

HEALTH-ORIENTED PHYSICAL ACTIVITY IN PREVENTION OF MUSCULOSKELETAL DISORDERS AMONG YOUNG POLISH MUSICIANS

AGNIESZKA NAWROCKA¹, WŁADYSŁAW MYNARSKI¹, ANETA POWERSKA¹, MAŁGORZATA GRABARA¹,
DOROTA GROFFIK², and ZBIGNIEW BOREK³

¹The Jerzy Kukuczka Academy of Physical Education in Katowice, Poland
Department of Recreation

²The Jerzy Kukuczka Academy of Physical Education in Katowice, Poland
Department of Theory and Methodology of Physical Education

³Cracow University of Economics, Kraków, Poland
Department of Tourism

Abstract

Objectives: Musicians represent a very specific professional group, which due to some occupational hazards is exposed to different health problems known as playing-related musculoskeletal disorders (PRMDs). The aim of this study was to assess correlations between the level of physical activity, and the occurrence of musculoskeletal pain among young instrumentalists. **Materials and Methods:** Total of 225 Polish musical school students were investigated. To assess the study participants' physical activity level, the moderate to vigorous physical activity (MVPA) index was used. To assess pain complaints on the side of the musculoskeletal system, Nordic Musculoskeletal Questionnaire (NMQ) was applied. The NMQ questionnaire was complemented by adding a visual-analog scale (VAS), which also allowed to assess pain intensity on a numerical scale 1–10. **Results:** The pain localized in neck, shoulders, upper and lower back was reported significantly more often by the participants who did not meet standard criteria for the recommended or minimal physical activity level. **Conclusion:** Performing the recommended health-oriented physical activity may reduce the prevalence of musculoskeletal pain in young musicians.

Key words:

Instrumentalists, Children, Physical exercises, Recommendations, PRMDs, Pain

INTRODUCTION

Musicians represent a very specific professional group, which due to some occupational hazards is exposed to different health problems, related to the musculoskeletal system, known as playing-related musculoskeletal disorders (PRMDs). Musculoskeletal pain complaints are well recognized among professional musicians and most frequently

they include: back pain, acute tendonitis, de Quervain's disease, Dupuytren's contracture, rotator cuff syndrome, carpal tunnel syndrome and tennis-player's elbow [1–4]. These syndromes are mostly a result of multiannual and prolonged trainings of playing a musical instrument. However, so far there have been only few studies which focus on young instrumentalists who prepare for professional career.

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Corresponding author: A. Nawrocka, Department of Recreation, The Jerzy Kukuczka Academy of Physical Education, Mikołowska 72a, 40-065 Katowice, Poland (email: a.nawrocka@awf.katowice.pl).

Preparation to perform the classical musician's profession starts already at the level of elementary school (at 7 years of age). However, it should be emphasized that the musical school selection for future education is very often related to a desire to continue one's personal passion of playing a musical instrument. As a consequence, static and dynamic load bearing, repetitive movements, excessive muscle activation as well as extreme body postures are being superimposed on the developing body, causing potential damage since early childhood. On the one hand, many educational programs in musical schools include some methods for prophylaxis of the musculoskeletal strain – mainly through a shorter playing practice in the case of younger students. On the other hand, however, the examination system, high expectations, demands and pressure from both parents and teachers, as well as numerous artistic competitions, frequently oblige the young students to long playing hours at home. This is a particularly dangerous situation, since during home practice, there is usually no supervision, which is necessary to correct some errors in the playing technique. According to some authors, this can be a common cause of the musculoskeletal system overload in young musicians [5,6]. As a result, more and more often complaints of the musculoskeletal pain already occur among very young musicians [2,7,8]. Moreover, it can be assumed that with age and continuation of playing the training time gets longer and the pain increases, which is confirmed by the studies estimating that the prevalence of musculoskeletal disorders in professional musicians probably reaches 97% [10].

Musical school students present shorter training period of playing a musical instrument and weekly practice time than professional musicians. However, alongside playing a musical instrument, also a sudden reduction of their physical activity associated with the beginning of their school education constitutes an additional workload on their musculoskeletal systems.

