

---

Original Article

# Musculoskeletal Symptoms in Professional Musicians: Do Self-employed and Employer-employed Musicians Differ?

Jessica Stanhope<sup>1,\*</sup>, Angus Cook<sup>2</sup>, Dino Pisaniello<sup>1</sup> and Philip Weinstein<sup>3</sup>

<sup>1</sup>School of Public Health, The University of Adelaide, Adelaide, South Australia 5005, Australia; <sup>2</sup>School of Population and Global Health, The University of Western Australia, Perth, Western Australia 6009, Australia;

<sup>3</sup>School of Biological Sciences, The University of Adelaide, Adelaide, South Australia 5005, Australia

\*Author to whom correspondence should be addressed. Tel: +61-8-8313-2063; e-mail: [jessica.stanhope@adelaide.edu.au](mailto:jessica.stanhope@adelaide.edu.au)

Submitted 27 July 2021; revised 12 December 2021; editorial decision 20 May 2022; revised version accepted 8 June 2022.

## Abstract

Concerns have been raised for the health and wellbeing of self-employed workers. Musicians are the 'original' gig workers, and musicians have a high prevalence of musculoskeletal symptoms (MSSs). Studies of musicians' MSSs have typically focused on classical, employer-employed musicians; leaving self-employed musicians under-investigated. We investigated the prevalence of MSS outcomes in all types of professional musicians, and compared the MSS outcomes between self-employed and employer-employed musicians. We conducted a cross-sectional study of professional musicians. Given the large proportion of musicians who were both self-employed and employer-employed, three groups were compared: self-employed only (self-employed group), employer-employed only (employer-employed group), and both self-employed and employer-employed (both group) musicians. Multivariable regression analyses were conducted. A total of 225 professional musicians were included in the study, 87.9% of whom reported MSSs in the last 12 months. For MSSs that impaired musical activity, the 12-month prevalence was 43.2%. Musicians in the self-employed group reported a significantly higher 7-day prevalence of MSSs compared with those in the employer-employed group. Compared with musicians in the employer-employed group, musicians in the both group reported a higher 12-month prevalence of MSSs that impaired musical activity. A higher proportion of symptomatic musicians in the both group reported seeing a health professional for their MSSs, compared with the employer-employed group. Similarly, symptomatic musicians in the both group reported higher ratings of emotional impact from MSSs, compared with symptomatic musicians in the employer-employed group. The majority of musicians have experienced MSSs. Several significant differences were reported between the three groups of musicians, with musicians in the both group generally reporting poorer MSS outcomes, compared with musicians in the employer-employed group. There are several potential reasons for why musicians who are both self-employed and employer-employed appear to have poorer MSS outcomes, including

**What's important about this paper**

Musicians are the 'original' gig workers, and experience high rates of musculoskeletal symptoms. This study found that the prevalence of symptoms and utilization of healthcare varied among musicians who were self-employed, employer-employed, or had both types of employment. Further research is required to understand how employment terms affect musculoskeletal symptoms and outcomes, and ensure that self-employed musicians can access effective interventions.

the stress of balancing multiple demands. Further research is required into the risk factors for MSS outcomes in self-employed musicians, including those who are both self-employed and employer-employed, and interventions should be directed towards self-employed musicians to minimise the MSS burden.

**Keywords:** comparative; gig workers; health; musculoskeletal; musculoskeletal symptoms; music; musicians; pain; self-employed; workers

**Introduction**

The 'gig economy' has been gaining increased attention, particularly with the rise of digital platforms to facilitate food delivery and ride sharing. Concerns have been raised regarding the health and wellbeing of workers in the gig economy (Gray *et al.*, 2020; Park *et al.*, 2020). However, traditional surveillance mechanisms for work-related health problems do not cover self-employed workers, making it difficult to ascertain the scale or nature of the problem.

Musculoskeletal conditions are an important consideration in public health and represent the leading cause of years lived with disability globally (James *et al.*, 2018). Musculoskeletal disorders are also the main cause of workers' compensation claims (Lane *et al.*, 2016) and new work-related injuries and illnesses (Australian Bureau of Statistics, 2018). Comparisons between self-employed (self-employed) and employer-employed (employer-employed) workers' musculoskeletal symptom (MSS) outcomes across a range of industries have led to mixed results (Park *et al.*, 2020), and therefore industry-specific studies are required. In this study, we compare the MSS outcomes between self-employed and employer-employed musicians: the 'original' gig workers. Such comparisons have not been made previously (Stanhope *et al.*, 2019a), and are necessary if appropriately targeted occupational health recommendations are to be made to reduce the MSS burden in these different groups.

Musicians are an occupational group for whom MSSs are common, with the majority of professional musicians reporting MSSs over a 12-month period (Kok *et al.*, 2016b). Musculoskeletal disorders account for the majority of musicians' workers' compensation claims, and

for the majority of the cost of claims (Stanhope *et al.*, 2020). Musicians experience high physical (Rosenbaum *et al.*, 2012) and psychosocial demands (Vaag *et al.*, 2013), and the majority of professional musicians are engaged in freelance/self-employed work (Throsby and Petetskaya, 2017). These characteristics may increase the risk of MSSs for musicians. Professional musicians who experience MSSs report a range of consequences, including an impact on their ability to engage in their musical activities at their usual level (Berque *et al.*, 2016), taking leave from work (Chimenti *et al.*, 2013), and feeling stigmatised, depressed, isolated, and experiencing a loss of self-worth and identity (Rickert *et al.*, 2014). These impacts may be more significant for self-employed musicians, who do not have access to sick leave or workers' compensation, who may have less ongoing support from other musicians, and for whom maintaining their reputations as being reliable is important for securing future work.

Despite the majority of musicians working in a freelance/self-employed capacity (Throsby and Petetskaya, 2017), and musicians being the original gig workers, the MSS outcomes of self-employed musicians have not specifically been investigated or compared with employer-employed musicians (Stanhope *et al.*, 2019a). We were therefore interested in the prevalence and profile of MSS outcomes for both self-employed and employer-employed musicians. The objectives of this study were to determine (i) the prevalence and profile of MSS outcomes for all professional musicians, and self-employed and employer-employed musicians specifically, (ii) whether the prevalence and profile of MSS outcomes differ between self-employed and employer-employed musicians, and (iii) where differences were identified, were they due

to inherent differences in the tasks of self-employed and employer-employed musicians. We focused on MSSs rather than the findings of physical assessments or diagnoses, because of the variable correlation between formal clinical findings and MSSs in musicians (Paarup *et al.*, 2012), and because MSSs are what the individual experiences, and what influences their ability to engage in musical activities.

