Medycyna Pracy 2022;73(2):85–93
http://medpr.imp.lodz.pl/en

https://doi.org/10.13075/mp.5893.01230

ORIGINAL PAPER

THE ANGLE OF TRUNK ROTATION AND SYMMETRY OF A LOWER LIMB LOADING IN MUSICIANS OF A SYMPHONY ORCHESTRA IN POLAND: A PILOT STUDY CONCERNING INSTRUMENT-SPECIFIC RESULTS

Antonina Kaczorowska, Magdalena Kornek, Agata Mroczek, Ewelina Lepsy, Alina Radajewska

University of Opole, Opole, Poland
Institute of Health Sciences

Abstract

Background: The study aimed to evaluate the angle of trunk rotation (ATR) and symmetry of lower limb loading in professional musicians. **Material and Methods:** A total of 60 instrumentalists were examined: cellists, violinists and musicians playing wind instruments. The scoliometer examination was used to assess trunk asymmetry. The angle of trunk rotation was measured at segment: Th1–Th4, Th5–Th12, and Th12–L4. The maximum value (ATR max) and the sum of three rotations (STR) were calculated. Two scales were used to assess the symmetry of lower limb loading. Loading symmetry index (LSI) of the lower limb was calculated. **Results:** Violinists have the highest mean values of ATR, ATR max, STR and LSI and musicians playing wind instruments have the lowest mean values. In the group of violinists and musicians playing wind instruments, a positive correlation was found between playing experience and ATR Th1–Th4. **Conclusions:** The body position during playing violin and cello may increase the angle of trunk rotation and the lower limb loading's asymmetry. Med Pr. 2022;73(2):85–93

Key words: occupational diseases, scoliosis, violinists, cellists, angle of trunk rotation, scoliometer

Corresponding author: Antonina Kaczorowska, University of Opole, Institute of Health Sciences, pl. Kopernika 11a, 45-060 Opole, Poland, e-mail: antonina.kaczorowska@uni.opole.pl
Received: November 29, 2021, accepted: February 7, 2022

INTRODUCTION

Dysfunctions and overloads of the musculoskeletal system occur in various professional groups. A highly specialised professional group is represented by musicians who are particularly exposed to various health problems related to the musculoskeletal system [1,2]. During playing an instrument, the body is in a forced position. Forced postures are postures in which the body is not in a natural position and in which tension is caused in different parts of the body. An instrumentalist's work involves daily practice, often many hours, so the period of being in a non-physiological position of the body takes a large part of the day [3,4]. Performing repetitive movements for a long time, engaging the same group of muscles may lead to pathological changes in the musculoskeletal system [5].

The frequent dysfunctions in musicians are postural disorders [6–8]. The trunk's asymmetry in the frontal plane and an increase in the spine's physiological curvature may appear in children and adolescents studying at a music school and in students of higher music schools [9–11]. The long-term assumption of a forced, often asymmetrical position may also disturb posture and balance stability [12]. Stability and postural asymmetry may lead to severe posture disorders, including scoliosis. Due to the different types of musical instruments, defects and postural stability disorders may differ between musicians. Musicians playing asymmetrical instruments such as the violin or the cello seem to be particularly at risk of posture disorders [13,14]. Recent studies confirm the occurrence of musculoskeletal disorders in 80–90% of the musicians [15–17].

Although research on musculoskeletal disorders in musicians is systematically conducted abroad, Poland's research, including Polish instrumentalists, is still limited. The results obtained in studies of instrumentalists from different countries may differ because elements from the psychosocial working environment may influence on the musicians' musculoskeletal problems [18]. Local labour market conditions – such as working hours and sickness allowance – as well as the local health care system and accessibility to health care services may lead to different results between countries. Therefore, it is

worth investigating musculoskeletal disorders in musicians in different countries.

The study aimed to evaluate the trunk rotation and symmetry of lower limb loading in professional Polish musicians, as well as to analyse the relationships between trunk rotation and the symmetry of lower limb loading with the time spent practising, the experience of playing an instrument and basic anthropometric variables.

