
Cardiorespiratory efficiency	0.14891	0.34401	0.01198 *

Source: own research

Among 14-year-old girls and boys playing the grand piano, the differences between reference values and mean results of each test were moderately significant. The difference was insignificant only among boys in the flexibility test, Table 5.

Table 5. Significance of the differences between references and mean results of each Eurofit test at the age of 14, within gender, class III (n) K= 11, M=9

Age	14 years	
Gender	K	M
Parameter	Grand piano	Grand piano
Balance	0.00714 **	0.00826 **
Flexibility	0.00292 **	0.02935 *
Explosive strength	0.00384 **	0.00861 **
Static strength	0.00338 **	0.00885 **
Endurance of trunk muscles	0.00347 **	0.00849 **
Functional endurance	0.00377 **	0.00885 **
Agility run	0.00377 **	0.00903 **
Speed of upper limbs	0.00367 **	0.00891 **
Cardiorespiratory efficiency	0.0036 **	0.00861 **

Source: author's own research

Among 15-year-old female players of the grand piano the differences between references and mean results of each test were insignificant and among the guitar and cello players they were moderately significant. Insignificant differences were reported in the balance test in grand piano players and in the agility run in cello players. As regards the boys playing the grand piano, a significant difference was observed in the following tests: balance, static strength, functional endurance, and the speed of upper limbs. Moderately significant differences were reported in the explosive strength test, trunk muscle endurance test and agility run test, while the differences in the flexibility test were insignificant. Among guitar players, all the differences were insignificant except for the balance test where the difference was insignificant. As for the cello, all the differences were insignificant except for the functional endurance test with a moderately significant difference, Table 6.

Table 6. Significance of the differences between references and mean results of each Eurofit test at the age of 15 years, within gender, class III, IV and V (n) K=30, M=27

Age	15 years					
	K			M		
Parameter	Grand piano	Guitar	Cello	Grand piano	Guitar	Cello
Balance	0,14002	0,00228 **	0,00952 **	0,00084 ***	0,04771 *	0,01028 *
Flexibility	0,03351 *	0,00228 **	0,00218 **	0,02782 *	0,05334	0,01154 *
Explosive strength	0,03552 *	0,00249 **	0,00242 **	0,00103 **	0,05676	0,01356 *
Static strength	0,03451 *	0,00233 **	0,00233 **	0,00096 ***	0,09751	0,01198 *
Endurance of trunk muscles	0,03501 *	0,00245 **	0,00241 **	0,00106 **	0,05791	0,01368 *
Functional endurance	0,03054 *	0,00248 **	0,00247 **	0,00098 ***	0,0625	0,00781 **
Agility run	0,03103 *	0,00233 **	0,09056	0,0011 **	0,0625	0,01403 *
Speed of upper limbs	0,03552 *	0,00241 **	0,00244 **	0,00098 ***	0,05791	0,01415 *
Cardiorespiratory efficiency	0,03401 *	0,00241 **	0,0024 **	0,00107 **	0,05791	0,01415 *

Source: author's own research

Among 16-year-old female and male players of the grand piano and the violin, the differences between references and mean results of each test were insignificant. Moderately significant differences in all tests were observed among cello female players except for the balance test with an insignificant difference. Highly significant differences were reported in the girls playing the guitar and in male guitar and cello players, Table 7.

Table 7. Significance of the differences between references and mean results of each Eurofit test at the age of 16 years, within gender, class III, IV, V and IV (n) =50, M=57

Age	16 years							
Gender	K				M			
Parameter	Grand piano	Guitar	Violin	Cello	Grand piano	Guitar	Violin	Cello
Balance	0.2763	6*10 ⁻⁵ ***	0.19747	0.14413	0.05447	0 ***	0.09467	0.00024 ***
Flexibility	0.05334	0 ***	0.08897	0.00849 **	0.78353	0 ***	0.08897	0.00028 ***
Explosive strength	0.0625	0 ***	0.09751	0.00849 **	0.05447	0 ***	0.125	0.00046 ***
Static strength	0.05791	0 ***	0.09467	0.00849 **	0.05791	0 ***	0.09467	0.00046 ***
Endurance of trunk muscles	0.0625	0 ***	0.09751	0.00885 **	0.05791	0 ***	0.125	0.00044 ***
Functional endurance	0.0625	0 ***	0.09751	0.00891 **	0.05676	0 ***	0.125	0.00047 ***
Agility run	0.0625	0 ***	0.125	0.00391 **	0.0625	0 ***	0.125	0.00047 ***
Speed of upper limbs	0.05676	0 ***	0.125	0.00891 **	0.05334	1*10 ⁻⁵ ***	0.09751	0.00046 ***
Cardiorespiratory efficiency	0.05334	0 ***	0.125	0.00879 **	0.05791	0 ***	0.125	0.00045 ***

Source: author's own research

Among 17-year-old girls and boys playing the violin, the differences between references and mean results of each test were highly significant, whereas among the cello players they were insignificant. As for guitar players, the differences were insignificant as well except for a slight difference in the test of the upper limb speed, Table 8.