### Theoretical framework and hypothesis

There are many theories regarding the development of MSSs and their consequences (Karsh, 2006; Stanhope, 2019). These models indicate that both internal and external factors may contribute to MSS outcomes. The external factors may include work-related factors, physical load, and psychosocial factors. These factors may have direct, indirect, and/or moderating effects on MSS outcomes. Furthermore, some models suggest feedback loops or bidirectional relationships between factors and MSS outcomes and may consider these factors in the transition from MSSs to the consequences of these MSSs.

These frameworks highlight the important role that external factors may play in the development of MSS outcomes. People who are self-employed may experience different work-related exposures, and psychosocial and physical factors compared with those who are employer-employed. For example, self-employed work is often less secure, more reliant on pro-actively seeking out work opportunities, and maintain their reputation to secure future work. For musicians, being self-employed may place these musicians at increased risk of experiencing MSSs and consequences of MSSs, as their employment status may result in greater unpaid musical practice to improve their reputations even when experiencing MSSs, greater psychosocial stress resulting from their insecure

work, lower social support from other musicians, and less financial security limiting access to early health treatments compared with employer-employed musicians, in addition to lack of access to workers' compensation (Fig. 1). We therefore hypothesised that musicians who were self-employed would have poorer MSS outcomes compared with employer-employed musicians.

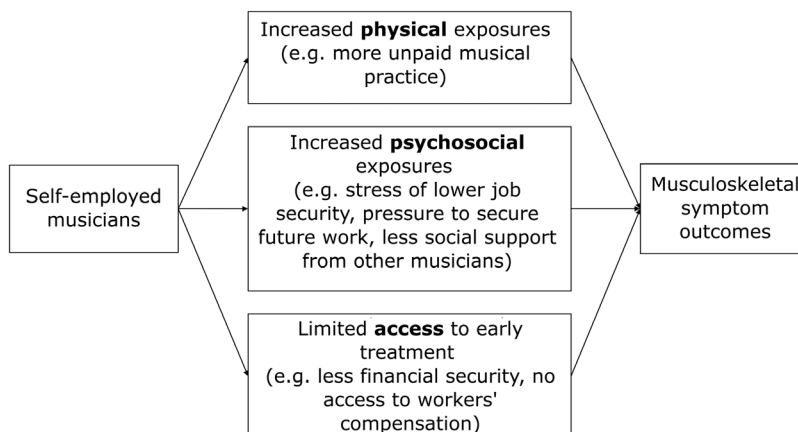
### Methods

This cross-sectional study was approved by The University of Adelaide Human Research Ethics Committee (H-2015-279) and the Australian Defence Organisation Joint Health Command Low-Risk Ethical Review Panel (LREP 16-006).

### Recruitment and sampling

Professional musicians were recruited in 2016–2017 from the Australian Musicians' Union, two Music Teachers' Associations, two universities, three orchestras, two opera companies, two universities, and five military bands, from two Australian states. Musicians were eligible for inclusion if they were aged 18 years or older, and were professional musicians. For the purpose of this study, we defined professional musicians as those who were employed as teachers or performers (instrumentalists, singers, conductors, and drum majors), or who were members of Music Teachers' Associations or the Australian Musicians' Union.

Two recruitment strategies were employed: online and/or face-to-face, depending on organisational policy and logistical constraints. Face-to-face recruitment involved a short presentation regarding the project, and paper questionnaires, information sheets (including the abovementioned inclusion criteria), and reply-paid



**Figure 1.** Proposed theoretical framework.

envelopes, all of which were distributed. Return boxes were also left onsite for 2–3 weeks as another means of returning the questionnaires, while the lead researcher visited the sites within a 2–3-week period where possible. Where permitted by organisational policy, the information sheet also included a Quick Response (QR) code which linked to an online version of the questionnaire (Survey Monkey). Online recruitment involved an email that summarised the project, with the information sheet attached, and a link to the online questionnaire provided. The email was distributed by the relevant organisation. As an incentive, participants who completed the questionnaire within 2–3 weeks could opt to go into a prize-draw.

### Questionnaire

A questionnaire package was developed for this project and was pilot tested prior to administration (Stanhope, 2019). Participants were asked to provide their age, gender, height, and weight (to calculate body mass index [BMI]), residential postcode (to determine socioeconomic status based on the Index of Relative Socioeconomic Advantage and Disadvantage (Australian Bureau of Statistics, 2011)), an estimate of their typical daily sitting time (<4 h, 4–8 h, 8–12 h, >12 h), number of employers in the last 12 months and in the last 7 days, total number of hours of paid work in the last 7 days, time engaged in musical activity in the last 7 days, musical activities in the last 12 months and in the last 7 days (to determine music-related biomechanical exposures), whether they were currently studying music at university, and musical employment information (e.g. self-employed, names of employers in the last 12 months).

Participants were also asked to complete measures of musical career satisfaction, musical social support, psychosocial stress, and psychological distress. Musical career satisfaction was measured using the Michigan Organizational Assessment Questionnaire – Job Satisfaction Scale (Nadler, 1975), which was modified such that it related to musical study and/or work (Stanhope, 2019). The original scale has acceptable construct validity, internal consistency, and test-retest reliability, and has been used with a 5-, 6-, or 7-point Likert scale (Bowling and Hammond, 2008). A 5-point Likert scale was selected for this study, and was examined with musicians using Rasch analysis (Stanhope, 2019). There was no measure available for musical social support, hence the General Nordic Questionnaire for Psychological and Social Factors at Work (QPS<sub>Nordic</sub>) (Dallner *et al.*, 2000) support from co-workers scale was modified for this purpose by specifying that the social support was from other musicians (Stanhope, 2019).

The original scale has been found to be valid and reliable across a range of populations (Wännström *et al.*, 2009), and was tested using Rasch analysis for use with musicians (Stanhope, 2019).

Psychosocial stress was measured using Littman *et al.*'s (2006) two-item psychosocial stress questionnaire. Ratings were made using 6-point rating scales (Littman *et al.*, 2006). The questionnaire has established validity and reliability (Littman *et al.*, 2006), which was further investigated for use with musicians using Rasch analysis (Stanhope, 2019).

To measure psychological distress, the Patient Health Questionnaire-4 (PHQ-4), an ultra-brief screening tool for distress (Kroenke *et al.*, 2009; Löwe *et al.*, 2010) was used. The PHQ-4 has established validity (Kroenke *et al.*, 2009; Löwe *et al.*, 2010; Stanhope, 2016b) and reliability (Stanhope, 2016b). Rasch analysis was used to examine the psychometric properties of the PHQ-4 for use with musicians (Stanhope, 2019).