MATERIAL AND METHODS

Study design and setting

This cross-sectional study was carried out from January to February 2020 in the Opolskie Voivodeship, Poland. The research was conducted at the Opole Philharmonic and the City Hall in Brzeg. The research was an excerpt from research registered on the ISRCTN platform under number 37 451, which has been discontinued since March 2020 due to the COVID-19 pandemic. The research was carried out in accordance with the guidelines of the Declaration of Helsinki and Good Clinical Practice. The Bioethical Commission approved it at the Opole Medical School (permission No. KB/240/FI/2020). All participants gave written informed consent after a thorough explanation of the procedures involved. The STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines were followed [19].

Participants

For the research 79 musicians were qualified, but 19 people withdrew from the study, because it did not respond to the written invitation to the study. Finally total of 60 people were examined (34 women and 26 men), including 40 instrumentalists from the Symphony Orchestra of the Opole Philharmonic Józef Elsner and 20 musicians from the Princely Symphony Orchestra in Brzeg. The inclusion criteria were: 1) status of the professionally active instrumentalist, 2) a minimum 5-year experience in playing the instrument, and 3) voluntary written consent to participate in the study. Exclusion criteria included: 1) infection, 2) acute injury, 3) cancer, 4) pregnancy, and 5) lack of written consent to participate in the study.

The participants were divided into 3 groups: cellists (N = 20), violinists (N = 20), and musicians playing wind instruments (N = 20). The wind instruments included musicians playing the trombone (N = 3), clarinet (N = 3), bassoon (N = 3), flute (N = 1), French horn (N = 4), trumpet (N = 5) and horn (N = 1). The mean age of cellists was 33.20±11.95 years, violinists 33.20±13.15 years and musicians playing wind instruments – 31.10±13.77 years.

Measurement tools

The scoliometer examination with a combination of the *Adams Forward Bending Test* was used to assess trunk asymmetry. This tool was chosen because of its good specificity, sensitivity, and predictive capability (correlation with the radiographic analysis $r = 0.7$ with $p < 0.05$ [20]. The scoliometer has good repeatability and reproducibility of measurements [21]. During the examination the researcher did not know which instrument the examined musician was playing.

Participants were in a standing position with the lower limbs extended and the trunk leaning forward. The trunk flexion movement started with pulling the chin towards the chest, the clasped hands between the feet. The scoliometer was applied without pressure across the long axis of the spine at 3 levels – thoracic proximal (Th1–Th4), thoracic main (Th5–Th12), and thoracolumbar (Th12–L4) [22]. The measured angle of trunk rotation (ATR) was interpreted according to Bunnel's recommendations [23,24]:

- 0–3° – the limit of the norm, physiological rotation of the trunk,
- 4–6° – a intermediate values, suspected rotation,
- ≥7° – scoliosis.

The trunk rotation's maximum value was calculated for each participant, taking into account the highest score from each level of the spine (ATR max). Then, the sum of three rotations (STR) was calculated, indicating the global trunk deformation, by summing the maximum values of the angle of trunk rotation at 3 levels according to the algorithm, depending on the direction of trunk rotation at individual levels [25].

In order to assess the body weight distribution and symmetry of lower limb loading, a test of 2 scales was performed. The subject was in a standing position, with their feet evenly spaced on 2 scales standing next to each other, with the upper limbs lowered along the body and the eyes directed straight ahead. The measurement was performed on an electronic scale with an accuracy of 0.1 kg. The loading symmetry index (LSI) was calculated as the quotient of the greater to the lower value based on the obtained data. The correct value is in the range 1.00–1.15 [26].

In addition, body weight and height were measured, and the BMI was calculated. The research was supplemented by questions about the number of hours of

Table 1. Descriptive statistics of age and anthropometric variables for instrumentalists from Symphony Orchestra of the Opole Philharmonic Józef Elsner and the Princely Symphony Orchestra in Brzeg, study carried out in January–February 2020, in the Opolskie Voivodeship, Poland

Variable	Cellists (N = 20)		Violinists (N = 20)		Wind instrumentalists (N = 20)	
	M±SD	Me (IQR)	M±SD	Me (IQR)	M±SD	Me (IQR)
Age [years]	33.20±11.95	29.50 (20.50)	33.20±13.15	33.50 (8.00)	31.10±13.77	25.00 (18.00)
Body height [cm]	169.75±6.99	170.00 (9.00)	167.85±8.38	168.00 (8.00)	175.50±9.23	177.00 (9.50)
Body mass [kg]	68.60±17.03	61.50 (16.00)	61.40±14.88	58.00 (19.50)	79.25±12.80	83.00 (13.50)
BMI [kg/m^2]	23.62±4.82	22.45 (3.59)	21.59±3.82	20.43 (4.22)	25.62±3.25	25.72 (4.52)

IQR – interquartile range.

practice per week and the experience (number of years playing an instrument).

