

Playing-related musculoskeletal disorders among violin players – a cross-sectional study

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Abstract

Background: Playing-related musculoskeletal disorders (PRMD) are an often-reported problem in the literature. PRMD are usually defined as pain, numbness, weakness, paresthesia, or other feelings affecting the musician's performance.

Aims: The study aimed to assess the epidemiology of PRMD among violin players in relation to their age, sex, and experience. Additionally, the analysis covered prevention strategies.

Material and methods: A total of 70 musicians (Me 24 years, IQR 18-30) were enrolled in the study (with an advantage of women – 83%). The study was carried out with an online questionnaire based on the modified Standardized Nordic Questionnaires for the Analysis of Musculoskeletal Symptoms (SNQ). The questionnaire was equipped with additional questions regarding the prevention strategies used by the respondents.

Results: The majority of the respondents (53 people, 76%) confirmed to have sustained a PRMD in the period of the last 12 months. Reported PRMD were significantly related with sex (women at higher risk) and specific body locations such as the cervical and lumbar spine, as well as shoulder joints/arms. They did not correlate with the inability to carry out day-to-day activities but had an effect on musical performance ($p < 0.001$). Most of the respondents with PRMD resorted to the help of a medical specialist, of which physiotherapist was found to be highly effective according to their subjective assessment.

Conclusion: PRMD constitute a serious problem among violin players. Physiotherapy plays an important role in minimizing the effects of PRMD.

Key words

physiotherapy,
pain, prevention,
injury, PRMD.

Introduction

Playing-related musculoskeletal disorders (PRMD) are an often-reported problem by professional musicians [1]. PRMD is defined as a feeling of any pain, weakness, numbness, paresthesia, or any other sensations that may affect the ability to play an instrument at the usual level for the musician [2].

The symptoms may be limited to a low-intensity painful discomfort associated with a burning or weakness sensation. However, it can also present as a chronic, long-lasting condition that makes it impossible to play the instrument. Playing the violin at a high level requires musicians to start their training at the early stages of their life. It is associated with many high-stress situations related to public performances. Studies show that PRMD are likely to appear even at the beginning of the training process [3, 4].

Playing the string instruments forces musicians to constantly repeat the same set of motions, spending hours holding a heavy instrument while maintaining an asymmetrical body posture and dealing with technical difficulties accompanying the musical piece. All of that combined is likely to have an adverse effect on the upper limbs, cervical and lumbar spine [5]. Unfortunately, the number of available studies on PRMD does not allow currently to prepare an efficient prevention programme for violin players (professionals and amateurs) [6].

Aims

The aim of the following study was to assess the scale of the PRMD problem (within the last 12 months) among professional and amateur violin players in relation to their age, sex, PRMD location, experience (years), training frequency (days/week, hours/day) and their daily activities. Additional aim included the prevention strategies undertaken by the study subjects to minimize the effect of PRMD.

Material and methods

The following cross-sectional study was conducted with the use of a modified Standardized Nordic Questionnaire for the Analysis of Musculoskeletal Symptoms (SNQ) online questionnaire. The SNQ was supplemented with additional questions related to accompanying diseases and prevention interventions used by the respondents. SNQ (1987) was established by Kuorinka et al. [7] as a questionnaire to be filled out independently by respondents all around the globe, used to assess the epidemiology of PRMD in terms of safety and health within the workplace. The questionnaire addresses nine anatomical regions (3 within the upper limbs, 3 – in the lower limbs, and 3 of the central body part). Respondents are asked whether they experienced PRMD during the last 12 months and/or seven days which had affected their abilities to play the violin and/or their daily function. According to studies, SNQ presents high compliance with the functional clinical assessment [7]. Therefore, the authors decided to use a 12-month period for further analysis.

The SNQ was expanded with questions on age, sex, professional status, and violin experience. In addition, if the respondent confirmed PRMD within the last 12 months, he/she was asked to answer additional questions about their general health status and prevention strategies that were used.

The questionnaire was prepared using Microsoft Forms (Microsoft 365, Microsoft Corporation, Redmond, WA). The URL address to the questionnaire was delivered to an online group that brings together violin players at different levels of advancement, which is operational through social media. The group aims to exchange experiences on violin playing in relation to particular musical pieces, the playing technique, and the instrument itself.