Unquestionably, playing a musical instrument involves a specific physical effort, leading to an increased energy

expenditure. However, this is characterized by a static muscle activity that is required to stabilize some selected regions of the musculoskeletal system in certain positions. In addition, it has a monotypic nature, including repetitive movements and engaging the same muscle groups, often performing non-physiological range of motions [9].

This in turn, may lead to some pathological changes in different parts of the musculoskeletal system, where the painful sensations represent the main signal of potential damage. However, this warning sign is often ignored by the young instrumentalists or it is even eliminated by using a pharmacologic analgesia [10].

According to the newest Compendium of Physical Activities, the intensity of physical efforts performed by instrumentalists during their play, oscillates in the range of 1.8–3.0 MET (metabolic equivalent), depending on a musical instrument [11,12]. According to the World Health Organization (WHO) criteria, a health-oriented physical activity should cause some specific physiologic effects, based on performing moderate (4–6 MET) or vigorous (> 6 MET) exercises [13]. Our study hypothesizes that the majority of young musical school students may suffer at some stage of their career from musculoskeletal pain of different intensity, and therefore, performing the recommended health-oriented physical activity may reduce their pain, and may potentially indicate some preventive strategies that can be implemented for daily playing practice in young musicians.

The aim of this study was to assess correlations between the level of habitual physical activity, categorized as 'met' versus 'not met' criteria for the recommended physical activity level and the occurrence and intensity of musculoskeletal pain among young musical school students.

METHODS

The study was approved by the Ethics Committee of the University of Physical Education in Katowice (NR 20/2007) and performed at National Association of Musical Schools

(I-st and II-nd degree) in Katowice, Poland, during April, May 2012. Recruitment of the study participants included an initial interview to evaluate whether each potential candidate met the inclusion and exclusion criteria. Inclusion criteria were: age 10–18 years, at least 2 years of professional musical training and playing a string, keyboard, or wind instrument. Exclusion criteria were: documented excuse from participating in physical education classes.

Finally, a total of 225 study subjects – Polish musical school students including 138 (61%) girls and 87 (39%) boys, after signing a written informed consent (by participants or their guardians) were investigated. The study group included string-players (N = 106; 47%), keyboard-players (N = 64; 28%), and wind-players (N = 55; 25%).

To assess the study participants' physical activity level, the moderate to vigorous physical activity (MVPA) index was used (as a recommended screening measure, in clinical practice with adolescents) [14]. Based on the included in the study questionnaire, a short definition of physical activity and a description of the characteristic body's reactions to different intensity of physical exertion, the participating students reported how much time, during their daily routine, they devoted to moderate to vigorous physical activity. In this evaluation of physical activity, playing musical instrument was not included. The students also provided additional, various information concerning e.g., their age, frequency of their playing practice (number of days per week) and an average daily practice time.

To assess pain complaints of the musculoskeletal system, Nordic Musculoskeletal Questionnaire (NMQ) was applied, in which, the students provided information related to the pain occurrence over the past year, and during an average week, including the following body parts: neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees and ankles/feet [15]. A special map, facilitating identification of any particular body part was used. The younger students completed the study questionnaire with the help of their parents, who verified the

provided information. This approach allowed to ascertain more accurate information and also reduced many potential answering errors, related to misunderstanding of the questions. The NMQ questionnaire was complemented by adding a visual-analog scale (VAS), which in the case of pain complaints, also allowed to assess the pain intensity on a numerical scale 1–10 (1 – minimal pain; 10 – intense or unbearable pain).

The participants' level of physical activity was interpreted, based on some selected standards of the health-oriented physical activity for children and adolescents, aged 5–18 years (WHO, 2010). According to the newest recommendations by WHO, children and adolescents should be engaged in moderate (4–6 MET) or intensive (> 6 MET) physical activity on a daily basis, for at least 60 min per day (WHO, 2010).