Statistical methods

The obtained data was encoded and transferred to MS Office Excel 2017 and then subjected to statistical analysis using Statistica version 13.3 (TIBCO Inc., Tulsa, USA).

Descriptive statistics were calculated – mean (M), median (Me), standard deviation (SD) and interquartile range (IQR). The distribution of the variables was assessed in terms of normality using the Shapiro-Wilk test. Non-parametric methods were used. The results of qualitative scales in the analyzed groups were compared by χ^2 Pearson's test. The Kruskal-Wallis ANOVA rank test and Dunn's *post hoc* test were used to assess the significant differences between the 3 groups formed by the instrument type. Spearman's rank correlation was used to assess the relationship between somatic variables, angle of trunk rotation, maximum rotation, the sum of three rotations, symmetry of lower limb loading with the number of hours playing per week and experience of playing. The level of $p \leq 0.05$ was adopted for the assessment of statistical significance.

RESULTS

Descriptive data

The participants (N = 60) were divided into 3 groups: cellists (N = 20), violinists (N = 20) and musicians playing wind instruments (N = 20). The mean age in the individual groups was similar. The mean values of BMI in the groups of violinists and cellists are within the normal range, while the BMI of the group of musicians playing wind instruments is within the lower limit of overweight. The age and anthropometric variables of the participants were presented in Table 1.

Main results

In assessing the differences between the groups of musicians in terms of the variables: experience in playing an instrument, number of hours practising per week, the values of ATR max and ATR measurements at individual spine levels and LSI, the following results were recorded.

In relation to the ATR max results, a result of scoliosis was noted in 10% of cellists and as many as 70% of violinists, while in the group of musicians playing wind instruments, none of the respondents had scoliosis. Intermediate values of trunk rotation (suspected rotation) occurs in 80% of cellists, 30% of violinists, and 20% of musicians playing wind instruments. Normal spine without rotation was found in 80% of wind instrument musicians and 10% of cellists, while none of the violinists achieved normal ATR max (Table 2).

The highest ATR score at individual levels were obtained in the group of violinists in the Th1–Th4 vertebrae in 65% of musicians and the Th12–Th4 vertebrae in 50% of musicians (Table 2).

The LSI index within the normal range was found in 85% of musicians playing wind instruments, 25% of cellists and 5% of violinists (Table 3).

The highest average score and the median ATR at each level of the spine, ATR max, STR and LSI were obtained in the violinist's group, while the lowest in the group of musicians playing wind instruments. The differences between the results of all groups of musicians were statistically significant. The mean LSI score in the violinist's group was outside the normal range (Tables 4 and 5).

Statistically significant differences were found with regard to the number of hours playing per week. Cellists spent an average of 25 h a week playing an instrument, violinists 33.4 h and musicians playing symmetrical instruments 20 h. The difference between the scores of violinists and musicians playing symmetrical instruments

Table 2. The angle of trunk rotation (ATR) depending on the spine section and trunk rotation's maximum value across instrumental groups from Symphony Orchestra of the Opole Philharmonic Józef Elsner and the Princely Symphony Orchestra in Brzeg, study carried out in January–February 2020, in the Opolskie Voivodeship, Poland