Table 8. Significance of the differences between references and mean results of each Eurofit test at the age of 17 years, within gender, class IV, V, VI (n) K=22, M=29

Age	17 years				
Gender	K		M		
Parameter	Violin	Cello	Guitar	Violin	Cello
Balance	0.00071 ***	0.34578	0.05676	3*10 ⁻⁵ ***	0.34578
Flexibility	7*10 ⁻⁵ ***	0.5	0.05676	1*10 ⁻⁵ ***	0.34578
Explosive strength	9*10 ⁻⁵ ***	0.5	0.05791	4*10 ⁻⁵ ***	0.34578
Static strength	6*10 ⁻⁵ ***	0.5	0.05676	4*10 ⁻⁵ ***	0.5
Endurance of trunk muscles	9*10 ⁻⁵ ***	0.5	0.05791	4*10 ⁻⁵ ***	0.5
Functional endurance	9*10 ⁻⁵ ***	0.5	0.05791	4*10 ⁻⁵ ***	0.5
Agility run	9*10 ⁻⁵ ***	0.5	0.0625	4*10 ⁻⁵ ***	0.5
Speed of upper limbs	8*10 ⁻⁵ ***	0.5	0.04771 *	4*10 ⁻⁵ ***	0.5
Cardiorespiratory efficiency	9*10 ⁻⁵ ***	0.5	0.05791	4*10 ⁻⁵ ***	0.5

Source: author's own research

Among 18-year-old girls and boys playing the violin, the differences between reference values and mean values in each test were of moderate significance except for an insignificant difference in the balance test conducted by girls, Table 9.

Table 9. Significance of the differences between references and mean results of each Eurofit test at the age of 18 years, within gender, class V (n) K=12, M=13

Age	18 years	
Gender	K	M
Parameter	Violin	Violin
Balance	0.03624 *	0.00145 **
Flexibility	0.0019 **	0.00123 **
Explosive strength	0.00241 **	0.00161 **
Static strength	0.00216 **	0.00135 **
Endurance of trunk muscles	0.0024 **	0.00159 **
Functional endurance	0.00241 **	0.02497 **
Agility run	0.00248 **	0.00163 **
Speed of upper limbs	0.00248 **	0.00243 **
Cardiorespiratory efficiency	0.0024 **	0.00163 **

Source: author's own research

Discourse

Body posture disorders can be observed in virtually every physical activity providing this activity is conducted for a long time and intensively. Unfavourable postural changes and the associated symmetry disorders in the frontal plane as well as determined abnormal values of sagittal parameters are common among the players of various disciplines of qualified sport [5, 6, 7, 8]. Proportionally the least postural defects have been reported in swimmers, but the biggest number of them turned out to have rounded back [9].

The study of Bittner-Czapińska and Janiszewski shows that the index of dynamic and static strength is an important diagnostic element of the performance of an accordion player's executive functional system. Based on the research, the index of muscle strength, motor coordination, **tromometry** and the underlying response time may be a factor informing about the loading level in the accordion performance [10].

The study of Janiszewski et al. has showed a significant increase in the percentage of postural defects and progression of the already existing defects in the pupils of music schools with a 6-year-education experience. Interestingly enough, the diagnosed defects of body posture were observed in the players of symmetrical and asymmetrical instruments. The authors' observations also included common postural mistakes in the students of music schools and their poor physical activity presumably caused by the fear of extremity injury [11].

The study conducted by Nawrocka et al. [12], Janiszewski et al. [11], and Potter [13] has revealed that pain problems depend on the type and intensity of the instrument user and pursued physical activity.

Summary

The physical performance of female pupils of music schools was slightly higher than of male students. The physical performance at the age of 13, 14 and 18 was at a higher level than at the age of 11, 12, 15, 16 and 17 years. It was also significantly higher than the level represented by the peers in the area of flexibility, explosive and static strength, endurance of trunk muscles, agility and cardio-respiratory efficiency, but significantly higher within balance, functional endurance and the speed of upper limbs. As regards both girls and boys, the fittest pupils were among grand piano, violin and cello players, whereas accordion players turned out to be less fit and guitar players were even more unfit. 17-year-old violin players, 16-year-old guitar players and 12-year-old accordion players were reported to be the most unfit students. Among girls, the fittest pupils were observed in the group of accordion, grand

piano, violin and cello players, while the most unfit individuals were 16-year-old guitar players and 17-year-old violin players. As regards boys, the fittest pupils were violin, grand piano and cello players and the most unfit ones were 12-year-old accordion players, 16-year-old guitar and cello players as well as 17-year-old violin players.

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