

# Evaluation of work-related musculoskeletal disorders and ergonomic risk levels among instrumentalist musicians

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## Abstract

**Aim:** The study aimed to evaluate work-related musculoskeletal disorders and ergonomic risk levels in instrumentalist musicians.

**Material and Methods:** This is a cross-sectional study. The present study consists of 46 musicians, including 11 violinists, 11 side flutists, 13 pianists and 11 baglama players between the ages of 18 and 50 years who are play at least one of the instruments. The socio-demographic characteristics of the musicians and the data of instrument were questioned by using a descriptive questionnaire. The Quick Exposure Check method was used to analyze the ergonomic risk and Expanded Nordic Musculoskeletal System Questionnaire was used to question musculoskeletal diseases.

**Results:** 48.2% of the participants were male and 52.8% were female. 79.3% of all participants had a daily instrument playing time more than 2 hours. Only 9.6% of the musicians had a low level of ergonomic risk. The most common musculoskeletal problems were seen on the wrist, neck and shoulders. The ergonomic risk levels of the musicians who reported pain were also high. Ergonomic risk levels were significantly higher in musicians who reported low back pain and hip-thigh pain ( $p < 0.05$ ). There was a significant difference between the musical instrument types and ergonomic risk levels of musicians, and it was found that the level of ergonomic risk was higher among piano and violin users ( $p < 0.05$ ).

**Conclusion:** In our study, the ergonomic risk levels and the incidence of musculoskeletal disorders related to work of musicians were found to be remarkably high. For this reason, preventive rehabilitation studies should be conducted in musicians. We think that our study will shed light on intervention research in which ergonomic risk management is planned.

**Keywords:** Work-related musculoskeletal disorders; ergonomic risk; musicians.

## INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are defined as damage or disease of muscles, nerves, tendons, joints, cartilages, and spinal discs that develop as a result of exposure to risk factors in the work environment. The common features of WMSDs are that they are caused or aggravated by work and may lead to restrictions in the work-related or non-work-related activities (1).

WMSDs represent the most important medical problems among musicians (2). In the literature, the lifetime prevalence of WMSDs among professional musicians were reported to vary between 62-93% (3,4). Musculoskeletal disorders or injuries related to playing activity can vary according to the used instrument type. Paarup et al. have found out that the musicians who are playing in the orchestras have discomforts at their necks, shoulders and back parts of their bodies (5).

Static muscle work in an instrument-specific posture often leads to excessive stretching of the tendons and joints, resulting in pain in the musculoskeletal system (6). Long-term instrument playing bears the risk of developing chronic pain syndrome (7). Generally, chronic pain is accompanied by neuromuscular changes. These may collectively risk musicians' professional career. Performance based WMSDs are due to a number of factors from the interaction between the instrument and the musician. Extrinsic factors include the musician's technique and the performance environment (8,9).

Working in an ergonomically well-designed environment is known to reduce musculoskeletal problems and increase working performance (10,11). Ergonomics is a science of work design. It is aimed to reduce the risks faced by employees during their tasks by designing the work equipment appropriately (12).

Ergonomic risks are affected by physical factors such as

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poor posture and repetitive coercion, psychosocial factors such as job dissatisfaction, and personal factors such as gender. It has been reported that the incidence of WMSDs decreases when information and awareness level on ergonomic risks is increased (10,13).

Since musical instruments were developed to produce the necessary sounds, the design principles of ergonomics were not considered as an important factor in the design process. However, the lack of ergonomics in the design and use of musical instruments can cause musculoskeletal symptoms or discomfort for musicians while playing instruments (14).

Currently, the relationship between instrumentalist musicians at ergonomic risk and musculoskeletal disorders is still unclear. The aim of this study was to evaluate the musculoskeletal diseases and ergonomic risk levels of instrumentalist musicians and laying the groundwork for further studies.

## MATERIAL and METHODS

The study was planned as a cross-sectional study and was conducted at the Department of Music, Faculty of Fine Arts and Design, İnönü University (Turkey). Prior to the research, the approval was obtained from İnönü University Health Sciences Non-Interventional Clinical Research Ethics Committee (2019/4-43). Each participant included in the study was informed with the "Informed Volunteer Consent Form" and their consent was obtained with a signature.

The present study consists of 46 musicians between the ages of 18 and 50 years and who are playing at least one of the instruments (violin (n=11), side flute (n=11), piano (n=13) and baglama (n=11)). Participants with a history of upper extremity surgery, 90° shoulder abduction, structural scoliosis, neurological or systemic diseases, and body mass index > 39 kg/m<sup>2</sup> were excluded from the study.