Variable	Participants [n (%)]			p*
	ATR 0–3°	ATR 4–6°	ATR ≥7°	
Vertebrae				
Th1–Th4				**<0.001**
cellists	11 (55)	9 (45)	0 (0)	
violinists	0 (0)	7 (35)	13 (65)	
wind instrumentalists	19 (95)	1 (5)	0 (0)	
Th5–Th12				**<0.001**
cellists	8 (40)	10 (50)	2 (10)	
violinists	2 (10)	11 (55)	7 (35)	
wind instrumentalists	19 (95)	1 (5)	0 (0)	
Th12–L4				**<0.001**
cellists	9 (45)	10 (50)	1 (5)	
violinists	3 (15)	7 (35)	10 (50)	
wind instrumentalists	17 (85)	3 (15)	0 (0)	
ATR max				**<0.001**
cellists	2 (10)	16 (80)	2 (10)	
violinists	0 (0)	6 (30)	14 (70)	
wind instrumentalists	16 (80)	4 (20)	0 (0)	

* p-value of Pearson's χ^2, significant difference ($p \leq 0.05$) denoted in bold.

Table 3. The range of the loading symmetry index (LSI) across instrumental groups from Symphony Orchestra of the Opole Philharmonic Józef Elsner and the Princely Symphony Orchestra in Brzeg, study carried out in January–February 2020, in the Opolskie Voivodeship, Poland

Variable	Participants [n (%)]		p*
	LSI ≤1.15	LSI >1.15	
Instrumental group			**<0.001**
cellists	5 (25)	15 (75)	
violinists	1 (5)	19 (95)	
wind instrumentalists	17 (85)	3 (15)	

* p-value of Pearson's χ^2, significant difference ($p \leq 0.05$) denoted in bold.

was statistically significant. Violinists spent significantly more time playing than musicians playing symmetrical instruments (Tables 4 and 5).

Cellists had an average experience of 24.15 years, violinists 25.95 years, and musicians playing symmetrical instruments 18.35 years. The differences in the length of professional experience between musicians' groups were not statistically significant (Table 4).

No statistically significant relationships were found between the time spent playing per week and ATR on individual sections of the spine, ATR max, STR and LSI in any group of musicians. In the group of violinists and musicians playing wind instruments, a positive correlation was found between playing experience on the instrument and ATR Th1–Th4 (Table 6).

In the group of cellists, negative correlations were found between body height and weight and ATR Th12–L4 and LSI, between body weight and STR, and between BMI and ATR Th5–Th12 and ATR Th12–L4. In the group of musicians playing wind instruments, positive relationships were found between body height and weight and ATR Th1–Th4 (Table 6).

DISCUSSION

Key results and interpretation

The study aimed to assess the trunk rotation and symmetry of lower limb loading in professional musicians playing various instruments. The conducted research results showed that the group of violinists was the most

exposed to the occurrence of permanent trunk rotations. Trunk rotation values indicative of scoliosis were found in 70% of them, and only in 5% of violinists, the symmetrical lower limb loading was found.

Among violinists, the highest values in the angle of trunk rotation in each section of the spine, the sum of three rotations and the lower limb loading asymmetry were observed. Musicians playing wind instruments have the lowest results of the measured variables. The percentage of musicians with trunk rotation indicative of scoliosis and asymmetry of lower limb loading was the highest among violinists, lower among cellists, and the lowest among musicians playing wind instruments. Greater trunk asymmetry in violinists may be associated with a forced position during playing. In violinists, the left upper limb is raised when playing and holding the instrument. Playing the violin requires extreme outer shoulder rotation, shoulder lift, and constant max left forearm inversion. Contrary to the left limb, the right upper limb's range of motion is wide [4,27].

Physical exertion such a maintaining a sitting position by the violinist during playing is a significant discomfort factor due to the increase in the static loading. Chairs usually do not have the possibility of individual adjustment; that is because a forced posture or position must be held throughout the exertion of playing the violin [4]. The cellists also play in a sitting position. The cello's body is placed between the musician's knees while the fingerboard is on the head's left side. The position of the finger and grip are similar to playing the violin [27].

Playing for many hours string instruments, especially the violin, often in forced positions, may cause static loads and increase the trunk rotation or asymmetry of the lower limb loading and contribute to scoliosis.

Research also shows that violinists spend more hours practising than other instrumentalists – cellists and musicians playing symmetrical wind instruments. Perhaps a greater number of hours of playing an asymmetric instrument negatively affects the body posture and asymmetry of lower limb loading.