The main inclusion criteria of the study were the ability to play the violin (according to the respondent) as well as the consistency of the data

(only complete questionnaires were accepted). Exclusion criteria included insufficient experience with violin (less than a year) and missing or conflicting data within the questionnaire. A total of 71 filled questionnaires were collected. The group mainly comprised younger individuals (Me 24 years, IQR 18-30) with a substantial advantage of women (83% of the group, Me=24, IQR 18-30) over men (17%, Me 19, IQR 17-32). Most of the study subjects identified themselves as professional musician or a pupil (24 people/34% and 22/31%, respectively). The rest of the group was classified as a student (15/21%) or other (i.e., amateur, handworker, 10/14%).

Analysis was performed with the use of Statistica 12 (TIBCO Software, StatSoft, Palo Alto, CA) and Microsoft Excel (Microsoft Office 365, Microsoft Corporation, Redmond, WA). Due to the abnormal character of the data (Shapiro-Wilk test), statisti-

cal data is presented with the use of median (Me), first and third quartile (Q₁-Q₃). Description of additional symptoms was presented with a mean (M), minimum (min), maximum (max), and standard deviation (SD). The relation between the data was verified with the chi² test. Values of p < 0.05 were considered to be statistically significant.

Results

A total of 54 respondents (76% of the study group) confirmed that they had experienced PRMD within the last 12 months that preceded the questionnaire. Groups with and without a PRMD did not differ in terms of their age. There was, however a difference in relation to the sex of the respondents and the reported PRMD incidence (p<0.001). The group with PRMD mostly contained women (85% reported disorders in comparison to 33% in the men group) (Table 1).

Table 1. Characteristics of the study group.

	Prevalence of playing-related musculoskeletal disorders (PRMD) within the last 12 months		p
	Yes (n=54)	No (n=17)	
Age (Me, Q ₁ -Q ₃) [years]	22.5; 18-29	28; 21-32	0.173
Sex (M/W)	33% / 85%	67% / 15%	<0.001
Violin experience (Me, Q ₁ -Q ₃) [years]	14; 9-22	22; 15-25	0.075

Abbreviations: Me, median; Q₁-Q₃, first and third quartile; M / W, men/women.

Disorders were mainly reported in groups of inexperienced players still under training (everybody from the student group and 81% from the pupil group) or amateur musicians (80% of respondents from this subgroup). Most respondents declared

to have been playing violin every day (49%, n=35) or 3-4 times a week (24%, n=17). The differences were not statistically relevant (p=0.065). There was also no dependence between the intensity of the training (hours playing violin per day, p=0.393)

nor the experience playing the violin (days playing the violin per week, $p=0.552$)

Respondents were significantly more likely to report PRMD located in the area of the spine (cervical and lumbar) and shoulder joints/arms. Therefore, players were allowed to indicate more than one location (**Table 2**).

According to the respondents, the reported PRMD problems (last 12 months) affected their violin performance but did not have a direct impact on activities of daily living or other activities specific to particular individuals ($p<0.001$). Problems reported by the study subjects had been identified to appear with similar frequency during the violin performance/training and out of it. General health status, assessed subjectively by the questioned violin players, was established

as good – in a scale of 1-5 (whereas 1 – very bad, 5 – very good); a mean score for the group with PRMD was 3.7 (1-5, SD 0.9).

Additionally, the respondents were asked about the accompanying symptoms which might have been observed by them in the last 12 months preceding the questionnaire. The potential symptoms contained numbness, paresthesia, muscle weakness, decreased range of motion, lack of concentration, and difficulty carrying out precise movements. All symptoms were assessed on a Likert scale of 1-5 (1 – no problem, 5 – very severe). Respondents from the PRMD group were more likely to report additional symptoms than the lack of them ($p<0.001$). Difficulty in performing precise movements, paresthesia, and muscle weakness were the most common symptoms to be reported (**Table 3**).

Table 2. Location of playing-related musculoskeletal disorders as reported by the respondents in the last 12 months.