Sociodemographic variables and data regarding the musical instrument were gathered using a questionnaire.

The Quick Exposure Check (QEC) method was used to analyze the ergonomic risk. The method was tested with approximately 200 practitioners both in real tasks and experimental studies, and the reliability and validity of the test were established. Various studies demonstrated that QEC has inter-observer and intra-observer reliability. QEC has high sensitivity and availability. Field studies show that it can be applied to a wide variety of tasks (15). The QEC method consists of two parts: "Employee Assessment Checklist" and "Observer Assessment Checklist". The total percentage QEC score is considered to be low level of risk if it is equal or lower than 40%, moderate if it is between 41-50%, high if it is between 51-70%, and very high level of risk if it is above 70% (16).

Expanded Nordic Musculoskeletal System Questionnaire was used to investigate WMSDs. The aim of this

questionnaire was to evaluate waist, neck, shoulder and general musculoskeletal complaints with standardized questions. The questionnaire provides reliable information about the onset, prevalence and outcome of musculoskeletal pain in nine body regions (neck, shoulders, back, elbows, wrists/hands, waist, hips/thighs, knees, ankles/feet) and can be applied with personal interview technique or individually (17).

## Statistical analyses

The quantitative data for descriptive statistics were reported as mean ± standard deviation and qualitative data were summarized as numbers and percentages. The normality of data was assessed using Shapiro-Wilk Test ( $p < 0.05$ ). Chi-square and Kruskal Wallis variance analysis methods were used for data analysis. A  $p$  value of  $< 0.05$  was considered statistically significant throughout the experiment. The data were analyzed using IBM SPSS Statistics v. 22.0 for Windows (SPSS Inc, Chicago, IL) package software.

## RESULTS

About 48.2% of the participants were male and 52.8% were female. Demographic characteristics of the individuals included in our study are summarized in Table 1.

**Table 1. Demographic variables of the participants**

Demographic Variables	(X) ± SD
Age (year)	25.18±4.17
Height (m)	1.67±7.29
Body weight (kg)	69.14±9.3
Duration of work (year)	6.59 ± 2.2
Length of daily instrument playing (hour)	4.3±2.2

SD: Standard deviation

**Table 2. Distribution of musculoskeletal problems among musicians by body part**

	Pain, suffer or discomfort so far (%)	Pain, suffer or discomfort in the last 12 months (%)	Pain, suffer or discomfort in the last month (%)	Pain, suffer or discomfort today (%)
Neck	58.8	39.7	17.4	10.9
Shoulders	54.1	32.6	10.9	9.6
Back	52.3	43.5	15.2	4.3
Elbows	10.9	6.5	2.2	2.2
Wrists/hands	65.2	50.0	17.4	5.6
Waist	41.3	30.4	17.4	7.2
Hips/thighs	13.0	10.9	8.4	6.2
Knees	10.9	6.5	3.2	2.2
Ankles/feet	4.3	2.2	1.4	0.0

The distribution of musculoskeletal problems among musicians by body parts is indicated in Table 2. In the current study, the most common pain areas in any period during their lifetime were found as hand-wrist (65.2%), neck (58.8%), and shoulders (52.3%). The most frequent pain areas in the last 12 months were wrist (50.0%), back

**Table 3. QEC exposure score results of musicians**

QEC exposure Score (overall exposure score)	N	%
Low	9	9.6
Moderate	16	34.8
High	16	34.8
Very High	5	10.9
Total	46	100

**Table 4. Distribution of musicians' QEC exposure score results according to the type of instrument played**

Instrument played	(X) ± SD	p*
Transverse Flute	45.28±7.13	0.003
Baglama	47.15±9.04	
Piano	53.94±10.1	
Violin	59.61±12.08	

\*Kruskal-Wallis H test

**Table 5. Musculoskeletal problems among participants according to ergonomic risk level**

	Low-medium ergonomic risk (%)	High-very high ergonomic risk (%)	p*
<b>Neck</b>			
Yes	12 (48.0)	13 (52.0)	0.536
No	12 (57.1)	9 (42.9)	
<b>Shoulders</b>			
Yes	11 (44.0)	14 (56.0)	0.226
No	13 (61.9)	8 (38.9)	
<b>Back</b>			
Yes	11 (44.0)	14 (56.0)	0.226
No	13 (61.9)	8 (38.9)	
<b>Elbows</b>			
Yes	1 (20.0)	4 (80.0)	0.127
No	2356.1	18 (43.9)	
<b>Wrists/hand</b>			
Yes	16 (46.7)	14 (53.3)	0.829
No	8 (50.0)	8 (50.0)	
<b>Waist</b>			
Yes	5 (26.3)	14 (73.7)	0.003
No	19 (70.4)	8 (29.6)	
<b>The hips/thighs</b>			
Yes	0 (0.0)	6 (100.0)	0.006
No	24 (60.0)	16 (40.0)	
<b>Knees</b>			
Yes	0 (0.0)	2 (100.0)	0.131
No	24 (54.5)	20 (45.5)	
<b>Ankles/feet</b>			
Yes	0 (0.0)	2 (100.0)	0.452
No	23 (52.3)	21 (47.7)	