With regard to the occurrence of trunk asymmetry, the authors' results correspond to previous reports. Other researchers also obtained similar results. Music students demonstrate a twofold higher risk of developing musculoskeletal problems in comparison to non-music students [7]. The research on the asymmetry of posture was conducted among students of a music conservatory in Italy. All instruments were classified

Table 4. Statistical characteristics of the angle of trunk rotation (ATR), the sum of three rotations (STR), the loading symmetry index (LSI) and the time spent on playing across instrumental group from Symphony Orchestra of the Opole Philharmonic Józef Elsner and the Princely Symphony Orchestra in Brzeg, study carried out in January–February 2020, in the Opolskie Voivodeship, Poland

Variable	Me (IQR)	p*
Vertebrae ATR [°]		
Th1–Th4		**<0.001**
cellists	3.00 (1.50)	
violinists	7.00 (3.00)	
wind instrumentalists	1.00 (1.50)	
Th5–Th12		**<0.001**
cellists	4.5 (2.00)	
violinists	6.00 (2.50)	
wind instrumentalists	1.00 (1.00)	
Th12–L4		**<0.001**
cellists	4.00 (2.00)	
violinists	6.50 (4.50)	
wind instrumentalists	2.00 (2.50)	
ATR max [°]		**<0.001**
cellists	5.00 (1.50)	
violinists	8.00 (4.00)	
wind instrumentalists	3.00 (1.00)	
STR [°]		**<0.001**
cellists	9.50 (7.50)	
violinists	19.00 (11.00)	
wind instrumentalists	4.00 (2.50)	
LSI		**<0.001**
cellists	1.13 (0.60)	
violinists	1.16 (0.06)	
wind instrumentalists	1.05 (0.07)	
Practising [h/week][a]		**0.019**
cellists	28.00 (15.00)	
violinists	42.00 (18.00)	
wind instrumentalists	20.00 (16.00)	
Experience [years][b]		0.073
cellists	20.50 (19.00)	
violinists	26.50 (15.00)	
wind instrumentalists	13.50 (16.50)	

IQR – interquartile range.
* p-value of Kruskal-Wallis one-way analysis of variance; significant difference ($p \leq 0.05$) denoted in bold.
[a] Number of hours playing an instrument per week.
[b] Experience in playing an instrument in years.

Table 5. Pairwise comparisons using Dunn *post hoc* test, by instrument specialisation from Symphony Orchestra of the Opole Philharmonic Józef Elsner and the Princely Symphony Orchestra in Brzeg, study carried out in January–February 2020, in the Opolskie Voivodeship, Poland

Variable	Cellists (N = 20)	Violinists (N = 20)	Wind instrumentalists (N = 20)
Vertebrae angle of trunk rotation (ATR) [°]			
Th1–Th4			
cellists		**<0.001**	**<0.001**
violinists	**<0.001**		**<0.001**
wind instrumentalists	**<0.001**	**<0.001**	
Th5–Th12			
cellists		**0.037**	**<0.001**
violinists	**0.037**		**<0.001**
wind instrumentalists	**<0.001**	**<0.001**	
Th12–L4			
cellists		**<0.001**	**0.004**
violinists	**<0.001**		**<0.001**
wind instrumentalists	**0.004**	**<0.001**	
ATR max [°]			
cellists		**<0.001**	**<0.001**
violinists	**<0.001**		**<0.001**
wind instrumentalists	**<0.001**	**<0.001**	
Sum of three rotations (STR) [°]			
cellists		**<0.001**	**0.001**
violinists	**<0.001**		**<0.001**
wind instrumentalists	**0.001**	**<0.001**	
Loading symmetry index (LSI)			
cellists		**0.014**	**<0.001**
violinists	**0.014**		**<0.001**
wind instrumentalists	**<0.001**	**<0.001**	
Practicing [h/week]			
cellists		0.123	0.552
violinists	0.123		**0.010**
wind instrumentalists	0.552	**0.010**	

Bolded are significant differences with $p < 0.05$.

as asymmetric or symmetrical. The study showed that playing an asymmetric instrument exposed musicians to postural disorders [6].