PRMD – location	Prevalence of playing-related musculoskeletal disorders (PRMD) within the last 12 months		p
	Yes N*/%	No N*/%	
Cervical spine	40 / 74.1%	14 / 25.9%	<0.001
Thoracic spine	32 / 59.3%	22 / 40.7%	0.053
Lumbar spine	36 / 66.7%	18 / 33.3%	0.001
Shoulder joints/arms	38 / 70.4%	16 / 29.6%	<0.001
Elbow joints/forearm	18 / 33.3%	36 / 66.7%	0.001
Wrist/hands	32 / 59.3%	22 / 40.7%	0.053
Hip joints/thigh	13 / 24.1%	41 / 75.9%	<0.001
Knee joints/lower legs	6 / 11.1%	48 / 88.9%	<0.001
Ankle joint/feet	3 / 5.6%	51 / 94.4%	<0.001

Abbreviations: N, number of answers.

Table 3. Additional symptoms accompanying playing-related musculoskeletal disorders as reported by the respondents.

Symptom	N	M	Me	Min	Max	SD
Numbness	54	1.2	1	0	4	1.4
Paresthesis	54	2.7	3	0	5	1.6
Muscle weakness	54	2.2	2	0	5	1.5
Decreased range of motion	54	1.9	1.5	0	5	1.8
Lack of concentration	54	1.8	2	0	5	1.6
Difficulty in performing precise movements	54	2.6	3	0	5	1.8

Abbreviations: N, number of answers; M, mean; Me, median; SD, standard deviation.

The final step of the study was to analyze the PRMD prophylactic measures undertaken by the questioned violin players. The most common interventions (respondents could choose more than one) included stretching exercises (46% of the injured group) and gym/fitness (22%). At the same time, more than 1 in 5 players reported no physical activity or treatment plan. Following the PRMD onset, respondents from the injury group mostly choose interventions such as: rest (not playing the violin, 72%), stretching (55.5%), and OTC drugs (*over the counter*, 18.5%). The majority of the respondents (63%) are looking for help among the medical professions (physician, physiotherapist, masseuse) as the PRMD exacerbate ($p=0.007$). Medical professions that violin players usually searched for include mainly physiotherapists and orthopedists (chosen by 43% and 33% of the PRMD group, respectively). These choices were followed by masseurs and neurologists (30% and 17%, respectively). According to the opinion of those who decided to use the above mention medical assistance – physiotherapists and masseurs were the most efficient professions (satisfaction rates for them were 87 and 100%, accordingly). On the other hand, positive feedback for orthopedists and neurologists was lower (50 and 33.5%).

Discussion

The following study, as well as the available scientific literature, confirm that violin players (both professional and amateur) are a group associated with a high risk of PRMD [1, 6, 8]. In our study group, a total of 76% of the respondents, mainly women, were affected by this problem. Paarup et al. [9] reported that 97% of the studied women suffered from PRMD within the last 12 months and 86% in the last week (in comparison to men, the results were 83 and 67%, respectively). According to Dawson, the difference between women and men may be associated with various factors. Some of these include smaller muscle mass and size of the hands in comparison to men. The author believes this may lead to a faster overload, depending on the size of the instrument. These factors may affect muscle endurance and strength, disrupting musical performance [10].

Additionally, women are more likely to have joint hypermobility, which is mentioned as one of the risk factors associated with violin players. The difference in pain susceptibility (between men and women) was appointed as another crucial risk factor for PRMD. This may be associated with differential hormone activity in men and women and the sociocultural belief that pain is gener-

ally a concern for women. The belief associated with the fact that they are given a wider social approval for admitting and experiencing a variety of health issues [11].

PRMD prevalence, within the last 12 months, observed in our study is comparable to the studies by Steinmetz et al. (408 professionals – of which 89.5% with PRMD) and Kok et al. [3] (83 musical academy students – 89.2%) [5, 13]. Furthermore, according to Kok et al. [3], this result is similar for amateur players – 74.2%.

