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ORIGINAL ARTICLE

Prevalence of musculoskeletal pain and associated factors among professional orchestra musicians in Norway

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Abstract

Background: Orchestra musicians have a high risk of experiencing musculoskeletal problems. These problems may lead to sleep and psychological disturbance. *Objectives:* This study investigated the occurrence of musculoskeletal pain (MSP) among orchestra musicians and the coherence between pain and predictors such as gender, age and instrument. Further, the impact of pain on sleep and mental health was analysed to assess pain as a predictor threatening musicians' wellbeing. *Methods:* Some 358 musicians in eight different professional orchestras in Norway completed a questionnaire. Questions about pain experienced within the last 30 days were based on a national survey. Standardised screening tools like the Hopkins Symptom Checklist-25 (HSCL-25) and Bergen Insomnia Scale (BIS) were used to assess psychological distress and sleeping problems. Kruskal–Wallis tests were used to analyse the differences in the pain-related variables: experienced pain severity (EPS), number of pain areas, and work being perceived as the source of pain based on age. Mann–Whitney U tests were conducted to evaluate the statistical significance between gender and the pain-related variables. Spearman's rank correlations were used to examine the relationship between EPS and BIS, HSCL-25 and pain area. Additionally, simple linear regression models were employed to determine whether EPS can predict higher scores on the HSCL-25 and BIS scales. *Results:* The prevalence of MSP experienced in the last 30 days among orchestra musicians in Norway was 85%. Musicians experienced frequent pain regardless of their gender, age or instrument group. Neck, shoulders and upper back represented the most reported pain areas. Further, it was observed that increased EPS was correlated with an increase in the number of pain areas and in work being perceived as the source of pain. EPS significantly predicted sleep- and psychological distress. *Conclusions:* Orchestra musicians have a high risk of encountering MSP. Furthermore, their psychological distress and sleeping problems seem to be related to experienced MSP. To deliver optimal health, these problems should be handled simultaneously.

Keywords: *Orchestra musicians, musculoskeletal pain, sleep, mental health, psychologic distress, musicians' health, performing arts medicine, occupational health, professional musician, classical musicians*

Introduction

Orchestra musicians perform prolonged repetitive movements in asymmetrical postures. In addition, they experience immense psychological pressure at work [1]. Therefore, they present a high risk for physical and psychological health problems that may prevent them from performing, potentially affecting their careers.

The lifetime prevalence of musculoskeletal injuries in professional musicians varies widely, ranging from 46% to 93%, suggesting that musculoskeletal issues are worryingly common [2-4]. A study examining Danish symphony orchestra musicians (n = 342) found that they experience a higher frequency and persistence of musculoskeletal symptoms compared to the general workforce [5]. Similarly, a study investigating Finnish orchestra musicians (n = 920)

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reported that they have approximately twice the number of neck and upper extremity complaints compared to the general population of the same age [3]. These findings make it undeniable that musculoskeletal complaints are widespread among professional musicians.

Demographic features, instrument-related physical load, psychological state, and psychosocial factors are frequently associated as risk factors of musculoskeletal issues [3,4,6,7].

The development of musculoskeletal health issues may lead to psychological distress in musicians since musicians' identities are so closely intertwined with their work [8].

Musculoskeletal problems among professional orchestra musicians have been widely studied outside Norway; however, in Norway, studies have focused on mental health and work-related stress rather than musculoskeletal issues. The aim of this cross-sectional study was to fill this gap by investigating the prevalence of musculoskeletal pain (MSP) and the coherence between MSP, age, gender and instrument group. This study also aimed to examine the impacts of pain on sleep and psychological wellbeing.

Below, the influence of age, gender and instrument on pain and the impacts of pain on musicians' psychological wellbeing and sleep will be presented, as identified through previous literature.

Associated risk factors of musculoskeletal issues among orchestra musicians

Age and gender are frequently investigated as injury risk factors. Multiple studies confirm that female orchestra musicians are significantly more prone to experiencing musculoskeletal problems than their male colleagues [5,7,9]. Findings related to age are less clear, with a higher prevalence of musculoskeletal disorders in the hand and wrist of musicians over 60 years old [10], and some significant connections between pain in specific body regions and age have been presented [6]. Contrasting those findings, some studies found no statistically significant results between injury rate and age among professional orchestra musicians [3,11].