Rensing et al. [8] showed that asymmetric posture while playing an instrument and the related muscle activity and joint mobility contribute to problems with the musculoskeletal system in violinists and violists. Ohlendorf et al. [28] examined the body position during playing in professional violinists and violists. They showed that playing the instrument changes the static sitting position through increased trunk rotation, specific shoulder adaptation with little effect on the pelvis. Such forced position can cause chronic health effects.

The study aimed to analyse the relationships between the trunk rotation and symmetry of lower limb loading with the time practising per week, professional experience in playing the instrument and somatic variables. There were no statistically significant relationships

Table 6. Spearman's rank correlation coefficients by instrumental group from Symphony Orchestra of the Opole Philharmonic Józef Elsner and the Princely Symphony Orchestra in Brzeg, study carried out in January–February 2020, in the Opolskie Voivodeship, Poland

Variable	ATR			ATR max	STR	LSI
	Th1–Th4	Th5–Th12	Th12–L4			
Cellists						
body height	–0.109	–0.136	**–0.454**	–0.342	–0.308	**–0.465**
body mass	–0.116	–0.368	**–0.537**	–0.430	**–0.449**	**–0.509**
BMI	0.019	**–0.477**	**–0.526**	–0.442	–0.428	–0.434
practicing[a]	–0.076	0.018	0.300	0.176	0.084	0.197
experience[b]	0.282	–0.344	–0.212	–0.221	–0.243	–0.291
Violinists						
body height	0.007	–0.265	–0.051	–0.133	–0.102	0.032
body mass	0.152	–0.119	0.032	0.026	0.003	0.205
BMI	0.349	0.075	0.165	0.274	0.191	0.375
practicing[a]	0.371	0.091	0.233	0.337	0.173	0.255
experience[b]	**0.459**	0.220	0.257	0.300	0.248	0.329
Wind instrumentalists						
body height	**0.449**	0.190	0.333	0.322	**0.504**	0.282
body mass	**0.459**	0.152	0.275	0.297	0.311	0.151
BMI	0.297	0.004	0.065	0.063	0.035	–0.033
practicing[a]	–0.115	0.004	–0.093	–0.063	–0.094	–0.160
experience[b]	**0.539**	0.227	0.034	0.397	0.269	0.385

ATR – angle of trunk rotation, LSI – loading symmetry index, STR – sum of three rotations.
[a] Number of hours playing an instrument per week.
[b] Experience in playing an instrument in years.
Bolded are significant differences with $p < 0.05$.

between the time spent playing weekly with the trunk rotation and symmetry of lower limb loading in any group of musicians. On the other hand, a positive relationship was observed between the experience of playing the instrument and ATR Th1–Th4 among violinists and musicians playing wind instruments. It has been observed that the longer the professional experience of playing an instrument, then the greater the angle of trunk rotation in the proximal thoracic section. Several negative relationships were found between the somatic variables and the trunk rotation and lower limb loading asymmetry in the group of cellists. The cello is a large and heavy instrument. Holding the cello while playing causes a high static load on the musculoskeletal system. Therefore, in musicians with lower height, weight and BMI, the trunk rotation and lower limb loading asymmetry may be greater.

Few of the other researchers have also observed the relationship of postural disorders among musicians with the experience of playing an instrument. Research by Ramella et al. [6] among the Music Conservatory students in Milan showed that the years of playing an instrument were significantly associated with posture disorders among students.

As asymmetry of posture can lead to serious posture disorders, preventive measures to improve symmetry and stability of posture in instrumentalists' education should be considered. Future research into the epidemiology of musculoskeletal disorders in musicians should focus on related risk factors and the prevention of instrument playing-related problems.

Limitations

The manuscript has some limitations. A small number of musicians were examined. The research sample included participants who volunteered to participate in the study. Research involving volunteers always carries the risk that they are often people with greater awareness or openness to experience, which can potentially affect the results obtained. Moreover, musicians who already had health problems related to playing

an instrument could be interested in taking part in the research [16]. Therefore, when interpreting the results, it is worth remembering that they only approximate musicians' situation in this region of Poland. The next limitation of the study is the lack of a medical history of instrumentalists. The authors don't know exactly in which lifecycle scoliosis developed.

