Prevalence of Playing-related Musculoskeletal Problems Among Professional Orchestra Musicians in South Africa: an MPIIQM approach

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Abstract

BACKGROUND: The prevalence of playing-related musculoskeletal problems in professional musicians is well documented in the literature, but few studies have been done on South African professional musicians. OBJECTIVE: The present study aimed to evaluate the prevalence of PRMPs, pain intensity, and pain interference among full-time and part-time orchestral musicians, using a validated self-report instrument specifically designed for musicians. METHODS: Seventy-nine full-time and part-time professional orchestral musicians took part in the study and completed the Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (MPIIQM). RESULTS: A lifetime prevalence of PRMPs was 76%, and point prevalence 30%. Of the PRMP group, 30% experienced current pain that interfered with their ability to play. Upper strings reported the most PRMPs. The most commonly reported pain locations were right and left upper limb, neck, forearm, and elbow. The mean pain intensity score for the PRMP group was 16.3 (SD 6.62) (out of 40) and the mean pain interference score 21.2 (SD 9.98) (out of 50). Female musicians reported experiencing pain more frequently and intensely, and also reported more pain sites than males. CONCLUSIONS: This study, the first to make use of a validated self-report instrument, shows that musculoskeletal problems are common among full-time and part-time professional orchestral musicians in South Africa.

Introduction

Musicians in general are particularly vulnerable to work-related injuries. Contributing factors include many hours of constant repetitive movements performed over long periods, ergonomic

constraints, and self-imposed pressures.[1] Elite professional musicians consistently report an alarmingly high (84-90%) percentage of performance-related musculoskeletal pain severe enough to interfere with performance, and in some cases, end careers.[2-3] Musculoskeletal problems are the most common health complaints among musicians with a 12-month prevalence rate of 86-89% in professional and university music students.[4-5]

Playing-related medical disorders (PRMD) include pain, weakness, numbness, tingling, or symptoms that interfere with performance.[6] The vast majority (71%) of studies have focused on classical professional and student musicians. These injuries have led musicians to stop playing altogether or change career. PRMD's are associated with various factors such as gender, hypermobility, and age[7,8] and extrinsic factors such as lack of warming up, number of playing hours, poor posture, and playing technique.[9]

Non-musculoskeletal injuries as a result of psychosocial factors such as performance anxiety, lack of sleep, and general anxiety, leads to increased stress and muscle tension, which in turn, exacerbates musculoskeletal injuries.[2,10,13] Research in this area, however, is inconclusive. Work-related stress was found to be associated with the onset of PRMD.[6,11,12] Kenny and Ackermann found a relationship between music performance anxiety, depression, and PRMDs severity, however, more research is needed to fully understand this complex phenomenon in musicians.[2]

Among the instrument groups concerning pain prevalence, 68% of reported musculoskeletal pain was experienced in the upper extremities by string players, and 32% by wind players.[9,14] String players are particularly at high risk of musculoskeletal injuries in the upper body, shoulder, neck, and jaw.[15-18]

Female instrumentalists report a higher prevalence of PRMD’s compared to males.[6,10,19] Gender was found to be the only individual variable to predict PRMD.[9] Kenny and Ackermann[2] found the female musicians reported significantly more occasions of pain interfering with their performance than males, and had significantly higher mean scores for frequency and severity of PRMDs.

While a large body of research reflects work in the field of injury in musicians the past 30 years, there are still gaps in the literature regarding underreported sub-populations such as opera musicians and military band musicians.[20] Stanhope further suggests that more research is needed to close the geographical bias in the number of primary studies which have mostly been conducted in high-income countries such as Europe (38%) and North America (29%).

Few studies have been conducted in Africa, although the last ten years or so have seen increase research exploring injury prevalence among South African musicians. In 2010 Hols[21] conducted a master's study featuring the injury profiles of two professional orchestras. Similarly, Barnes et al.[22] reported the injury profile of musicians in a professional orchestra Bloemfontein, South Africa. Ajidahun and Phillips[23] explored the prevalence of musculoskeletal injury among instrumental musicians at a center for performing arts in South Africa. More recently Ajudahun et al. [24] focused on musculoskeletal injury in string players in South Africa. This study reported a 77% injury rate in one or more anatomical regions.