STATISTICAL ANALYSIS

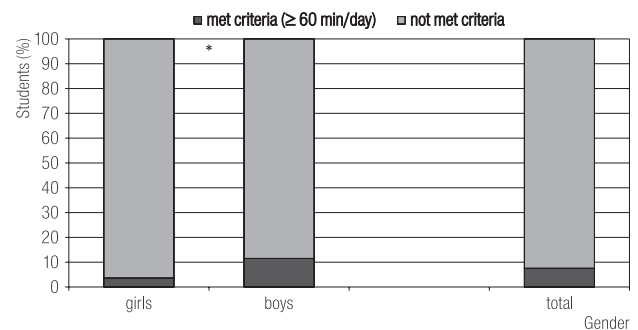
For the evaluated variables (from the study questionnaire and pain scale) some basic descriptive statistical parameters were calculated, including an arithmetic mean (M), a standard deviation (SD), and minimal (min.) and maximal (max) values. To evaluate the differences between characteristics of girls and boys, the Mann Whitney U test was used. The significance of differences in the mean results of pain intensity in musicians who met and did not meet criteria of health-oriented physical activity was evaluated using the Mann Whitney test. The logistic regression analysis was performed to evaluate association between years in the profession, weekly playing days, daily playing minutes and musculoskeletal symptoms in various body parts.

We also carried out a multivariate logistic regression analysis in order to assess the mutual impact of physical activity deficiency and years in the profession on the risk of pain occurrence in selected body parts. This method was applied stepwise in an enter approach. We calculated coefficient (B),

standard error (SE), odds ratio (OR) and confidence interval (CI). To assess correlations between the WHO recommendations (≥ 60 min/day) of physical activity, performed by the study participants and the occurrence of their musculoskeletal pain, an independent Chi² test was used. Statistical analyses were performed using IBM SPSS program; (p) value was set up at a 5% level of significance.

RESULTS

Our analysis of the study survey answers revealed that the mean number of years, spent by the participating students on professional training (playing a musical instrument) practice was about 7 years (6.96 – in girls, and 6.57 – in boys). The students declared their regular playing practice to be on average 6 days per week. On a given day, the boys were practicing slightly more often than the girls (Table 1). Further analysis showed that the frequency and daily time of playing did not constitute a statistically significant risk factor for the presence of musculoskeletal pain (Table 2). The results of logistic regression analysis indicated that the prevalence of pain in shoulders, elbows, wrists, hips, knees, ankles was not correlated with years in the profession and training time. However, a significant correlation between years of playing and the prevalence of pain in neck (OR = 1.118; 95% CI: 1.003–1.246), upper back



* $p < 0.05$.

Fig. 1. Gender differences between musicians who met the WHO physical activity recommendations [13]

(OR = 1.154; 95% CI: 1.036–1.285) as well as lower back (OR = 1.160; 95% CI: 1.046–1.286) was demonstrated. The risk of pain in these areas increased with every consecutive year of playing the instrument (Table 2).

Only 7.5% of the participating students (3.6% girls and 11.5% boys) achieved the physical activity level recommended by WHO (e.g., moderate to vigorous exercises for at least 60 min/day) (Figure 1). Boys met the standard WHO criteria for the recommended physical activity level (for children and adolescents) significantly more often than girls ($p < 0.05$).

The main goal of this study was to assess correlations between the ‘met’ versus ‘not met’ criteria for the recommended standard physical activity level, and the

Table 1. Characteristics of the study participants (musical school students)

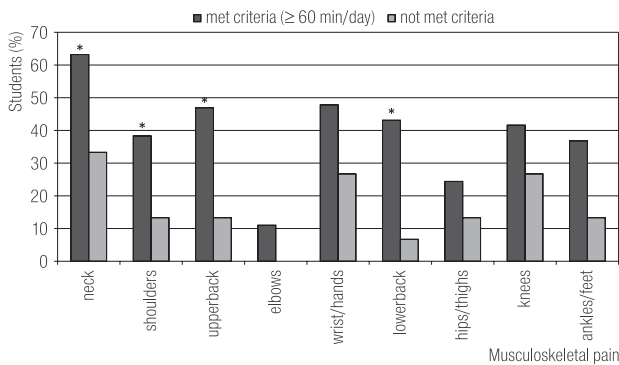
Variables	Girls (N = 138)		Boys (N = 87)		Total (N = 225)		p
	M	SD	M	SD	M	SD	
Age (years)	14.04	2.601	13.92	2.047	13.99	2.40	0.748
Body height (cm)	160.58	8.900	166.49	12.790	162.87	10.94	0.000
Body weight (kg)	50.17	10.030	57.93	14.610	53.17	12.56	0.000
Seniority (years)	6.96	2.740	6.57	2.590	6.81	2.69	0.364
Weekly playing (days)	6.04	1.250	6.25	1.200	6.12	1.25	0.128
Daily playing (min)	88.82	44.830	102.86	61.080	94.25	52.04	0.203