Also the examination of the trunk rotation with a scoliometer may be subject to a measurement error, and the examination of the distribution of body weight with the 2-weight test gives only basic results. A more precise method would be the examination with a stabilometric platform and a computer system for examining body posture. There was no control group in the study. Future research should include the group of subjects with similar characteristics but not playing any instruments. In addition, when analysing the factors causing the asymmetry of the posture, the focus was on the instrument type. More research is needed to consider a much larger number of musicians and analyse other risk factors for the occurrence of musculoskeletal disorders, such as gender, overweight and obesity, levels of physical activity and stress.

Practical implications

Identification of risk factors for the occurrence of musculoskeletal disorders among professional musicians will allow the development of prevention strategies and interventions. Early intervention can minimise the risk of severe postural disorders in musicians.

CONCLUSIONS

1. Forced while playing, musicians' body position, especially violinists, increases the angle of trunk rotation and increases the asymmetry of lower limb loading.
2. There were moderate positive relationships between the length of experience with the angle of trunk rotation in the proximal thoracic segment among violinists and wind musicians.
3. In order to minimize the musculoskeletal system disorders in professional musicians, the therapy should include physical exercises to strengthen and stretch the muscles of the trunk and limbs, as well as manual therapy and massage treatments.
4. More research is needed, involving many people and analysing various risk factors for developing posture disorders and asymmetry among professional musicians.

ACKNOWLEDGEMENTS

The authors would like to thank the musicians for their contribution in this research.

REFERENCES

1. Nawrocka A, Mynarski W, Powerska A, Grabara M, Groffik D, Borek Z. Health-oriented physical activity in prevention of musculoskeletal disorders among young Polish musicians. Int J Occup Med Environ Health. 2014;27(1): 28–37. https://doi.org/10.2478/s13382-014-0224-5.
2. Hinkamp DL, McCann M, Babin A. Occupational Health and the Arts. J Occup Environ Med. 2017;59(9):835–842. https://doi.org/10.1097/JOM.0000000000001027.
3. Janiszewski M, Gałuszka G, Ochwanowska A, Gąciarz A, Hak A, Ochwanowski P, et al. [Biomechanical analysis of dynamic and static of the motion organ in instrumentalist]. Med Pr. 2005;56(1):25–33. Polish.
4. De Souza Moraes GF, Papini Antunez A. Musculoskeletal disorders in professional violinists and violists. Systematic review. Acta Ortop Bras. 2012;20(1):43–47. https://doi.org/10.1590/S1413-78522012000100009.
5. Paarup HM, Baelum J, Holm JW, Manniche C, Wedderkopp N. Prevalence and consequences of musculoskeletal symptoms in symphony orchestra musicians vary by gender: a cross-sectional study. BMC Musculoskelet Disord. 2011;12:223. https://doi.org/10.1186/1471-2474-12-223.
6. Ramella M, Fronte F, Converti RM. Postural disorders in conservatory students: the Diesis project. Med Probl Perform Art. 2014;29(1):19–22. https://doi.org/10.21091/mppa.2014.1005.
7. Steinmetz A. Muskuloskeletale Funktionsstörungen bei professionellen Musikern. Manuelle Medizin. 2015;53: 1316. German.
8. Rensing N, Schemmenn H, Zalpour C. Musculoskeletal Demands in Violin and Viola Playing: A Literature Review. Med Probl Perform Art. 2018;33(4):265. https://doi.org/10.21091/mppa.2018.4040.
9. Wilk K. Posture defects of students in grades 1–4 of music oriented classes in Primary School Complex no. 2 in Szczecin. Centr Eur J Sport Sci Med. 2013;4(4):39–51.
10. Handlich R. Proper and incorrect body posture in students from music school. J Educ Health Sport. 2017;7(2):562–584.
11. Barczyk-Pawelec K, Sipko T, Demczuk-Włodarczyk E, Boczar A. Anterioposterior spinal curvatures and magnitude of asymmetry in the trunk in musicians playing the violin compared with nonmusicians. J Manipulative Physiol Ther. 2012;35(4):319–26. https://doi.org/10.1016/j.jmpt.2012.04.013.

12. Nusseck M, Spahn C. Comparison of Postural Stability and Balance Between Musicians and Non-musicians. Front Psychol. 2020;11:1253. https://doi.org/10.3389/fpsyg.2020.01253.
13. Heming MJE. Occupational injuries suffered by classical musicians through overuse. Clin Chiropr. 2004;7(2):55–66. https://doi.org/10.1016/j.clch.2004.02.008.
14. Jacukowicz A, Wężyk A. [Musculosceletal, hearing and skin problems related to playing the instrument]. Med Pr. 2018;69(4):383–394. https://doi.org/10.13075/mp.5893.00688. Polish.
15. Joubrel I, Robineau S, Pétrilli S, Gallien P. Musculoskeletal disorders in instrumental musicians: epidemiological study. Ann Readapt Med Phys. 2001;44(2):72–80. https://doi.org/10.1016/s0168-6054(00)00063-5. French.
16. Ajidahun AT, Mudzi W, Wood WA, Myezwa H. Musculoskeletal problems among string instrumentalists in South Africa. S Afr J Physiother. 2017;73(1):e327. https://doi.org/10.4102/sajp.v73i1.327.
17. Gómez-Rodríguez R, Díaz-Pulido B, Gutiérrez-Ortega C, Sánchez-Sánchez B, Torres-Lacomba M. Prevalence, Disability and Associated Factors of Playing-Related Musculoskeletal Pain among Musicians: A Population-Based Cross-Sectional Descriptive Study. Int J Environ Res Public Health. 2020;17(11):3991. https://doi.org/10.3390/ijerph17113991.
18. Johansson YL, Theorell T. Satisfaction with work task quality correlates with employee health. Med Probl Perform Art. 2003;18(4):141–149. https://doi.org/10.21091/mppa.2003.4025.
19. Von Elm E, Altman DG, Egger M, Pocock S, Gøtzsche PC, Vandenbroucke JE. Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335(7624):806–808. https://doi.org/10.1136/bmj.39335.541782.AD.
20. Coelho DM, Bongamba GH, Oliveira AS. Scoliometer measurements of patient with idiopatihic scoliosis. Braz J Phys Ter. 2013;17:179–184. https://doi.org/10.1590/S1413-35552012005000081.
21. Fine NF, Stokes OM. Clinical examination of the spine. Surgery (Oxf.). 2018;36:357–361. https://doi.org/10.1016/j.mpsur.2018.04.002.
22. Adamczewska K, Wiernicka M, Michałowski M, Furmaniuk L, Goliwąs M, Flis-Masłowska M, et al. Angle of trunk rotation in 10 year old primary school children in Poznań. Pol J Physiother. 2017;3(17):96–102.
23. Bunnell W. Outcome of Spinal Screening. Spine 1993;18:1572–1580. https://doi.org/10.1097/00007632-199309000-00001.
24. Bunnell W. Selective screening for scoliosis. Clin Orthop Relat Res. 2005;434:40–4. https://doi.org/10.1097/01.blo.0000163242.92733.66.
25. Kotwicki T, Kinel E, Chowańska J, Bodnar-Nanuś A. [POTSI, Hump Sum and Sum of Rotation – new surface topography parameters for evaluation of scoliotic deformity of the trunk]. Fizjoter Pol. 2008;8(3):231–240. Polish.
26. Czesak J, Szczygiel A, Żak M. [Effects of physiotherapy on the loading symmetry index (LSI) in patients over 65 years old – pilot study]. Gerontol Pol. 2011;19(3–4):171–175. Polish.
27. Lee HS, Park HY, Yoon JY, Kim JS, Chun JM, Aminata IW, et al. Musicians' Medicine: Musculoskeletal Problems in String Players. Clin Orthop Surg. 2013;5(3):155–160. https://doi.org/10.4055/cios.2013.5.3.155.
28. Ohlendorf D, Marx J, Clasen K, Wanke EM, Kopp S, Groneberg DA, et al. Comparison between the musician-specific seating position of high string bow players and their habitual seating position – a video raster stereographic study of the dorsal upper body posture. J Occup Med Toxicol. 2018;6:13:34. https://doi.org/10.1186/s12995-018-0217-6.

Publisher: Nofer Institute of Occupational Medicine, Łódź, Poland