Another area that is commonly examined is the association between musculoskeletal issues and instrument group. A high prevalence of musculoskeletal problems and a higher risk of sick leave were reported particularly among upper-string musicians (e.g. violinists, violists) [3,4,6,9]; this was assumed to be caused by the asymmetric playing posture required for these instruments [12]. In addition to evaluations of frequency, the interplay between affected body parts and instruments has been extensively studied given the assumption of physical workload variations within the different instrument groups [4,6,7,12-14]. A high incidence rate of hand, wrist, elbow and shoulder problems has been observed in string players compared to other orchestra members [4,7,9], although neck and shoulder issues are common for all instrument players [15]. However, contrasting these studies, Sousa et al. found no significant relationship between the instrument played and complaints in different body parts [13]. Specific instrument-related issues were listed as one of the prominent perceived sources of musculoskeletal issues by conservatory and professional musicians [16].

Impacts of pain on sleep and psychological wellbeing

Sleep has a considerable role in restitution and indirectly maintaining physical and mental wellness [17]. Frequently, sleep difficulties are linked to mental and psychological issues such as depression and anxiety [18,19]; however, the relationship between sleep and musculoskeletal problems, especially chronic pain [20], has been investigated in depth in many professions but not among musicians. Ahlberg et al.'s study presenting the relation between orofacial pain and disturbed sleep among Finnish orchestra musicians is unfortunately the solitary example in musician-related health literature [21].

The prevalence of mental health issues was reported to be up to 39% among professional classical musicians [22], indicating that mental health problems such as anxiety and depression among this cohort may be of equal concern as musculoskeletal issues with regard to threatening their wellbeing. Anxiety and depression are frequently presented as risk factors for musculoskeletal issues in the literature [14,22–24]; however, there is a lack of research in this field demonstrating how pain may affect psychological wellbeing by increasing psychological distress among orchestra musicians. A prominent study by Kenny and Ackermann in 2015 found a significant association between depression and pain frequency, intensity and severity among orchestra musicians in Australia [24].

Hypotheses

Considering the aims of the study and the previous research in this field, the following hypotheses were formulated:

Table I. Demographic features of sample.

	Category	Frequency	Percentage
Gender	Male	196	54.7
	Female	160	44.7
	Missing data	2	0.6
Age (years)	20–29	17	4.7
	30–39	74	20.7
	40–49	92	25.7
	50–59	117	32.7
	60–69	58	16.2
Category of instrument	Brass instrument	60	16.8
	Woodwind	66	18.4
	Percussion, harp and keyboard	20	5.6
	Violin and viola (upper-string instruments)	150	41.9
	Cello and contrabass (lower-string instruments)	62	17.3
How many years have you been playing your main instrument?	Less than 10 years	-	-
	Between 10 and 20 years	17	4.7
	Between 20 and 30 years	75	21
	More than 30 years	265	74.2
	Missing data	1	0.1
Employment	Full time	353	98.6
	Long-term temporary (>6 months)	4	1.1
	Short-term temporary (<6 months)	1	0.3

Impact of demographic features and instrument on MSP

H1.1 Gender has a significant influence on MSP, with females experiencing more MSP.
H1.2 Age has a significant influence on MSP, with musicians over 60 years old experiencing more MSP.
H1.3 Instrument group has a significant influence on MSP, with upper-string musicians experiencing more MSP.

Impact of MSP on sleep and psychological wellbeing

H2.1 Musicians with MSP have increased sleeping problems.
H2.2 Musicians with MSP have increased psychological distress.

Methods

Data

This cross-sectional study examined the data collected in January 2021 by the Norwegian Defence Research Establishment (FFI) for a project investigating the working environments and health profiles among musicians in military and civil symphony orchestras [25].

All the data collected was anonymised. The necessary permission was granted by FFI on 3 March 2022 in order to conduct further data analysis as part of a master's dissertation in Performing Arts Medicine at University College London (UCL). UCL's research ethics committee subsequently approved the study on 4 July 2022 (Project ID: 22555.001).