The questionnaire development for MSS outcomes items was based on a review of the literature specific to musicians (Stanhope *et al.*, 2019b). The Nordic Musculoskeletal Questionnaire (NMQ) (Kuorinka *et al.*, 1987) was used to identify the body regions in which MSSs (ache, pain, discomfort) were experienced in the last 7 days and 12 months. The NMQ is a valid and reliable questionnaire (Kuorinka *et al.*, 1987; Crawford, 2007), that has been used with a range of populations (Crawford, 2007), including musicians (Stanhope *et al.*, 2019b). Three additional body regions were included for this study (head, orofacial, and chest/abdominal regions), and for the 7-day period the laterality of MSSs was also recorded. These changes necessitated a modified body chart (Stanhope, 2019). Participants were also asked to indicate whether they had experienced their MSSs on most days for at least the last 3 months.

Whether MSSs impacted musical activity or not was also investigated, as a common MSS outcome in studies of musicians (Stanhope *et al.*, 2019b). The term used in this study was music-related musculoskeletal disorders (MRMDs), which was an extension of Zaza *et al.*'s (1998) definition of playing-related musculoskeletal disorders, to include singing, conducting, and being a drum major. Zaza *et al.*'s (1998) definition was developed through qualitative work with musicians and health professionals, and has been widely adopted by researchers in this field (Stanhope *et al.*, 2019b). To gather data regarding MRMDs we modified the NMQ, where instead of asking about 'ache, pain or discomfort' we asked about 'music-related musculoskeletal disorders' and provided the following definition: 'pain, weakness, lack of control, numbness, tingling or other symptoms

that have interfered with your ability to do your musical activity at the level to which you are accustomed' (Stanhope, 2019). Musical activities were specified as playing an instrument, singing, conducting, or being a drum major. A similar substitution method in the NMQ for playing-related musculoskeletal disorders has been previously employed (Kok *et al.*, 2016a) using Zaza *et al.*'s (1998) definition. Musicians were asked to indicate their MRMDs in the last 12 months and 7 days, and to indicate the relevant body regions (as per the same body chart as the MSSs), and were also asked whether they had experienced their MRMDs on most days for at least the last 3 months.

Pain intensity in the last 7 days was assessed using three numeric rating scales (NRSs) with anchors 'no pain' (0) and 'pain as bad as you can imagine' (10). Pain intensity was rated at its worst, on average, and at its least, following the recommendations by Dworkin *et al.* (2005), and in accordance with the Brief Pain Inventory-Intensity Scale (Cleeland and Ryan, 1994; Stanhope, 2016a). Pain intensity ratings made on the 11-point NRSs are considered valid and reliable (Ferreira-Valente *et al.*, 2011), and the validity is thought to be improved by combining multiple measures (Von Korff *et al.*, 2000) (e.g. at its worst, on average, and at its least (Chien *et al.*, 2013)). The severity of MRMD was assessed in a similar manner, asking participants to rate the impact of their MSSs on their musical activities, instead of using the anchors 'does not interfere' to 'completely interferes', which were taken from the Brief Pain Inventory-Interference Scale (Cleeland and Ryan, 1994; Stanhope, 2016a). Rasch analysis was used to further investigate the utility of these two scales for pain intensity (Stanhope, 2019; Stanhope and Weinstein, 2021) and MRMD severity (Stanhope, 2019), the implications of which are described further in the data analysis section below.

Musicians were also asked about the broader impact of their MSSs. Musicians were asked whether their MSSs had resulted in changes to, or leave from, work/study in the last 12 months, based on the valid and reliable Extended NMQ (Dawson *et al.*, 2009). Musicians were also asked to indicate whether these consequences related to musical or non-musical work/study. Similarly, musicians were asked whether they had claimed workers' compensation in the last 12 months due to their MSSs, and whether this was for musical or non-musical work.

Health consequences were also considered in terms of the health practitioners consulted (medical professionals; physiotherapists or occupational therapists; psychologists or counsellors; personal trainers, Pilates instructors or yoga instructors; chiropractors, osteopaths, massage therapists, or Bowen therapists; naturopaths

or homeopaths; Alexander technique practitioners, Feldenkrais practitioners, and body mapping teachers; and other) and self-management strategies engaged in (exercises/stretching, medication, heat/ice, braces/strapping/taping, and other) during the last 12 months due to MSSs. Musicians were also asked whether they had consulted another musician about their MSSs in the last 12 months, and whether they were currently having treatment.

Finally, musicians who reported MSSs in the last 7 days were asked to complete the Brief Illness Perception Questionnaire (Broadbent *et al.*, 2006). Ratings were entered on 11-point NRSs for a range of perceptions. The scales are valid and reliable (Broadbent *et al.*, 2006; Broadbent *et al.*, 2015), and have been used in a wide range of studies (Broadbent *et al.*, 2015), including of musicians' MSSs (Kok *et al.*, 2013). As recommended by Broadbent *et al.* (2006) the term 'illness' was changed to the specific condition of interest (in this case ache, pain or discomfort), consistent with the NMQ (Kuorinka *et al.*, 1987).

### Data analysis

Data were cleaned and coded in Microsoft Excel before being exported into Stata 14 (StataCorp, 2015) for further coding and analysis. Body mass indexes (BMIs) were estimated based on height and weight. Residential postcodes were used to determine socio-economic status quartiles from the Index of Relative Socioeconomic Advantage and Disadvantage (Australian Bureau of Statistics, 2011). Due to small numbers in some response categories, sitting time was collapsed into three groups: <4, 4–8, and >8 h. Musical activity time categories were also collapsed into three categories: <10, 10–20, and >20 h. W-scores derived from the Rasch analyses were used instead of raw scores throughout (Stanhope, 2019; Stanhope and Weinstein, 2021). Rasch analysis identified that the combined pain intensity scale was not appropriate (Stanhope, 2019; Stanhope and Weinstein, 2021), hence the pain intensity 'on average' scale was used alone. The median and interquartile range from the 11-point scale was reported, although for analysis a binary variable was created. The pain intensity variable was based on cut-points for 'healthy' community adults using an 11-point NRS for pain intensity (Palos *et al.*, 2006), with ratings of 5 or more considered moderate–severe pain. Similarly, the illness perception ratings were reported as a median and interquartile ranges for the 11-point scales, but were analysed as a binary variable with a median mid-point.

Descriptive statistics were used to summarise the characteristics of the population as well as the prevalence

and profile of MSS outcomes overall and for sub-groups, to address Objective 1. The five most common body regions for both MSSs and MRMDs were the neck, upper back, lower back, shoulder, and wrist/hand in the broader analysis, and were considered to be 'priority regions' (Stanhope, 2019).

