

Assessment of the occurrence of musculoskeletal dysfunctions and pain among violinists

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Abstract

Background: Playing the violin is a task in which bow strokes load the right hand with a dynamic pattern combined with a static grip on the left hand. Movement automatization and motor memory are essential factors affecting the quality of playing. In the available literature, few papers still assess the prevalence of motor dysfunction and pain complaints among violinists.

Aim: Assessment of the occurrence of musculoskeletal dysfunction and pain among violinists and evaluation of movement system overload in experienced violinists.

Material and methods: The material for the study consisted of questionnaires completed by 122 violinists who started playing before the age of 11, completed a minimum of one grade of music school, averaged a minimum of 10 hours per week devoted to playing the violin regardless of changing circumstances, averaged no more than 7 hours per week devoted to playing another instrument, and reliably completed the questionnaire. The method of the study was to analyze data from a survey created using Google Form.

Results: The results indicate that violinists are an occupational group at significant risk for musculoskeletal disorders, with a prevalence of 82%. The most common problems occur sequentially with the back and spine, temporomandibular joints, headaches, and upper and lower extremities.

Conclusions: Violinists are at significant risk of musculoskeletal dysfunctions and complaints of pain in various body parts. Many years of playing promote the summation of micro-injuries, which can significantly affect the professional activity of musicians.

Key words

violinists, pain, musculoskeletal disorders, movement system overloads, survey study.

Introduction

The violin is the smallest stringed instrument, which consists of a vibrating and resonating system. Their acoustic effect is influenced by several factors, such as their construction, external conditions, and the skill of the person playing [1,2].

The playing technique is defined as the ability to purposefully use the instrument, which is developed through long-term and methodical practice. The playing apparatus is defined as the arrangement and functioning of the body during playing, to which the sound is directly related. In the ideal performance of a piece, there must be an adequacy of means and ends [2].

Playing the violin is a task in which bow strokes load the right hand with a dynamic pattern combined with a static grip on the left hand. Therefore, motor automation and memory are very important factors affecting playing quality. Human divisibility is limited, and the acquisition of appropriate motor skills makes the performance of pieces with a significant difficulty level possible [2].

Aims

This study aimed to assess the occurrence of musculoskeletal dysfunction and pain among violinists and evaluation of movement system overload in experienced violinists.

Material and methods

The study material comprised questionnaires completed by 122 people, including 120 women (90.2%) and 12 men (9.8%) who agreed to participate in the study. The age of the subjects ranged from 13 to 64 years, which averaged 25.7 years.

The study consisted of an analysis of surveys created using Google Form and shared via social media. At the outset, information about the author and the goals of the study was provided, as well as information that the survey was anonymous, accessible, and voluntary and that one could opt out without giving a reason at any stage.

Musicians were not informed of the specific eligibility criteria for the survey, which included: 1. the respondent took up the violin before the age of 11; 2. the respondent currently plays a minimum of an average of 10 hours a week, regardless of changing circumstances; 3. the respondent has completed at least one stage of music school; 4. the respondent does not devote more than an average of 7 hours a week to playing another instrument; 5. the respondent completed the survey honestly and clearly, and the answers were relevant to the questions.

The form used different types of questions divided into 10 sections. Descriptive analyses with a percentage breakdown of the results were used. Calculations were made using an Excel calculation spreadsheet.

Results

The most significant number (47.5%) began their music education at age 7, and the most minor (1.6%) at age 10. The average age of starting playing is 6.7 years. The most frequently indicated time frame regarding the average weekly number of hours devoted to playing the violin was between 15 and 25 hours per week (40.2%), while the least frequent was more than 50 hours (0.8%).

In questions about pain and problems of specific body parts, most people (82%) indicated the spine and back, as well as the cervical spine and neck (73.8%). The occurrence of headaches was reported by 65.6% of people. Temporomandibular joint problems were reported by 50.8% of respondents, while upper extremity problems were reported by 42.6% of violinists. Lower extremity problems were found to be the rarest complaints (19.7%).

Those individuals experiencing headaches specified their intensity on the Visual Analogue Scale (VAS) from 0 to 10. Any person did not indicate a value of 1, while the most frequently marked value was 4 (13.9%). The average intensity is 5.7 on the scale in question. Those who reported the pres-

ence of temporomandibular joint pain localized the problems most often, 26.2% of people, in both joints, only on the left in 13.1% of people, only on the right in 2.5% of people, while 9% of people could not localize the dysfunction. Violinists with back and spine problems, in turn, most often indicated lumbar (50%), cervical (45.1%), thoracic (43.4%), and sacral (27.9%).

Respondents were asked to locate their upper limb problems, divided into left and right sides. The data collected shows that similar problems occur in both limbs. The details of the upper limb

problems are shown in **Table 1**. created for this study. In addition, all violinists were asked to specify whether there was a sensation of numbness or tingling in the upper extremities. An affirmative answer to this question was indicated by 35.2% of people.

The violinists were asked to localize their finger problems by left and right hand. The survey shows that dysfunctions are significantly more common in the left hand for all fingers. Details of the location of problems in the hand are shown in **Table 2**.

Table 1. Percentage of respondents with a problem with particular sections of the upper limbs, divided into left and right sides.