Detailed literature reviews of epidemiological surveys revealed limitations in studies reporting on prevalence rates and risk factors among professional musicians. Limitations include lack of validated questionnaires, inconsistent and weak information about psychosocial factors impacting problems, lack of a uniform definition of pain, and insufficient information of the exact site and intensity of pain, and its impact on performance.[25] In answer to these limitations Berque et al.[26] developed a new biopsychosocial self-report questionnaire for professional orchestra musicians, the Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (MPIIQM). The application of the MPIIQM is spreading worldwide as cross-cultural adaption and translations of the instrument are available in German (Möller, 2018)[27], Polish (Cygańska, 2021)[28] and Brazilian (Kochem & Silva, 2021). While the definition PRMD, developed by Zaza and Farewell[6] is widely used in the literature, Berque et al.[26] modified the wording slightly to include the pain/problems instead of pain alone, therefore using the acronym PRMP, referring to playing-related musculoskeletal problems. This article will from now onward also refer to PRMP.

The current study aimed to evaluate the prevalence of PRMPs among full-time and part-time professional orchestral musicians in South Africa using the validated MPIIQM to gather information about pain intensity, pain activity interference, and affective pain interference.

Methods

Following ethics approval by the Ethics Committee of the University Pretoria and permission from relevant orchestra managers, permission was obtained to approach orchestra members. The aims of the study were explained, emphasizing that participation was entirely voluntary and that anonymity would be ensured. A letter of information and informed consent was given to all players. Once participants gave their written informed consent they completed the questionnaire.

Participants

Participants included 79 professional full-time and professional part-time orchestral musicians from six orchestras across South Africa, of which one employs musicians on a full-time basis. The inclusion criteria for the study were that participants are over the age of 18, play in a professional orchestra, and are English speaking. A convenience sampling method was used since musicians were recruited during orchestra rehearsals. The overall response rate was fairly low at approximately 35%. Reasons for the low response rate could include the fact that musicians were not willing to forfeit their break to complete the questionnaire, lack of incentive, and a general lack of trust in research and its outcomes.

Questionnaire and data collection

A printed version of the MPIIQM Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians was used to collect all data. Data were collected over two years. The MPIIQM was designed to address self-reported PRMP's in musicians, as well as to measure the intensity of pain and how much it interfered with normal playing .[26] The instrument was psychometrically tested for validity and evaluated according to the guidelines from the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN). The overall Cronbach's alpha level for the scale was 0.88. The scale consists of 22 items divided into two parts. The first part of the 12 items collects demographic information and history of playing-related pain. The answers include either a total number of hours or yes or no statement. The second half of the remaining 10 items include a rating scale from 0-10. Four of the questions probe pain intensity, and five questions related to pain interference. The pain interference items included two questions on the impact of pain on psychosocial variables (affective interference), and three representing the impact of pain on function. The pain intensity score was calculated as the sum of the four pain intensity questions (0-40), and the pain interference scores the sum of the five pain interference items (0-50). One item included a figure outline of the human body, allowing participants to mark the exact location of the pain. The questionnaire yielded high internal consistency with Cronbach's alpha score for pain interference 0.944 and pain intensity 0.947 respectively.

Statistical analysis

The data were coded before analysis and categories were chosen for musical instruments and anatomical sites. IBM SPSS Statistics for Mac (version 26) was used for the analyses. After testing for normal distribution of the data, differences between the group with PRMP and

those without PRMP were assessed using an independent sample t-test. The observed distribution of categorical variables and the associations between these variables were assessed using the Chi-squared test. Between-group differences were tested using independent sample t-tests and multivariate analysis of variance (MANOVA). All tests were performed using a 5% level of significance (α +0.5).