M – mean; SD – standard deviation.

Table 2. Logistic regression analysis of patterns of pain by years, frequency and daily time of playing

Variables	B	SE	p	OR	95% CI	
					lower bound	upper bound
Neck						
seniority (years)	0.112	0.055	0.044	1.118	1.003	1.246
weekly playing (days)	0.098	0.116	0.398	1.103	0.878	1.385
daily playing (min)	-0.001	0.003	0.858	0.999	0.994	1.005
Shoulder						
seniority (years)	0.080	0.056	0.149	1.083	0.972	1.208
weekly playing (days)	-0.023	0.117	0.847	0.978	0.777	1.230
daily playing (min)	-0.005	0.003	0.138	0.995	0.989	1.002
Upper back						
seniority (years)	0.143	0.055	0.009	1.154	1.036	1.285
weekly playing (days)	0.104	0.117	0.376	1.109	0.882	1.396
daily playing (min)	-0.003	0.003	0.331	0.997	0.991	1.003
Elbows						
seniority (years)	-0.043	0.087	0.625	0.958	0.807	1.137
weekly playing (days)	0.261	0.220	0.236	1.298	0.843	1.997
daily playing (min)	-0.002	0.005	0.740	0.998	0.989	1.008
Wrists/hands						
seniority (years)	-0.010	0.049	0.836	0.990	0.899	1.090
weekly playing (days)	0.020	0.062	0.748	1.020	0.904	1.152
daily playing (min)	-0.002	0.003	0.450	0.998	0.992	1.003
Lower back						
seniority (years)	0.148	0.053	0.005	1.160	1.046	1.286
weekly playing (days)	-0.159	0.065	0.014	0.853	0.751	0.969
daily playing (min)	-0.004	0.003	0.215	0.996	0.990	1.002
Hips/thighs						
seniority (years)	-0.061	0.056	0.274	0.940	0.842	1.050
weekly playing (days)	-0.103	0.070	0.141	0.903	0.787	1.035
daily playing (min)	0.000	0.003	0.909	1.000	0.993	1.006
Knees						
seniority (years)	0.017	0.050	0.737	1.017	0.922	1.121
weekly playing (days)	-0.082	0.063	0.193	0.921	0.814	1.042
daily playing (min)	0.000	0.003	0.980	1.000	0.994	1.006
Ankles/feet						
seniority (years)	-0.054	0.052	0.295	0.947	0.856	1.048
weekly playing (days)	-0.009	0.064	0.889	0.991	0.874	1.124
daily playing (min)	-0.002	0.003	0.526	0.998	0.992	1.004

B – coefficient; SE – standard error; OR – odds ratio; CI – confidence interval.



* p < 0.05.

Fig. 2. Musculoskeletal pain complaints reported over the last 12 months by the musicians, according to the recommended physical activity standard (for children and adolescents) [13]

occurrence and intensity of musculoskeletal pain among young Polish musical school students.

Over the past 12 months, majority of the study participants complained of pain of the neck, upper back and wrists area (Figure 2). The pain localized in these body parts was reported significantly more often by the participants who did not meet standard criteria for the recommended physical activity level (Figure 2).

In the cases of pain localized in the neck, arms, upper and lower back area, statistically significant differences were found, regardless of meeting the recommended physical activity standards.