For Objectives 2–3, the independent variable was the musician's status as being self-employed only, employer-employed only, or both self-employed and employer-employed. The dependent variables were the MSSs outcomes (MSS and MRMD overall and in each priority body region for the last 12 months and 7 days, chronic MSS and MRMD, leave from work/study, changes to work/study, consulting a health practitioner, engaging in self-management strategies and consulting another musician due to MSSs in the last 12 months, any impact and emotional impact due to MSSs in the last 7 days, and currently having treatment for MSSs, and ratings of pain intensity, MRMD severity, impact of MSSs on daily life and emotional impact of MSSs in the last 7 days). The three groups (self-employed only, employer-employed only, and both self-employed and employer-employed) were compared with regards to potential confounders (body mass index, typical daily sitting time, socioeconomic status, number of employers in the last 12 months and 7 days, hours worked in the last 7 days, whether they were currently studying music, age at which they started their musical activities, years of musical activity, whether they have performed in the last 12 months and 7 days, the amount of musical activity in the last 7 days, selected biomechanical exposures in the last 12 months and 7 days (see [Supplementary Material 1-2](#) for details, available at *Annals of Occupational Hygiene* online), musical career satisfaction, musical social support, psychological distress, and psychosocial stress), and the MSS outcomes of interest. Separate models were developed for each MSS outcome. To compare groups, binary outcomes were analysed using logistic regression, ordinal outcomes using ordered logistic regression, and continuous outcomes using linear regression. The unadjusted analyses were conducted to inform Objective 2, while adjusted analyses were conducted to inform Objective 3. Multivariable models all included age and gender, with the abovementioned potential confounders also considered in the model where the differences between the groups were near-significant ( $P < 0.20$ ). The threshold of  $P < 0.20$  has been recommended to ensure adequate control of potential confounders (Vittinghoff *et al.*, 2012). Final multivariable models were developed using forward and backwards stepwise regression (with age and gender held in all models, and consideration for biological plausibility). The Akaike and Bayesian

information criteria informed model selection. All model assumptions were checked. A 5% level of significance was used throughout.

## Results

A total of 225 professional musicians were included in the study. The majority (57.5) of participants were female, and the median age was 37 years (interquartile range [IQR] 22–54 years); details of the sample demographics for all professional musicians, and musicians classified into the two groups, self-employed and employer-employed, are reported in [Supplementary Material 1](#) (available at *Annals of Work Exposures and Health* online).

The group comprised of 24 (10.7%) participants classified as self-employed only (self-employed group), 90 (40.0%) as employer-employed only (employer-employed group), and 96 (42.7%) as both self-employed and employer-employed (both group). The remaining 15 (6.7%) participants could not be classified as self-employed or employer-employed, and were not included in the comparisons. The median ages were 60.5 years (IQR 20.0–69.5), 37.0 years (IQR 21.0–46.0), and 33.0 years (IQR 21.5–48.0 years) for the self-employed, employer-employed, and both groups, respectively ( $P = 0.021$ ). The self-employed group included 54.2% females, while the employer-employed group included 49.4% females, and the both group included 61.1% females. The demographics of the musicians in the three groups for comparison (self-employed group, employer-employed group, and the both group) are reported in [Supplementary Material 2](#) (available at *Annals of Work Exposures and Health* online).

There were significant differences between the three groups in terms of age, their number of employers (last 12 months and 7 days), years of musical activity, whether they had performed in the last 7 days, the amount of musical activity they engaged in during the last 7 days, their degree of musical social support, and some musical biomechanical exposures.

Details of all MSS outcomes (including the laterality of MSSs) for all professional musicians, all self-employed, and all employer-employed musicians are reported in [Supplementary Material 1](#) (available at *Annals of Work Exposures and Health* online). [Supplementary Material 2](#) (available at *Annals of Work Exposures and Health* online) reports the details for all MSS outcomes for the three comparison groups (self-employed only, employer-employed only, and both self-employed and employer-employed), as well as the unadjusted and adjusted analyses, where  $P < 0.10$ .

### Prevalence of musculoskeletal symptoms

The vast majority of musicians reported MSSs, with a 12-month prevalence of 87.9% and a 7-day prevalence of 71.5% reported (Table 1). Of the musicians who reported MSSs in the last 7 days, 54.6% reported chronic MSSs. Moderate–severe pain was reported by 24.7% of musicians who reported MSSs in the last 7 days. The most common body regions for MSSs were the shoulder, neck, lower back, wrist/hand, and upper back, for all

professional musicians, as well as the three comparison groups, and for both time periods (Table 1).

### Prevalence of music-related musculoskeletal disorders

The 12-month prevalence of MRMDs was 60.2% for all musicians, and the 7-day prevalence was 43.2%. Of the musicians reporting MRMDs in the last 7 days, 67.0% reported chronic MRMDs. For both time periods, the

**Table 1.** 12-Month and 7-day prevalence of musculoskeletal symptoms for all professional musicians, and the self-employed only, employer-employed only, and both self-employed and employer-employed professional musicians.

	All professional musicians	Self-employed only	Employer-employed only	Both self-employed & employer-employed
<b>Last 12 months</b>				
<i>Overall</i>	87.9	90.9	80.9	93.3
<i>Specific body regions</i>				
Head	26.2	27.3	20.5	31.1
Orofacial	26.2	18.2	23.9	32.2
Neck	62.6	45.5	59.1	74.4
Shoulder	63.6	54.5	59.1	70.0
Elbow	20.1	13.6	21.6	22.2
Wrist/hand	48.1	40.9	39.8	54.4
Upper back	43.5	27.3	39.8	51.1
Chest/abdomen	14.5	4.5	14.8	16.7
Lower back	52.8	50.0	48.9	58.9
Hip/thigh	22.0	18.2	17.0	23.3
Knee	22.9	27.3	21.6	22.2
Ankle/foot	19.2	22.7	18.2	18.9
<b>Last 7 days</b>				
<i>Overall</i>	71.5	87.5	63.3	77.4
Chronic <sup>a</sup>	38.6	45.8	31.8	43.8
Moderate–severe pain <sup>b</sup>	24.7	22.2	20.4	25.8
<i>Specific body regions</i>				
Head	15.2	20.8	9.1	18.7
Orofacial	13.8	16.7	6.8	20.9
Neck	37.8	37.5	28.4	49.5
Shoulder	41.9	50.0	38.6	45.1
Elbow	9.2	8.3	10.2	8.8
Wrist/hand	28.6	29.2	22.7	31.9
Upper back	26.3	25.0	22.7	30.8
Chest/abdomen	6.0	4.2	5.7	7.7
Lower back	35.5	41.7	29.5	41.8
Hip/thigh	12.9	8.3	11.4	15.4
Knee	10.6	16.7	10.2	9.9
Ankle/foot	8.3	16.7	9.1	5.5

Note: MSS: musculoskeletal symptom.

<sup>a</sup>Chronic refers to musculoskeletal symptoms on most days for at least the last 3 months.

<sup>b</sup>Ratings were only made by those who reported musculoskeletal symptoms in the last 7 days. Moderate–severe pain refers to ratings of pain on average of 5–10 on an 11-point numeric rating scale. Refer to [Supplementary Material 1-2](#) (available at [Annals of Work Exposures and Health](#) online) for the 95% confidence intervals.

neck, upper back, lower back, shoulder, and wrist/hand were the most commonly affected by MRMDs; consistent across all sub-groups of musicians (Table 2). The median reported severity of MRMDs in the last 7 days was 3 (Table 3).