RESULTS

The sample included 27 (34%) full-time and 52 (66%) part-time professional musicians, representing the following instrument groups: upper strings 36 (46%), lower strings 11 (14%); woodwind 16 (20%) brass 12 (15%); percussion 4 (5%). There were 47 (60%) female musicians and 32 (40%) males. The mean age of the participants was approximately 42 (SD 14.3), ranging from 21 to 71 years. The musicians had played professionally in an orchestra for an average of 19 years (SD 13.6), with a minimum of 1 year and a maximum of 50 years of playing experience. The musicians spent an average of 15.7 (SD 9.03) hours playing in the orchestra and on average 11 (SD 8.70) hours outside of orchestra duty, comprising personal practice, teaching, and other informal engagements. The average total hours playing per week is 27 (SD11.76), with a maximum of 63 hours. Full-time musicians spend an average of 23 (SD 6.92) hours per week playing in the orchestra whereas part-time musicians spent an average of 12 (SD 7.70) hours per week (p=0.001). Full-time musicians' total number of playing hours per week averaged 34.1 (SD 9.45) and part-time musicians 12.7 (SD 11.12) (p=0.001).

TABLE 1. Participant characteristics according to the presence or absence of PRMPs

	With PRMPs (*n*=30) M (SD)	Without PRMPs (*n*=49) M (SD)	p-Value
Gender, M (n=32):F (n=47)	13:17	19:30	
Full-time (n=27):Part-time (n=52)	13:17	14:40	
Age	38.5 (14.33)	43.5 (14.12)	0.852
Years of playing instrument	28.1 (14.64)	31.4 (13.83)	0.779
Years of playing in an orchestra	18.4 (15.01)	19.3 (12.85)	0.131
Weekly hours of playing in the orchestra	18.2 (10.33)	14.3 (7.97)	0.091
Weekly hours of playing outside the orchestra	12.5 (10.92)	10.3 (7.07)	**0.011**
Total weekly hours of playing	31.7 (13.93)	24.9 (11.76)	**0.025**

Data given as mean (SD), except for gender and full-time/part-time

Prevalence rates

The overall lifetime prevalence rate for the experience of PRMPs for the entire sample was 76.4% (n=59), of which 49% (n=38) experienced PRMPs in the past 12 months, 30% (n=24) in the past month, and 30% (n=24) reported having pain currently. (Table 1)

Among the group with PRMPs, 90% reported having experienced pain in the last 12 months, 80% in the last month, and 77% experienced current pain. Pain prevalence between the full-time (n=13) and part-time musicians (n=17) revealed the full-time musicians reported higher slightly higher prevalence of pain over the last 12 months (full-time 59% vs part-time 42%), the past month (full-time 33% vs part-time 28%) and current pain (full-time 33% vs 28%). The point prevalence for the PRMP group included 20% (n=6) PRMPs in one location, 23% (n=7) in two locations, 23% (n=7) in three locations, and 27% (n=8) in four or more locations. By gender, 58% females reported pain in three or more sites versus 38% in males. Males reported 69% pain in two or fewer sites, whereas females 29%.

TABLE 2. Prevalence of PRMPs by anatomical site expressed in numbers and percentages

Anatomical site	Male (*n*=13)	Female (*n*=17)	Total (*n*=30) (%)
Right forearm and elbow	1	5	6 (20%)
Neck	1	6	7 (23%)
Right shoulder and upper arm	5	9	14 (47%)
Right wrist and hand	5	8	13 (43%)
Left forearm and elbow	0	2	2 (7%)
Left shoulder and upper arm	4	10	14 (47%)
Left wrist and hand	4	7	11(37%)
Lower back	6	6	12 (40%)
Upper back	3	8	11 (37%)
Right lower limb	2	0	2 (7%)
Left lower limb	1	2	3 (10%)
Head, face, lips	0	0	0
Stomach	1	0	1 (3%)
No. of pain locations			
One area	6	0	6 (20%)
Two areas	2	5	7 (23%)
Three areas	3	4	7 (23%)
Four areas or more	2	6	8 (27%)

Regarding instrument group and locations of PRMPs, upper strings (n=16) reported the most problems, particularly in the left shoulder and upper arm, right shoulder and upper arm, left wrist, and lower back. The lower strings (n=3) reported equal problems in the right shoulder and upper arm, and right wrist and hand, and two reported problems in their right forearm and elbow, and upper back. Three of the five wind players reported most problems in their right wrist and hand, and two reported problems right and left shoulder and upper arm, as well as left forearm and elbow. