Original Article

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

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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
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 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

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**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 (QPSNordic) (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 (Wänström 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/stretches, 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 MSS 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 |
|----------------------|----------------------------|--------------------|------------------------|----------------------------------------|
| **Last 12 months**   |                            |                    |                        |                                        |
| Overall              | 87.9                       | 90.9               | 80.9                   | 93.3                                   |
| **Specific body regions** |                          |                    |                        |                                        |
| 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                   | 51.4                                   |
| 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                                   |
| **Last 7 days**      |                            |                    |                        |                                        |
| Overall              | 71.5                       | 87.5               | 63.3                   | 77.4                                   |
| Chronic\(^a\)        | 38.6                       | 45.8               | 31.8                   | 43.8                                   |
| Moderate–severe pain\(^b\) | 24.7                  | 22.2               | 20.4                   | 25.8                                   |
| **Specific body regions** |                        |                    |                        |                                        |
| 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.
\(^a\)Chronic refers to musculoskeletal symptoms on most days for at least the last 3 months.
\(^b\)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 |
|----------------------|---------------------------|--------------------|------------------------|----------------------------------------|
| **Last 12 months**   |                           |                    |                        |                                        |
| Overall              | 60.2                      | 70.8               | 47.1                   | 71.6                                   |
| **Specific body regions** |                       |                    |                        |                                        |
| 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                                    |
| **Last 7 days**      |                           |                    |                        |                                        |
| Overall              | 43.2                      | 58.3               | 29.9                   | 55.3                                   |
| Chronic<sup>a</sup> | 29.2                      | 43.5               | 21.8                   | 34.0                                   |
| **Specific body regions** |                       |                    |                        |                                        |
| 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\(^a\)      | 3                          | 3                   | 3                      | 3                                       |
| MRMD severity on average\(^b\)       | 3                          | 4                   | 2                      | 3                                       |
| Impact of MSSs on daily life\(^c\)   | 3                          | 3                   | 3                      | 4                                       |
| Emotional impact of MSS\(^c\)        | 3                          | 3                   | 2                      | 3                                       |

Notes: MRMD: music-related musculoskeletal disorder. MSS: musculoskeletal symptom.
\(^a\)Ratings were only made by those who reported musculoskeletal symptoms in the last 7 days.
\(^b\)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 |
|--------------------------------------|----------------------------|---------------------|------------------------|-----------------------------------------|
| **Work/study in the last 12 months** |                            |                     |                        |                                         |
| 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                                    |
| Consulting a health practitioner in the last 12 months | 69.8 | 75.0 | 58.3 | 76.2 |
| 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\(^a\)                          | 3.8                        | 5.0                 | 1.4                    | 6.2                                     |
| **Self-management in the last 12 months** | 88.4                 | 90.0                | 84.7                   | 90.5                                    |
| Exercises/stretches                  | 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\(^b\)                          | 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.
\(^a\)The other health professionals consulted were exercise physiologists, podiatrist, acupuncturist, Rolfing practitioner.
\(^b\)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 groups. 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>b</sup> | Both self-employed & employer-employed compared with employer-employed only<sup>a</sup> |
|----------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|
|                      | Unadjusted | Adjusted | Unadjusted | Adjusted | Unadjusted | Adjusted |
| MSSs in the last 12 months |                         |                       |           |          |           |          |
| Overall              | 0.286 (0.109–0.750)<sup>*</sup> | 0.305 (0.104–0.890)<sup>*</sup> | 3.306 (1.238–8.830)<sup>*</sup> |
| Neck                 | 0.286 (0.109–0.750)<sup>*</sup> | 0.305 (0.104–0.890)<sup>*</sup> | 2.017 (1.067–3.811)<sup>*</sup> |
| Upper back           | 0.306 (0.095–0.988)<sup>*</sup> | 2.406 (1.189–4.869)<sup>*</sup> |
| MSSs in the last 7 days |                         |                       |           |          |           |          |
| Overall              | 4.049 (1.122–14.706)<sup>*</sup> | 5.051 (1.279–20.000)<sup>*</sup> | 1.985 (1.038–3.795)<sup>*</sup> |
| Neck                 | 2.465 (1.327–4.579)<sup>**</sup> | 2.269 (1.191–4.324)<sup>**</sup> |
| Upper back           | 0.306 (0.095–0.988)<sup>*</sup> | 2.406 (1.189–4.869)<sup>*</sup> |
| MRMDs in the last 12 months |                         |                       |           |          |           |          |
| Overall              | 2.725 (1.027–7.246)<sup>*</sup> | 2.858 (1.537–5.315)<sup>**</sup> | 2.826 (1.530–5.217)<sup>**</sup> |
| Neck                 | 2.153 (1.108–4.186)<sup>**</sup> | 2.325 (1.188–4.547)<sup>**</sup> |
| MRMD in the last 7 days |                         |                       |           |          |           |          |
| Overall              | 3.247 (1.247–8.403)<sup>*</sup> | 3.472 (1.253–9.615)<sup>*</sup> | 2.818 (1.522–5.219)<sup>**</sup> |
| Chronic<sup>b</sup>  | 2.984 (1.490–5.976)<sup>**</sup> | 2.984 (1.490–5.976)<sup>**</sup> |
| Wrist/ hand          | 2.774 (1.168–4.428)<sup>*</sup> | 2.774 (1.168–4.428)<sup>*</sup> |
| Upper back           | 2.488 (1.282–4.831)<sup>**</sup> | 2.677 (1.298–5.518)<sup>**</sup> |
| Consequences of MSSs |                         |                       |           |          |           |          |
| Consulted a health professional in the last 12 months | 2.286 (1.150–4.542)<sup>*</sup> | 2.393 (1.181–4.851)<sup>*</sup> |
| Current treatment    | 2.157 (1.008–4.616)<sup>*</sup> | 2.157 (1.008–4.616)<sup>*</sup> |

Notes:
- <sup>*</sup>$P < 0.050$, **<sup>**$P < 0.010$, ***<sup>***$P < 0.001$.
- <sup>a</sup>Denotes the reference group.
- <sup>b</sup>Chronic refers to 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.

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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 need to maintain the privacy of individuals that participated in the study. The views expressed herein do not represent the views of SafeWork SA or the South Australian Government.

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