Side	Shoulder joint	Arm	Elbow joint	Forearm	Wrist	Hand
Left side	19,7	15,6	10,7	13,9	25,4	14,8
Right side	18	17,2	9	22,1	25,4	26,2
Both sides	9,8	8,2	4,9	12,3	15,6	11,5

Table 1. Percentage of respondents with a problem with particular sections of the upper limbs, divided into left and right sides.

Side	Thumb	Index finger	Middle finger	Ring finger	Little finger
Left side	10,7	6,6	2,5	3,3	2,5
Right side	12,3	7,4	6,6	9,8	15,6
Both sides	6,6	2,5	0,8	1,6	2,5

Discussion

Available research shows that musicians are an occupational group at significant risk of developing musculoskeletal disorders. This is due to long hours of work involving very precise movements. Among all musicians, string instrumentalists are most at risk. Few studies have been conducted on pain and musculoskeletal disorders in violinists. Available meta-analyses indicate the poor quality of previous studies, which often contradict each other [3-6].

Asymmetrical posture while playing the violin contributes to neck and shoulder pain [7]. Earlier studies have shown that these instrumentalists exhibit significant asymmetries in the shoulder girdle [8] and have reduced range of motion and muscle strength in this area compared to non-musicians [7,9,10]. Our own studies have shown that cervical spine and neck problems occur in 82% of violinists. In addition, available studies using electromyography (EMG) have shown differences in neuromuscular activity in the scapular and shoulder regions between symptomatic and asymptomatic individuals [11]. However, a later meta-analysis found conflicting evidence for this relationship [12].

Available EMG studies also indicated that the quadriceps muscle performed static and constant work under various conditions, which may be related to holding the instrument between the mandible and shoulder [13,14] and due to the high muscle work in the right shoulder [2,13]. In addition, previous studies have indicated the common occurrence, especially in those reporting pain, of tardive dyskinesias in the scapula, which can be defined as a disruption of natural mobility or position during movement [10,11,15].

Previous studies have indicated that the static position adopted during playing causes musculoskeletal overload and pain located most often in the lumbar region and shoulder girdle [8,16]. In violinists, the muscles of the lumbar region of the spine are often overused, resulting in weakness

[17] and significant impairment of lumbar-pelvic stabilization compared to other instrumentalists [16]. Available studies have found that violinists are more likely to have a significantly softer and shallower lumbar lordosis at the expense of a longer and deepened thoracic kyphosis. The reason for such changes may be the fact of prolonged playing in an abnormal and forced position, in which the body's center of gravity is forward, the back muscles are significantly loaded, and the lumbar lordosis tends to flatten [9,16]. Our study found problems in the spine and back in 82% of violinists. Dysfunctions in the cervical region were indicated by 45.2% of subjects, in the thoracic region by 43.4% of subjects, in the lumbar region by 50% of subjects, and in the sacral region by 28.7% of subjects.

Previous studies have shown that the left forearm muscles had higher static EMG levels than the right, consistent with the complex movement patterns for both sides during violin playing [18]. The low activity level on both sides confirms equally frequent injuries and pains with no difference between sides [19]. In our study, the occurrence of upper limb problems was indicated by 42.6% of the subjects. The right and left shoulder joints were shown to be similarly dysfunctional in 19.7% and 18% of people, respectively. When the proximal stabilizers of the scapula cannot move freely, distal compensation results in the excessive grip of the instrument and strain on the muscles of the forearm, fingers, and thumb [7]. Our own research showed that the most minor problems in the upper extremities occur at the elbow joint in 10.7% of people on the right side and in 9% of people on the left.

The present study found that wrist problems occur on both the left and right sides of the body in 25.4% of individuals while simultaneously on both sides in 15.6% of violinists. Disorders of individual fingers are much more common on the left side. Available studies have shown that violinists have lower handshake muscle strength compared

to the group, which was individuals not involved with any musical instrument. This effect has been attributed to the overuse of the flexors of the hand and forearms due to the specific demands of being an instrumentalist [7].

Research on temporomandibular joint dysfunction is very limited. Available studies show that violinists often experience subjective and clinical symptoms related to diseases of this joint, including increased sensitivity to touch or jaw movement, while there are no pathological changes on radiographic imaging [20]. The study found that problems with the temporomandibular joint were experienced by 51.6% of violinists. In 26.2% of the subjects, the problem occurs in both joints. Headaches are experienced by 65.6%, while the average pain intensity on the VAS scale was determined to be 5.7. There are no current studies on the prevalence of headaches in violinists.

Conclusions

Based on the conducted research and analysis of the available literature, it can be concluded that musculoskeletal dysfunctions and pain complaints among violinists are very common. In addition, it is possible to note the occurrence of more problems with the body regions whose activity during playing is crucial. It requires little muscular effort while repeating small and precise movements over many years of playing causes considerable strain on the musculoskeletal system. The most common problems occur with the spine and back, as well as the cervical spine and neck, headaches, and the temporomandibular joint. Upper extremities have an insignificant level of dysfunctionality, which is most likely due to the correct playing techniques used by those surveyed. The lower extremities were very rarely dysfunctional.

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