### Impact of musculoskeletal symptoms

Almost all symptomatic musicians (95.9%) reported that their MSSs had impacted their daily lives, while 79.3% reported an emotional impact of their MSSs.

Of the musicians reporting MSSs in the last 12 months, 13.5% reported making changes to work/study because of MSSs and 21.6% took leave from work/study (Table 4). The majority (69.8%) of symptomatic professional musicians reported consulting a health practitioner in the last 12 months for their MSSs; most commonly medical professionals and physiotherapists/occupational therapists. Of the musicians reporting MSSs in the last 7 days, 40.1% reporting currently having treatment. Self-management strategies were reportedly utilised in

**Table 2.** 12-Month and 7-day prevalence of music-related musculoskeletal disorders for all professional musicians, and the self-employed only, employer-employed only, and both self-employed and employer-employed professional musicians.

	All professional musicians	Self-employed only	Employer-employed only	Both self-employed & employer-employed
<b>Last 12 months</b>				
<i>Overall</i>	60.2	70.8	47.1	71.6
<i>Specific body regions</i>				
Head	10.0	4.2	5.7	16.0
Orofacial	15.0	8.3	11.5	22.3
Neck	39.5	41.7	27.6	52.1
Shoulder	40.0	37.5	28.7	53.2
Elbow	15.9	12.5	14.9	17.0
Wrist/hand	31.8	45.8	20.7	37.2
Upper back	29.5	33.3	20.7	39.4
Chest/abdomen	7.3	0.0	5.7	11.7
Lower back	31.8	33.3	28.7	38.3
Hip/thigh	8.6	4.2	8.0	9.6
Knee	6.4	8.3	6.9	6.4
Ankle/foot	5.9	12.5	6.9	4.3
<b>Last 7 days</b>				
<i>Overall</i>	43.2	58.3	29.9	55.3
Chronic <sup>a</sup>	29.2	43.5	21.8	34.0
<i>Specific body regions</i>				
Head	6.4	4.2	3.4	9.7
Orofacial	8.7	8.3	5.7	12.9
Neck	23.3	29.2	11.5	34.4
Shoulder	26.0	29.2	17.2	35.5
Elbow	7.3	8.3	6.9	8.6
Wrist/hand	19.2	29.2	13.8	22.6
Upper back	19.6	20.8	12.6	26.9
Chest/abdomen	2.7	0.0	2.3	4.3
Lower back	18.3	25.0	14.9	21.5
Hip/thigh	5.9	4.2	5.7	6.5
Knee	3.7	8.3	4.6	2.2
Ankle/foot	4.1	8.3	5.7	2.2

Notes: MRMD: music-related musculoskeletal disorder.

<sup>a</sup>Chronic refers to music-related musculoskeletal disorders on most days for at least the last 3 months. Refer to [Supplementary Material 1-2](#) (available at *Annals of Work Exposures and Health* online) for the 95% confidence intervals.



**Table 3.** Median musculoskeletal symptom outcome ratings made by all symptomatic professional musicians, and the self-employed only, employer-employed only, and both self-employed and employer-employed professional musicians.

	All professional musicians	Self-employed only	Employer-employed only	Both self-employed & employer-employed
Pain intensity on average <sup>a</sup>	3	3	3	3
MRMD severity on average <sup>b</sup>	3	4	2	3
Impact of MSSs on daily life <sup>a</sup>	3	3	3	4
Emotional impact of MSSs <sup>a</sup>	3	3	2	3

Notes: MRMD: music-related musculoskeletal disorder. MSS: musculoskeletal symptom.

<sup>a</sup>Ratings were only made by those who reported musculoskeletal symptoms in the last 7 days.

<sup>b</sup>Ratings were only made by those who reported music-related musculoskeletal disorders. Refer to [Supplementary Material 1-2](#) (available at *Annals of Work Exposures and Health* online) for the interquartile ranges.

**Table 4.** Prevalence of musculoskeletal symptom consequences for all symptomatic professional musicians, and the self-employed only, employer-employed only, and both self-employed and employer-employed professional musicians.

	All professional musicians	Self-employed only	Employer-employed only	Both self-employed & employer-employed
<i>Work/study in the last 12 months</i>				
Leave from work/study	21.6	5.0	18.3	27.2
Leave from musical work/study	15.9	5.0	14.5	21.3
Changes to work/study	13.5	0.0	12.7	16.0
Changes to musical work/study	9.5	0.0	10.3	11.4
<b>Consulting a health practitioner in the last 12 months</b>				
Medical professional	41.6	35.0	33.8	45.7
Physiotherapist/occupational therapist	40.0	40.0	26.8	53.1
Chiropractor/osteopath/massage therapist/Bowen therapist	30.8	20.0	31.0	32.1
Personal trainer/Pilates instructor/yoga instructor	17.3	20.0	15.5	18.5
Psychologist/counsellor	5.4	0.0	7.0	6.2
Naturopath/homeopath	4.3	0.0	2.8	7.4
Alexander technique practitioner/Feldenkrais practitioner/body mapping teacher	4.3	0.0	2.8	7.4
Other <sup>a</sup>	3.8	5.0	1.4	6.2
<b>Self-management in the last 12 months</b>				
Exercises/stretching	82.2	70.0	76.1	90.1
Heat/ice	43.8	35.0	39.4	49.4
Medication	42.2	50.0	36.6	44.4
Braces/strapping/ taping	23.8	35.0	22.5	23.5
Other <sup>b</sup>	7.6	10.0	7.0	7.4
Consulting other musicians in the last 12 months	25.1	20.0	21.7	32.1
Any impact in the last 7 days	95.9	90.5	92.9	100.0
Emotional impact in the last 7 days	79.3	76.2	75.0	84.1
Current treatment	40.1	38.1	31.5	47.8

Notes: The denominator for all prevalence estimates was the number of musicians reporting musculoskeletal symptoms in the last 12 months, with the exception of 'current treatment' where the number of musicians reporting musculoskeletal symptoms in the last 7 days was used.

<sup>a</sup>The other health professionals consulted were exercise physiologists, podiatrist, acupuncturist, Rolfing practitioner.

<sup>b</sup>The other self-management strategies used were improving posture, changing playing position, changing trombone mouthpiece, changing technique, more practice, meditation, hypnosis, massage, gels (e.g. Deep Heat), orthotics, moon boot, and rest. Refer to [Supplementary Material 1-2](#) (available at *Annals of Work Exposures and Health* online) for the 95% confidence intervals.

the past 12 months for MSSs by 88.4% of symptomatic professional musicians, with 82.2% of symptomatic musicians reporting doing exercises/stretches to manage their MSSs. Only 25.1% of symptomatic professional musicians consulted other musicians about their MSSs in the last 12 months.