A subjective evaluation of pain intensity, reported over the last 7 days by the study participants was also analyzed, using 1–10 numerical scale (Table 3). The mean pain intensity was, depending on its localization, in the range of 3.4–4.5 – among physically inactive students, and in the range of 1.0–4.7–5 – among those who systematically performed physical exercises. Statistically significant differences were found in the neck pain only. It should be noted, however, that the evaluation point scale had its Min.-Max range. In a group of the students ‘not meeting’ the recommendation criteria for beneficial health-oriented physical activity, some participants had even declared a 10-point pain intensity, which means unbearable pain. Such extreme assessments were not present among the students who ‘met criteria’ (performed the recommended – maximum 7 points, physical exercises).

Our analyses demonstrated that the number of years in the profession increased the pain occurrence in neck, upper

Table 3. Musculoskeletal pain intensity based on a numerical 1–10 point visual-analog scale (VAS) in the participating students

Anatomic region	Not meet criteria WHO* (< 60 min/day)			Meet criteria WHO* (≥ 60 min/day)			p
	M	min.	max	M	min.	max	
Neck	4.05	1	10	1.00	1	1	0.046
Shoulders	3.58	1	9	–	–	–	–
Upper back	4.24	1	10	–	–	–	–
Elbows	4.14	1	10	–	–	–	–
Wrist/hands	3.49	1	9	2.67	1	6	0.231
Lower back	4.51	1	9	–	–	–	–
Hips/thighs	4.28	1	10	4.33	3	6	0.259
Knees	4.48	1	10	4.00	4	4	0.571
Ankles/feet	4.21	1	9	4.66	3	7	0.186

* Recommended physical activity standard (for children and adolescents) [13].
M – mean; min. – minimum; max – maximum.

Table 4. Multivariate logistic regression of neck, upper and lower back pain by years in the profession and deficiency of physical activity

Variables	B	SE	p	OR	95% CI	
					lower bound	upper bound
Neck						
years in the profession	0.127	0.054	0.017	1.136	1.023	1.261
deficiency of physical activity	1.375	0.579	0.017	3.956	1.273	12.297
Upper back						
years in the profession	0.147	0.053	0.006	1.159	1.044	1.286
deficiency of physical activity	1.927	0.784	0.014	6.869	1.477	31.945
Lower back						
years in the profession	0.200	0.056	0.000	1.222	1.096	1.363
deficiency of physical activity	2.641	1.061	0.013	14.021	1.754	112.080

Abbreviations as in Table 2.

back and lower back (Table 2). We also observed that musical school students who did not perform recommended physical activity reported pain occurrence in the motor organ more frequently (Figure 2). Therefore, we estimated the impact of these 2 negative factors on the elements of the motor organ of young musicians (Table 4). The logistic regression analysis indicated that the number of years in the profession and the deficiency of physical activity significantly increased the risk of pain occurrence in neck and back, particularly in lower back. Along with the increase of playing time, the deficiency of physical activity increased the risk of ailments in this body part 14 times (Table 4).

DISCUSSION

Significance of the results

This clinical study, conducted among young musical school students has demonstrated that there is a correlation between the low level of habitual physical activity and the occurrence and intensity of musculoskeletal pain in the analyzed group of young musicians.

Professional musicians perform art work that in addition to their talent, passion and creativity, also requires long

hours of daily practice, starting from early childhood. Many years of exhausting training of proper playing technique, in extreme, often non physiological position, constitute one of the main risk factors for future musculoskeletal disorders, which have recently been a subject of many scientific studies. A particular attention has been paid to the musculoskeletal disorders which have been most commonly diagnosed among professional musicians. According to the studies by Lederman et al. (2003), conducted in a group of above 1300 instrumentalists, it was found that the major diagnoses included musculoskeletal disorders – in 64%, peripheral nerve problems – in 20%, and focal dystonia – in 8% of the study subjects [16].

According to the work of Paarup et al. [10], musculoskeletal disorders may be present even in 97% of women and 83% of men engaged in professional orchestral playing. Some more optimistic results were presented by Papandreou et al. [17], who identified musculoskeletal problems in 43% of the analyzed percussion players, aged 20–60 years.

It should be emphasized that majority of the studies which have been conducted among instrumentalists concern adults and orchestral classical musicians [10,18–21].