Participants

Some 749 musicians in military and civilian Norwegian orchestras were invited to participate in the study; 548 opted to take the survey, of which 482 were completed. However, this study only analyses the data of the civilian orchestras. Of the civilian orchestra musicians who received the survey, 28% did not open it at all, while 6% opened it but failed to complete it. Therefore, the responses of 358 professional musicians who completed the survey (average response rate 66%: 55% male (n = 196), 45% female (n = 160), 0.2% missing responses (n = 2)) across eight different professional civilian orchestras were analysed. Thirty-three percent (n = 117) of participants ranged in age from 50 to 59 years and 99% (n = 353) were full-time employees. Among those, 42% were upper-string musicians: violin and viola players (Table I). A written consent documenting participants' voluntary involvement was provided.

Survey

The survey had 127 questions across seven categories. Subsets of the original survey questions were assessed.

Musculoskeletal pain assessment. A section of the survey examining prevalence of MSP within the last 30 days was adapted from the National Survey on Living Conditions and Working Environment in Norway. Questions about MSP simultaneously assessed

experienced pain severity (EPS) and presence of pain in four different parts of the body using three options for confirming this ('Yes'): 'Heavily bothered', 'Somewhat bothered' and 'A little bothered', and one option for 'No': 'Not bothered'. Furthermore, it was also questioned whether the pain experienced was due to the musicians' current job in order to determine whether or not the work was seen as the source.

Hopkins Symptom Checklist-25. The Hopkins Symptom Checklist-25 (HSCL-25) is a valid tool commonly used as a diagnostic agent for screening symptoms of psychological distress, anxiety and depression [26]. An average total score >1.7 indicates mental health problems [26,27].

Bergen Insomnia Scale. The Bergen Insomnia Scale (BIS) is a highly valid diagnostic tool that consists of six items measuring symptoms of insomnia [28]. Participants score the sleeping issues they have experienced during the past month from 0 to 7 in a per-week assessment frame, thus the total score ranges between 0 and 42. Answering three or more to all questions strongly indicates insomnia [28].

Statistical analysis

Responses were analysed using IBM SPSS statistical software 28.0. MSP-related variables were recoded according to EPS and presence of pain for the four different areas. The level of pain was measured categorically from 'Not bothered' to 'Heavily bothered' with a verbal rating scale. Numerical values were assigned to these categories: 0 for 'Not bothered', 1 for 'A little bothered', 2 for 'Somewhat bothered', and 3 for 'Heavily bothered'. To compute the total EPS, the values representing these levels were summed, resulting in a continuous variable ranging from 0 to 12 that was derived from a categorical variable. Thereafter, total pain area, HSCL-25 and BIS were computed. HSCL-25 and BIS displayed high internal validity with Cronbach's alpha scores of 0.93 and 0.84, respectively. In the survey, age was treated as a categorical variable. Basic descriptive statistics were calculated for all variables, and Shapiro–Wilk tests were used to analyse the distribution of variables. Two responses with high EPS and 13 responses of the HSCL-25 were detected as outliers but were not removed; the outliers were thoroughly checked, and a Q-Q plot was used to confirm reliability.

Kruskal–Wallis tests were conducted to examine the differences in EPS, number of pain areas and work being perceived as the source of pain according to age (H1.2) and instrument group (H1.3). To analyse statistical significance between gender and pain-related variables (H1.1), Bonferroni corrected Mann–Whitney U tests were performed.

Spearman's rank correlations were determined for total EPS and total pain area, BIS and HSCL-25 respectively. Simple linear regressions were run to assess whether the dependent variables of sleep BIS (H2.1) and mental health HSCL-25 (H2.2) were predicted by the independent variable, experience of pain. A p-value <0.05 was accepted as statistically significant.

Results

Overall, the estimated prevalence of experienced pain reported within the last 30 days was 85% (n = 305), with pain in the neck, shoulders and upper back being the most prevalent at 72% and pain in the hips, legs, knees and feet the least prevalent at 38%. Distribution of pain according to the pain area number showed that 15% (n = 52) had pain in four areas of their body. Among those musicians who had pain (n = 305), 81% (n = 248) reported perceiving work as the source of the pain.

The mean of HSCL-25 was 1.61 for the total population (n = 358), 1.37 for musicians without pain (n = 53), 2.08 for those with severe pain in the arms, wrists and hands (n = 29), and 2.32 (SD = 1.03) for those with severe pain in the upper back and extremities (n = 16).

The mean of BSI was 13.37 for the total sample (n = 358), 10.35 for musicians without pain (n = 53), 21.48 for those with severe pain in the arms, wrists and hands (n = 29), and 21.69 (n = 16) for those with severe upper back and extremities pain (SD = 12.17) . Detailed BIS and HSCL-25 scores according to pain area are presented in Table II.

No significant difference between pain-related variables, age and instrument group was detected by the Kruskal–Wallis tests. Nor did the Bonferroni-corrected Mann–Whitney tests show significance between gender and EPS, total pain area and work being perceived as the source of pain. However, before the p-value was Bonferroni corrected, tests revealed that female participants (mean rank = 195.36, n = 160) reported higher experienced pain severity (EPS) than their male counterparts (mean rank = 164.73, n = 196; U = 12982, z = 2.819, p = 0.05, r = 0.14). In this study, due to the small effect size (r = 0.14) and the results of the Bonferroni correction, the hypothesis claiming gender has a significant influence on pain was rejected: H1.1, H1.2 and H1.3 were rejected.

Spearman's correlation coefficient was used to examine the relationship between EPS, total pain

Table II. HSCL-25 and BIS scores according to distribution of pain areas, pain source perception and heavily bothered pain.

		HSCL-25		BIS	
		Mean (SD)	95% CI	Mean (SD)	95% CI
Total sample 100% (n = 358)		1.61 (0.79)	1.53–1.69	13.37 (9.77)	12.4–14.4
Musicians without pain 14.8% (n = 53)		1.37 (0.61)	1.27–1.53	10.35 (8.52)	8.06–12.6
Lower back pain 46.6% (n = 167)		1.72 (0.85)	1.59 – 1.85	15.22 (10.13)	13.7–16.8
	Work as perceived source of pain 28.8% (n = 103)	1.81 (0.89)	1.64–1.98	15.99 (10.00)	14.1–17.9
	Heavily bothered 5.3% (n = 19)	1.73 (0.83) 1.79 (0.85)	1.36–2.1 1.33–2.2	16.32 (8.76) 16.63 (9.05)	12.4–20.3 12.2–21.06
	Heavily bothered + work as perceived source of pain 4.4% (n =16)				
Pain upper back, neck or shoulders 71.8% (n = 256)		1.69 (0.83)	1.59–1.79	14.26 (9.76)	13.1–15.4
	Work as perceived source of pain 60.6% (n = 217)	1.72 (0.84)	1.61–1.83	14.11 (9.41)	12.9–15.4
	Heavily bothered 10.9% (n = 39)	1.99 (0.94) 1.99 (0.94)	1.7–2.29 1.7–2.29	19.23 (10.98) 18.63 (10.46)	15.8–22.7 15.3–21.96
	Heavily bothered + work as perceived source of pain 10.6% (n = 38)				
Pain arms, wrists or hands 48.9% (n = 175)		1.73 (0.85)	1.6–1.86	15.27 (10.48)	13.7–16.8
	Work as perceived source of pain 43.3% (n = 155)	1.74 (0.85)	1.61–1.87	15.00 (10.18)	13.4–16.6
	Heavily bothered 8.1% (n = 29)	2.08 (1.00) 2.05 (1.00)	1.72–2.44 1.66–2.43	21.48 (12.09) 20.65 (12.03)	17.1–25.9 16.03–25.27
	Heavily bothered + work as perceived source of pain 7.2% (n =26)				
Pain hips, legs, knees or feet 38% (n = 136)		1.73 (0.84)	1.59–1.87	15.04 (10.4)	13.3–16.8
	Work as perceived source of pain 8.1% (n = 29)	1.97 (0.97)	1.62–2.32	17.90 (9.78)	14.3–21.5
	Heavily bothered 4.5% (n = 16)	1.99 (1.01) 2.17 (1.15)	1.5–2.48 1.02–3.31	19.25 (13.19) 24.86 (12.27)	12.8–25.7 15.78–33.96
	Heavily bothered + work as perceived source of pain 2% (n = 7)				

Note: CI: confidence interval.

Table III. Spearman's correlation table among variables, HSCL-25 and BIS.

	1	2	3	4
1. Experienced pain severity				
2. HSCL-25	0.40*			
3. BIS	0.29*	0.48*		
4. Pain area number	0.89*	0.35*	0.25*	
5. Perception of work as source of pain[a]	0.62*	0.30*	0.17*	0.64*

Note: HSCL-25: sum of Hopkins Symptom Checklist-25; BIS: sum of Bergen Insomnia Scale.

[a]N = 304.

*$p < 0.001$.

area, work-related pain perception and the sums of HSCL-25 and BIS (Table III). Spearman's correlation results showed there was a weak positive correlation between EPS and BIS ($r_{(356)} = 0.29, p < 0.001$), a moderate positive correlation between HSCL-25 and EPS ($r_{(356)} = 0.40, p < 0.001$), and a strong positive correlation between EPS and work as the source of pain ($r_{(302)} = 0.62, p < 0.001$).

Simple linear regression tests were carried out to estimate whether EPS was a predictor of psychological wellbeing and sleep. The results of the regression, with HSCL-25 as dependent variable, indicated that EPS explained 19% of the variance ($F_{(1,356)} = 81.381, p < 0.01$). EPS was a significant predictor of psychological distress ($B = 0.083, p < 0.001$), with a Cohen's f of 0.47, demonstrating a large effect size.

The result of the regression model in which BIS was the dependent variable demonstrated that EPS explained 10% of variance ($F_{(1,356)} = 41.422, p < 0.01$). EPS was a significant predictor of increased BIS scores ($B = 1.242$, $p < 0.01$). Cohen's f measured 0.34, indicating a medium to large effect size. H2.1 and H2.2 were consequently accepted: MSP may lead to psychological distress and sleeping problems among orchestra musicians.

Discussion

This study aimed to evaluate the occurrence of MSP among civilian orchestra musicians in Norway.

Simultaneously, the roles of age, gender and instrument in pain and the impact of pain on psychological wellbeing and sleep were examined.

Key findings of this study include that MSP is an immense problem among orchestra musicians and that it negatively affects their mental health and sleep regardless of their age, gender and instrument.

Three different aspects of pain were investigated: EPS, number of pain areas and perceived pain source. Some 85% of musicians had experienced pain in one or more areas within the last 30 days of completing the questionnaire, confirming the findings of previous studies that musicians suffer a high prevalence of MSP [3,4,9,10,14,18]. Our findings demonstrated that the upper back, neck and shoulders were the most frequently reported pain areas. This was consistent with the findings of Viljamaa et al. [3], who assessed experienced pain in the last 30 days among musicians of Finnish orchestras. In this study, a correlation was observed in the number of pain areas reported and EPS. Similarly, the correlation showed that participants who were bothered more by pain were more likely to report that they perceived work to be the source (Table III). Steinmetz et al. [6] demonstrated that 43% of musicians reported pain in more than five pain areas. Although they also investigated pain intensity, they did not examine the changes in pain intensity in relation to the number of pain areas.

Age, gender and instrument type have been especially noted in the literature as risk factors for MSP: younger and older musicians [4,6,9], females [5-7,9,24], and upper-string musicians [6,9,10] are frequently cited as being more prone to suffering from MSP. On the contrary, our findings demonstrated no significant differences between age, gender and instrument group in terms of MSP. However, although this study rejected the hypothesis about gender differences affecting pain, the results should be interpreted with caution; one explanation for this finding may be that the sample size was not large enough to test multiple hypotheses simultaneously. Since region-specific pain was not directly investigated in this study, there may be a difference between reported pain and specific body regions in relation to musicians' demographic features and instruments.

Further, this study's findings demonstrated that pain had negative effects on musicians' sleep and mental health. As stated, an HSCL-25 mean score above 1.7 indicates increased psychological distress [26,27]. The average score of musicians without pain was measured at 1.37 while it was above 1.7 in those with pain (Table II). Similarly, Figure 1 clearly illustrates changes in HSCL-25 scores in musicians without pain compared to those musicians who reported being heavily bothered by pain in their upper back and extremities. A previous longitudinal study (n = 500) explored the relationship between pain and mental health and demonstrated a strong correlation between EPS and depression [29]. Most musician mental health research has investigated mental health's impact on MSP [6,9,24] or looked at job demands and personality as predictors of mental health problems [1,9,27]; however, there is a lack of research on pain as a predictor of psychological problems. The findings of this study therefore provide another line of inquiry for musicians' mental health research.

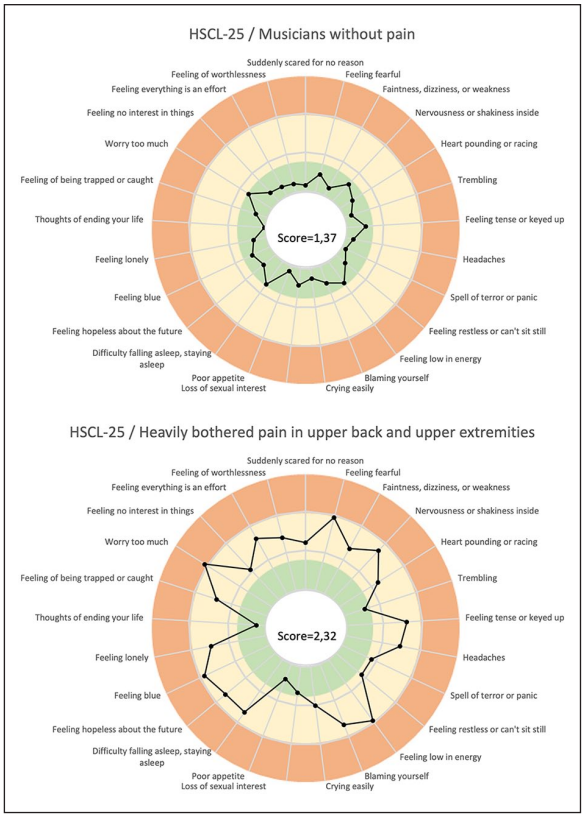

Figure 1. Average HSCL-25 score for musicians without pain (n = 53) and musicians reporting being heavily bothered by pain in their upper back and extremities (n = 16). The HSCL-25 scale consists of four response categories ranging from '1: Not at all' to '4: Extremely'. The green area represents average scores up to 1.7, while scores greater than 1.7 indicate mental health problems [26,27]. The yellow area represents scores ranging from 1.7 to 3.0, indicating significant distress, and the orange area represents scores from 3.0 to 4.0, indicating extreme distress.

Equally important is that a relationship between pain and sleep disturbance was found even though the relationship between pain and mental health was stronger. A 2016 study by Vaag et al. [18] examined 1,607 musicians and identified that they experienced greater sleep disturbance compared to the general population in Norway, with orchestra musicians

troubled the most. Average BIS score was previously measured to be 10.7 in the Norwegian population (n = 5,000) and 22.5 in sleep disorder patients (n = 225) [28], while in this study it was 13.4 for the total sample (n = 358). Comparing this study's result with Vaag et al.'s [18], we can conclude that musicians have a higher prevalence of sleeping disturbance compared to the general population. Table II demonstrates an increasing rate of BIS corresponding with pain areas and EPS. The average BIS score among musicians with severe pain in their arms, wrists, or hands was measured to be approximately as high as the average BIS rate of sleep disorder patients [28]. Pain should be therefore be considered a risk factor for sleeping problems in orchestra musicians.

Strengths and limitations

In relation to strengths, homogeneous sampling was provided by collecting data across eight professional orchestras with similar work demands. Furthermore, Cronbach's alpha measurements were taken to assess the inter validity of the standardised screening tools used, and Bonferroni-adjusted p-values were employed when testing the hypotheses to reduce Type 1 errors.

Despite these strengths, selection bias could have occurred due to the cross-sectional design of the study and response rate of 66%. Questions about musculoskeletal problems only assessed pain, they did not account for other playing-related physical symptoms such as weakness, tingling or experiencing 'pins and needles'. Pain regions were divided into four areas covering several anatomic regions without differentiating the right or left side of the body, making it difficult to analyse specific results related to asymmetrical issues. Studies have demonstrated that musicians suffer facial pain [21,30], a major weakness of the current study, therefore, was that no questions were asked about pain in the orofacial region and jaw – had this been assessed, the prevalence of pain could potentially have been even higher.

Conclusion

This study confirmed the findings of previous studies that MSP is frequent among orchestra musicians. The evidence also illustrated that musicians not only experience significant musculoskeletal problems but simultaneously suffer psychological distress and sleeping problems. The correlation between pain, psychological distress and sleeping issues was explicit; however, disentangling the cause-and-effect relationship between them remains a challenge. An increase in one may cause an increase in the others leading to disturbances in musicians' total wellbeing. Prospective intervention studies that aim to concurrently treat musculoskeletal problems, psychological distress and sleeping issues are needed.

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Ethical approval

University College London's research ethics committee approved the study on 4 July 2022 (Project ID: 22555.001).

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Supplemental material

Supplemental material for this article is available online.

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