### Group differences

When comparing the employer-employed and self-employed groups, the self-employed group reported a higher prevalence of MSS in the last 7 days of the unadjusted analyses (Table 5). The self-employed group also reported a higher prevalence of MRMDs in the last 12 months (unadjusted only), and 7 days (unadjusted and adjusted), and a higher prevalence of chronic MRMDs (unadjusted only). Despite these differences, there were no significant differences between the two groups regarding the consequences of MSSs. There were however additional differences related to specific body regions (Table 5).

There were very few significant differences between the self-employed and both group. Musicians in the both group reported a significantly higher prevalence of neck (unadjusted and adjusted), and upper back (adjusted only) MSSs in the last 12 months, compared with the self-employed group (Table 5).

Musicians in the both group reported a higher prevalence of MSSs in the last 12 months and 7 days (unadjusted only), and MRMDs in the last 12 months and 7 days (unadjusted and adjusted), compared with the employer-employed group (Table 5). In addition to reporting a higher prevalence of MSSs and MRMDs in a number of specific body regions, a higher proportion of symptomatic musicians in the both group reported consulting a health professional in the last 12 months for MSSs (unadjusted and adjusted), and currently having treatment (adjusted only), compared with the employer-employed group (Table 5). In addition to the outcomes reported in Table 5, symptomatic musicians in the both group also reported a higher emotional impact of their MSSs compared with the employer-employed group (unadjusted coefficient 0.734, 95% confidence interval 0.089–1.379; adjusted coefficient 0.787, 95% confidence interval 0.120–1.454).

### Discussion

The original contribution of this study is the comparison of musicians of different employment status. Musicians in the employer-employed group reported a significantly lower 7-day prevalence of MSSs compared with those in the self-employed group, but there were no significant differences for the 12-month prevalence or prevalence of chronic MSSs. Similarly, for MRMDs the prevalence

over the last 12 months and the last 7 days was significantly higher for musicians in the both group compared with those in the employer-employed group.

In addition, musicians in the employer-employed group reported a significantly lower 7-day prevalence of MRMDs compared with the self-employed group. Being an employer-employed musician is associated with a lower likelihood of MSS and MRMD, compared with those who are self-employed only or both self-employed and employer-employed. Among the symptomatic musicians, the emotional impact of MSSs was higher for those in the both group, compared with the employer-employed group, another indication that those who are both self-employed and employer-employed face additional burdens related to their MSSs.

More generally, MSSs are common among professional musicians, regardless of their employment status. The 12 month prevalence of MSSs was 87.9%, which is similar to that in previous reports for professional musicians (86–89%) (Kok *et al.*, 2016b), and the general working population (92%) (Widanarko *et al.*, 2011). The reports of chronic MSSs were slightly lower than previous findings (58%) (Kok *et al.*, 2016b), with only 38.6% of musicians reporting chronic MSSs. The 12 month prevalence estimates of MRMD was 60.2%, consistent with previous estimates for professional musicians (41–93%) (Kok *et al.*, 2016b). It has been suggested that musicians are reluctant to seek treatment for their MSSs (Zaza *et al.*, 1998). However, we found the majority of musicians (69.8%) reported consulting a health practitioner in the last 12 months. These were most commonly medical doctors, and physiotherapists/occupational therapists, consistent with the existing literature (Kok *et al.*, 2015). A higher proportion of symptomatic musicians in the both group sought help compared with the employer-employed group. The vast majority (84.7–90.5%) of musicians in all three groups engaged in self-management of their MSSs in the last 12 months. These most commonly included exercises/stretches (70.0–90.1%), which is in contrast with previous reports that musicians prefer more passive management of their MSSs (Stanhope *et al.*, 2014).

Previous qualitative reports have indicated that musicians are reluctant to discuss their MSSs with other musicians for fear of negatively impacting their reputations (Zaza *et al.*, 1998). Consistent with this suggestion, relatively few symptomatic musicians (25.1%) reported consulting another musician about their MSSs in the last 12 months. Although employer-employed musicians have more job security, and would therefore be expected to be more comfortable discussing MSSs with other musicians, there were no significant differences between the three groups of musicians.

**Table 5.** Odds ratio (95% confidence intervals) for the significant ( $P < 0.05$ ) differences between the self-employed only, employer-employed only, and both self-employed and employer-employed professional musicians regarding the 12-month prevalence of music-related musculoskeletal disorders.

	Self-employed only compared with employer-employed only <sup>a</sup>		Self-employed only compared with both self-employed & employer-employed <sup>a</sup>		Both self-employed & employer-employed only compared with employer-employed only <sup>a</sup>	
	Unadjusted	Adjusted	Unadjusted	Adjusted	Unadjusted	Adjusted
<b>MSSs in the last 12 months</b>						
Overall					3.306 (1.238–8.830)*	
Neck			0.286 (0.109–0.750)*	0.305 (0.104–0.890)*	2.017 (1.067–3.811)*	2.406 (1.189–4.869)*
Upper back				0.306 (0.095–0.988)*		
<b>MSSs in the last 7 days</b>						
Overall	4.049 (1.122–14.706)*	5.051 (1.279–20.000)*				
Neck						
<b>MRMDs in the last 12 months</b>						
Overall	2.725 (1.027–7.246)**				1.985 (1.038–3.795)*	
Neck					2.465 (1.327–4.579)**	2.269 (1.191–4.324)*
Shoulder					2.826 (1.530–5.217)**	2.153 (1.108–4.186)*
Wrist/ hand					2.858 (1.537–5.315)**	2.325 (1.188–4.547)*
Upper back	3.247 (1.247–8.403)*	3.472 (1.253–9.615)*			2.818 (1.522–5.219)**	2.984 (1.490–5.976)**
<b>MRMD in the last 7 days</b>						
Overall	3.289 (1.294–8.333)*	3.367 (1.195–9.524)*			2.274 (1.168–4.428)*	2.488 (1.282–4.831)**
Chronic <sup>b</sup>	2.755 (1.045–7.246)*				2.905 (1.573–5.363)**	2.382 (1.198–4.734)*
Neck	3.175 (1.056–9.524)*				4.039 (1.841–8.861)**	2.973 (1.290–6.853)*
Shoulder					2.640 (1.311–5.316)**	
Upper back					2.540 (1.163–5.547)*	
<b>Consequences of MSSs</b>						
Consulted a health professional in the last 12 months					2.286 (1.150–4.542)*	2.393 (1.181–4.851)*
Current treatment						2.157 (1,008–4.616)*

Notes:  
 \* $P < 0.050$ , \*\* $P < 0.010$ , \*\*\* $P < 0.001$ .  
<sup>a</sup>Denotes the reference group.  
<sup>b</sup>Chronic refers the experiencing music-related musculoskeletal disorders on most days for at least the last 3 months.