In our study, we did not find a relation between the age or experience of violin players and PRMD. Currently, the literature does not provide a consensus on the matter. Some authors report that the most experienced and longest-playing violin players are at the highest risk of a possible injury. Others claim that inexperienced, younger individuals are more likely to sustain PRMD due to the lack of a proper playing technique [1, 3, 13]. There was also no relation between the training frequency (days/week or hours/day spent on violin playing) and the reported PRMD. Kochem et al. observed in their study that intensive training may serve as a protective factor due to a greater experience with violin followed by an improved playing technique [8]. Opposite results were reported by Rodriguez-Lozano et al. [14], where the authors found that the violin players spend more time on training, the higher probability of PRMD (the study was focused on temporomandibular joints).

In the following study, parts of the body that were most affected by PRMD included the cervical and lumbar spine and shoulder joints/arms. Our findings are highly consistent with studies published by Kochem et al. [8] (cervical spine and arms) and Leaver et al. (cervical and lumbar spine, arms) [15].

The most popular prevention strategy chosen by the respondents was stretching (46%), which was even more common in the case of an acute PRMD episode (55.5%). Our study did not allow us to assess the efficiency of prophylactic strategies

based on physical activity. Due to the nature of the study (online questionnaire), the authors were unable to verify whether the exercises were carried out properly by the study subjects. Cooper et al. [16] claim that appropriately done stretching exercises (lasting 10 minutes with instructor supervision) substantially minimize the risk of PRMD in string players. The assistance of an experienced trainer allows for avoiding the adverse effects of stretching, such as pain, muscle stiffness, or a decrease in muscle strength [17].

In the case of an acute episode of PRMD, the first choices for interventions included rest (72%), followed by stretching and over-the-counter drugs (OTC, 18.5%). The low intake of painkiller drugs in our study is lower than could be expected. Even after combining OTC drugs with the recipe ones, the total percentage of drug intake does not exceed 26% of the PRMD group. Maric et al. [18] reported that among the professional players (86% out of 50 musicians with a PRMD), painkillers were used by 44% of respondents. Rest (restraining from violin playing) was reported significantly more often than other prevention strategies. According to the study by Gasenzer et al. [19], only 4% of respondents truly believe that rest alone is a sufficient prevention strategy.

The respondents in our study were highly aware of their health, as most of them decided to see a medical specialist ($p=0.007$). Gasenzer et al. [19] report that seeing a specialist is the most common way to deal with PRMD among German orchestra musicians. Our study subjects were most likely to seek medical assistance from physiotherapists or orthopedists. It should be emphasized that physiotherapists received higher satisfaction rates than both orthopedists and neurologists. At the same time, our study group with PRMD was relatively small ($n=53$). In comparison, Barnes et al. [20] reported that despite the fact that respondents had great faith in the abilities of physiotherapists (75% of questioned subjects), only 34.2% decided to use their help. The liter-

ature provides various examples of prevention strategies addressed to professional orchestras, onsite triage, or general health programs. However, these are more likely to be exceptions rather than rules for musicians. Nevertheless, our study shows that musicians understand the need for proper healthcare. A similar observation was delivered by Ioannou and Altenmuller [21], who reported that up to 77% of students claimed that a physician or other medical specialist should be available for them at their music academy.

Study limitations

The following study had a few limitations, which may have affected the results. The study was based on a questionnaire that was filled out without the supervision of the authors. Therefore, it was based on subjective data delivered by the respondents. The study sample could also be considered a limitation (70 people), but it was comparable with similar studies by other authors. Third, due to the nature of the study (online survey), the average age of the group was low, which may have affected some of the results (no relation between PRMD and ability to carry out daily activities). Fourth, since our study aimed at assessing PRMD

epidemiology among violin players, we did not analyze the details of the follow-up treatment. Therefore, the study does not contain exact information about the procedures undertaken by particular medical professionals nor a detailed assessment of their results. The last limitation may be associated with the disproportion in sex of the respondents as the groups of men and women were not equal in numbers.

Conclusions

People playing the violin are at high risk of sustaining a playing-related musculoskeletal disorder. PRMD in violin players is more common among women and is more likely to affect the cervical and lumbar spine and shoulder joints. According to the respondents, physiotherapists play an important role in treating PRMD.

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Conflict of interests

The authors have no conflict of interest to declare.

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