\*Chi-square test

(43.5%), and neck (39.7%). The most common pain areas in the last month were hand-wrist (17.4%), neck (17.7%) and waist (17.7%). On the day of evaluation, 16.8% of the participants reported neck, 12.8% reported the shoulders and 11.2% reported the lower back pain.

The QEC exposure score results of the musicians are presented in Table 3 and only 9.6% of the cases have low risk levels.

The QEC exposure score results according to the type of instrument played are demonstrated in Table 4. There was a statistically significant difference between the types of instruments used by musicians and ergonomic risk levels, and it was evaluated that ergonomic risk level was higher among piano and violin players ( $p < 0.05$ ). Lifetime pain prevalence was found to be significantly different among ergonomic risk levels ( $p < 0.05$ ). Ergonomic risk levels of musicians reporting pain were also high. Ergonomic risk levels were significantly higher among musicians who reported low back pain and hip-thigh pain, ( $p < 0.05$ ) (Table 5).

## DISCUSSION

In our study in which musculoskeletal system diseases and ergonomic risk levels are evaluated in the instrumentalist musicians, only 9.6% of the participants have low ergonomic risk levels. We also detected that musculoskeletal pain was most common on the wrist, neck and shoulder areas. Ergonomic risk levels were significantly higher among musicians who reported low back pain and hip-thigh pain.

It is known that the incidence of WMSDs is high among musicians. In the literature, lifelong pain prevalence in musicians ranged from 62 to 93%, pain prevalence in the last 12 months ranged from 41 to 93%, and point prevalence ranged from 9 to 68% (4,18). The prevalence of pain detected in the present study was similar to those reported earlier.

Earlier research indicated that the spine and upper extremity pain is more common among musicians (19). In our study, the most common musculoskeletal complaints were found in the wrists, shoulders, neck, back, and waist regions. Similarly, Zaza stated that the most common musculoskeletal pain complains by musicians were in hand and wrist (20). Papandreou et al. reported that pain complaints were more common in the upper extremity and spine (21).

Many studies reported that musicians are at risk for the development of occupational disorders. Performance-related disorders in musicians are caused by multiple risk factors. Lack of ergonomics in the design is an important risk factor for playing musical instruments (22,23).

Ergonomic risk analysis methods that assess the exposure level by determining the level of risk those employees are exposed to serve as a guideline for both employees and evaluators in health protection and promotion (6). It has been reported that ergonomic risk analysis methods

are frequently used in the evaluation of musculoskeletal problems caused by physical exposures among individuals working in different occupations. However, despite the frequent reports regarding the physical exposure amongst musicians, the number of studies evaluating the level of ergonomic risk in these individuals are limited (24,25). Assessing the level of ergonomic risk determines the level of risk to which employees are exposed and enables the detection of prioritized jobs and planning the training that require ergonomic change.

Musicians' health problems vary according to the instruments played. Dawson reported that the anatomical position and muscle forces required to hold and support the instrument while playing vary among different instruments (26). In the current study, a significant difference was detected between the types of instruments played and ergonomic risk levels, and the level of ergonomic risk was found to be higher among piano and violin players.

Thus, in our cross-sectional study, ergonomic risk levels and WMSDs prevalence values of musicians were found to be remarkably high. Because the prevention of WMSDs is easy, feasible and cost-effective, studies with larger sample sizes are suggested. Musicians must be protected from a wide range of WMSDs in order to maintain their profession. Therefore, preventive rehabilitation studies should be conducted among musicians. According to the results of the present study, it may be possible and effective to reduce the intensity and functional effects of musculoskeletal symptoms by referring musicians who are at high ergonomic risk to rehabilitation programs. We also believe that encouraging ergonomic intervention and preventive rehabilitation programs before pain occurs can reduce musculoskeletal disorders in musicians. We think that our study will shed light on the intervention studies where ergonomic risk management is planned.

## CONCLUSION

There are some limitations associated with our study. First, the number of people included in our study is low. This is because it is a cross-sectional study. Second, the types of instruments included in the study are limited.

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