Overall, musicians who were both self-employed and employer-employed had poorer MSS outcomes compared with those who were employer-employed only. There were few significant differences between musicians who were self-employed only and the other two groups. The lack of significant differences may relate to the relatively small sample size for this group, which may have resulted in a Type II error, particularly given that the descriptive statistics for the self-employed only, and self-employed and employer-employed groups were often similar. The differences between employer-employed and both group cannot simply be explained by the security of employer-employed work. These differences may relate to the need to balance both self-employed and employer-employed work, and less secure self-employed work compared with those who are employer-employed only.

It is possible that musicians' experience with MSSs, particularly MRMDs, might influence their work decisions. For example, musicians who experience consequences of MSSs might be less likely to be employed by an organisation due to the stigma surrounding musicians' MSS, their own confidence or ability to undertake work as musicians on an ongoing basis with little autonomy, or not achieving the same level of musical ability due to MSSs. Due to the cross-sectional design used in this study, we were unable to explore the temporal relationship between the experience of MSSs and status as being self-employed, employer-employed, or both. This design limitation does not, however, change the recommendations regarding target groups for prioritising interventions to prevent and manage MSSs for professional musicians.

Although we examined the psychometric properties of the measures used in the present study with musicians (Stanhope, 2019; Stanhope and Weinstein, 2021), and used valid and reliable measures wherever possible (Stanhope *et al.*, 2019b), some variables only had face validity, established through pilot testing of the questionnaire prior to data collection (Stanhope, 2019). While this is a limitation of the present study, the questions are unlikely to have been interpreted differently between the three groups of musicians (self-employed only, employer-employed musicians, and both self-employed and employer-employed), and are therefore not likely to have substantially impacted our findings related to the comparisons between these three groups of musicians.

Despite self-employed musicians reporting poorer MSS outcomes, self-employed musicians have been neglected in studies of the prevention and management of MSSs in professional musicians (Stanhope *et al.*, 2019a; Stanhope *et al.*, 2022). Although online approaches may

be convenient in meeting this need, musicians have reported a preference for face-to-face strategies (Stanhope, 2018). It is therefore important to understand the unique needs of self-employed musicians in the prevention and management of MSSs, and to investigate the effect of interventions in this more vulnerable group.

Musicians are the original gig workers, with an increasing majority of musicians reporting that they work in a self-employed/freelance capacity (Throsby and Zednik, 2010; Throsby and Petetskaya, 2017). Unlike workers in some other industries, musicians typically anticipate that they will likely be self-employed, at least in part. Musicians will often have teachers and mentors who have been self-employed, and can discuss with their students and mentees the implications of this work, including a lack of access to sick leave and workers' compensation. Such information and support might not be afforded to other types of gig workers.

## Conclusion

The majority of professional musicians have experienced MSSs in the last 12 months. Musicians who were both self-employed and employer-employed reported poorer MSS outcomes compared with those who were employer-employed only. These findings indicate that self-employed musicians require access to MSS prevention and management strategies, which are typically only accessible for employer-employed musicians. Furthermore, the findings of this study have broader implications for workers in the gig economy. Only with a better understanding of the specific needs of such different groups can occupational health interventions be better targeted.

## Supplementary Data

Supplementary data are available at *Annals of Work Exposures and Health* online.

## Acknowledgements

We would like to thank colleagues who provided advice regarding this project, and those who helped facilitate recruitment. We would also like to thank Elizabeth Broadbent for granting permission for us to use the Brief Pain Inventory. J.S. was a recipient of an Australian Government Research Training Program Scholarship, and a SafeWork SA WHS Supplementary Scholarship (funded by the South Australian Government). SafeWork SA and the South Australian Government do not endorse the content of this material, and the views expressed herein do not represent the views of SafeWork SA or the South Australian Government.

## Conflict of Interest

J.S. was a recipient of an Australian Government Research Training Program Scholarship, and a SafeWork SA WHS Supplementary Scholarship (funded by the South Australian Government). Both funding sources were stipends, not direct research funds. The two organisations had no influence over the research itself. SafeWork SA and the South Australian Government do not endorse the content of this material, and the views expressed herein do not represent the views of SafeWork SA or the South Australian Government.

## Data Availability

The data underlying this article cannot be shared publicly due to the need to maintain the privacy of individuals that participated in the study. The data will be shared on reasonable request to the corresponding author, where ethics approval has been granted.

## References

- Australian Bureau of Statistics. (2011) *Census of population and housing: socio-economic indexes for areas (SEIFA)*. Australia: Australian Bureau of Statistics.
- Australian Bureau of Statistics. (2018) *Work-related injuries, Australia, Jul 2017 to Jun 2018*. Australia: Australian Bureau of Statistics.
- Berque P, Gray H, McFadyen A. (2016) Playing-related musculoskeletal problems among professional orchestra musicians in Scotland: a prevalence study using a validated instrument, the Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (MPIQM). *Med Probl Perform Art*; 31: 78–86.
- Bowling NA, Hammond GD. (2008) A meta-analytic examination of the construct validity of the Michigan Organizational Assessment Questionnaire Job Satisfaction Subscale. *J Vocat Behav*; 73: 63–77.
- Broadbent E, Petrie KJ, Main J *et al.* (2006) The Brief Illness Perception Questionnaire. *J Psychosom Res*; 60: 631–7.
- Broadbent E, Wilkes C, Koschwanz H *et al.* (2015) A systematic review and meta-analysis of the Brief Illness Perception Questionnaire. *Psychol Health*; 30: 1361–85.
- Chien CW, Bagraith KS, Khan A *et al.* (2013) Comparative responsiveness of verbal and numerical rating scales to measure pain intensity in patients with chronic pain. *J Pain*; 14: 1653–62.
- Chimenti RL, Van Dillen LR, Prather H *et al.* (2013) Underutilization of worker's compensation insurance among professional orchestral musicians. *Med Probl Perform Art*; 28: 54–60.
- Cleland CS, Ryan KM. (1994) Pain assessment: global use of the Brief Pain Inventory. *Ann Acad Med Singapore*; 23: 129–38.
- Crawford JO. (2007) The Nordic musculoskeletal questionnaire. *Occ Med (Lond)*; 57: 300–1.
- Dallner M, Elo AL, Gamberale F, Hottinen V. (2000) *Validation of the General Nordic Questionnaire (QPSNordic) for psychological and social factors at work*. Copenhagen, Denmark: Nordic Council of Ministers.
- Dawson AP, Steele EJ, Hodges PW *et al.* (2009) Development and test-retest reliability of an extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E): a screening instrument for musculoskeletal pain. *J Pain*; 10: 517–26.
- Dworkin RH, Turk DC, Farrar JT *et al.* (2005) Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. *Pain*; 113: 9–19.
- Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. (2011) Validity of four pain intensity rating scales. *Pain*; 152: 2399–404.
- Gray BJ, Grey CNB, Hookway A *et al.* (2020) Differences in the impact of precarious employment on health across population subgroups: a scoping review. *Perspect Public Heal*; 141: 37–49.
- James SL, Abate D, Abate KH *et al.* (2018) Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet*; 392: 1789–858.
- Karsh B-T. (2006) Theories of work-related musculoskeletal disorders: implications for ergonomic interventions. *Theor Issues Ergon Sci*; 7: 71–88.
- Kok LM, Haitjema S, Groenewegen KA *et al.* (2016a) The influence of a sudden increase in playing time on playing-related musculoskeletal complaints in high-level amateur musicians in a longitudinal cohort study. *PLoS One*; 11: e0163472.
- Kok LM, Huisstede BM, Voorn VM *et al.* (2016b) The occurrence of musculoskeletal complaints among professional musicians: a systematic review. *Int Arch Occup Environ Health*; 89: 373–96.
- Kok LM, Nelissen RG, Huisstede BM. (2015) Prevalence and consequences of arm, neck, and/or shoulder complaints among music academy students: a comparative study. *Med Probl Perform Art*; 30: 163–68.
- Kok LM, Vilet Vlieland TP, Fiocco M *et al.* (2013) Musicians' illness perceptions of musculoskeletal complaints. *Clin Rheumatol*; 32: 487–92.
- Kroenke K, Spitzer RL, Williams JBW *et al.* (2009) An ultra-brief screening scale for anxiety and depression: the PHQ-4. *Psychosomatics*; 50: 613–21.
- Kuorinka I, Jonsson B, Kilbom A *et al.* (1987) Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon*; 18: 233–37.
- Lane T, Collie A, Hassani-Mahmooui B. (2016) *Work-related injury and illness in Australia, 2004 to 2014. What is the incidence of work-related conditions and their impact on time lost from work by state and territory, age, gender and injury type?* Melbourne, Australia: Institute for Safety, Compensation and Recovery Research.
- Littman AJ, White E, Satia JA *et al.* (2006) Reliability and validity of 2 single-item measures of psychosocial stress. *Epidemiology*; 17: 398–403.