Our study, however, was conducted in a group of children and adolescents, aged 10–18 years, with a much shorter experience of professional playing. Our results indicate that young age of musicians does not exclude the occurrence of some problems related to the musculoskeletal system. According to our data, pain complaints were localized in at least one of the analyzed anatomical areas (over the past year – 88%, and over the past week – 76% of the study participants reported pain complaints). Our findings concur with the results presented by Ranelli et al. [8], according to which, 67% of the respondents (young musical students) reported PRMP – over the past year, and 56% of them – over the past month. In addition, in 30% of these respondents, the musculoskeletal pain temporarily precluded them from continuation of their routine playing practice. In the light of these findings, the prophylaxis of musculoskeletal disorders among musical school students seems extremely important.

The results of numerous international studies indicate that the factors increasing the risk of pain complaints in musicians include: years in the profession, frequency of playing practice and practice time [22–24]. In our study the frequency of playing practice and practice time did not significantly influence the incidence of pain complaints. It resulted most likely from the young age of the subjects, who spend less time practicing as compared to professional musicians.

The number of years in the profession significantly influenced the incidence of pain complaints in neck, upper back and lower back. Moreover, the co-occurrence of the deficiency of the physical activity level recommended by WHO significantly increased the risk of pain complaints. However, it should be highlighted that the number of years in the profession is a factor that is often impossible to eliminate within the prophylaxis of the motor organ, therefore particular attention should be paid to the health-oriented physical activity.

Findings of our study have revealed that regularly performed physical activity can be recommended as an important element in the prevention of musculoskeletal disorders among young musicians. This potential indication has been based on the finding that the musical school students who met standard criteria for the recommended (as beneficial health-oriented) physical activity (especially the ones, engaged in a daily 60 min physical exercise sessions), significantly less often reported complaints of pain, as compared to those, who were less physically active. However, the percentage of students, analyzed in our study, who performed a sufficient physical activity on a regular basis was only 7%. This is drastically low, in comparison to the data from HELENA (Healthy Lifestyle in Europe by Nutrition in Adolescence) project, (investigating physical activity among children and adolescents), which has revealed that 42% of the participants met the recommended physical activity (> 60 min/day) standard. The lack of physical activity (hypokinesia) among children and adolescents is a serious problem, which has now been emphasized worldwide [25–27]. Our findings indicate, that this is especially important among young musicians, who due to their lack of time and fear of contusions may avoid physical exercises. Hypokinesia in combination with repetitive movements and load bearing related to playing practice, represent a huge risk for a development of the musculoskeletal system in young musicians. Due to the fact that the majority of students will continue their professional playing, the awareness of prophylactic role of the recommended physical activity, regularly performed by musical school students during their leisure time, should be promoted.

Study limitations and strengths

The strengths of our study data are related to the use of the standardized measurement tools, and to the study sample, generated from a large urban area, in a highly industrialized part of Central Europe.

One limitation of the study lies in the fact that some subjective methods of physical activity assessment (e.g. study questionnaire) were applied. In the future, more objective measurement tools, monitoring the musculoskeletal system activity such as an accelerometer could be considered.

Implications for further studies

Further studies in this area need to evaluate associations between the level of physical activity and the prevalence of musculoskeletal disorders in different populations, including young musicians of both genders, from public and private schools, in different areas (e.g., urban, rural), as well as among adult and older classical musicians. Since the number of years in the profession of musicians is an important risk factor of neck and back pain, there is also a need for further research, in order to define prevention strategies for musical routines and patterns.

CONCLUSION

1. Pain complaints of the musculoskeletal system are common among young musical school students. In some body parts the risk of their occurrence increases along with the increase of time of playing the instrument.
2. Performing the recommended health-oriented physical activity may reduce the prevalence of musculoskeletal pain in young musicians.
3. In the light of the newest health-oriented physical activity recommendations, the majority of the analyzed study subjects did not achieve their recommended activity level.
4. It is necessary to educate young musicians, their parents and musical school teaching faculty about the importance of performing physical exercises regularly, since this may be an attractive and simple strategy used for prevention of the musculoskeletal system disorders.

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