- Löwe B, Wahl I, Rose M *et al.* (2010) A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. *J Affect Disord*; 122: 86–95.
- Nadler DA. (1975) *Michigan Organizational Assessment Package. Progress report II*. Ann Arbor, MI: Institute for Social Research, The University of Michigan.
- Paarup HM, Baelum J, Manniche C *et al.* (2012) Occurrence and co-existence of localized musculoskeletal symptoms and findings in work-attending orchestra musicians - an exploratory cross-sectional study. *BMC Res Notes*; 5: 541.
- Palos GR, Mendoza TR, Mobley GM *et al.* (2006) Asking the community about cutpoints used to describe mild, moderate, and severe pain. *J Pain*; 7: 49–56.
- Park J, Han B, Kim Y. (2020) Comparison of occupational health problems of employees and self-employed individuals who work in different fields. *Arch Environ Occup Health*; 75: 98–111.
- Rickert DLL, Barrett MS, Ackermann BJ. (2014) Injury and the orchestral environment: part III. The role of psychosocial factors in the experience of musicians undertaking rehabilitation. *Med Probl Perform Art*; 29: 125–35.
- Rosenbaum AJ, Vanderzanden J, Morse AS *et al.* (2012) Injuries complicating musical practice and performance: the hand surgeon's approach to the musician-patient. *J Hand Surg Am*; 37: 1269–72.
- Stanhope J. (2016a) Brief Pain Inventory review. *Occup Med (Lond)*; 66: 496–97.
- Stanhope J. (2016b) Patient Health Questionnaire-4. *Occup Med (Lond)*; 66: 760–61.
- Stanhope J. (2018) University woodwind students' playing-related injuries: a pilot study investigating beliefs, attitudes and prevention strategies. *Aust J Music Educ*; 52: 29–42.
- Stanhope J. (2019) *The preventable burden of musculoskeletal conditions in Australian musicians: a study of university music students and professional musicians*. Adelaide, Australia: University of Adelaide.
- Stanhope J, Milanese S, Grimmer K. (2014) University woodwind students' experiences with playing-related injuries and their management: a pilot study. *J Pain Res*; 7: 133–48.
- Stanhope J, Tooher R, Pisaniello D *et al.* (2019a) Have musicians' musculoskeletal symptoms been thoroughly addressed? A systematic mapping review. *Int J Occup Med Environ Health*; 32: 291–331.
- Stanhope J, Weinstein P, Tooher R *et al.* (2019b) How do we assess musicians' musculoskeletal symptoms?: a review of outcomes and tools used. *Ind Health*; 57: 454–94.
- Stanhope J, Weinstein P. (2021) Should pain scales be combined? *Int J Epidemiol*; 50: dyab168.633.
- Stanhope J, Weinstein P, Pisaniello D. (2020) What can musicians' claims data reveal about their musculoskeletal conditions? *Arch Environ Occup Health*; 75: 177–90.
- Stanhope J, Weinstein P, Pisaniello D. (2022) The effect of strategies to prevent and manage musicians' musculoskeletal symptoms: a systematic review. *Arch Environ Occup Health*; 77: 185–208.
- StataCorp. (2015) *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.
- Throsby D, Petetskaya K. (2017) *Making art work: an economic study of professional artists in Australia*. Sydney, Australia: Australia Council for the Arts.
- Throsby D, Zednik A. (2010) *Do you really expect to get paid? An economic study of professional artists in Australia*. Sydney, Australia: Australia Council for the Arts.
- Vaag J, Giæver F, Bjerkeset O. (2013) Specific demands and resources in the career of the Norwegian freelance musician. *Arts Health*; 6: 205–22.
- Vittinghoff E, Glidden DV, Shiboski SC *et al.* (2012) *Predictor selection. Regression methods in biostatistics: linear, logistic, survival, and repeated measures models*. New York: Springer.
- Von Korff M, Jensen MP, Koraly P. (2000) Assessing global pain severity by self-report in clinical and health services research. *Spine (Phila Pa 1976)*; 25: 3140–51.
- Wännström I, Peterson U, Asberg M *et al.* (2009) Psychometric properties of scales in the General Nordic Questionnaire for psychological and social factors at work (QPSNordic): confirmatory factor analysis and prediction of certified long-term sickness absence. *Scand J Psychol*; 50: 231–44.
- Widanarko B, Legg S, Stevenson M *et al.* (2011) Prevalence of musculoskeletal symptoms in relation to gender, age, and occupational/industrial group. *Int J Ind Ergon*; 41: 561–72.
- Zaza C, Charles C, Muszynski A. (1998) The meaning of playing-related musculoskeletal disorders to classical musicians. *Soc Sci Med*; 47: 2013–23.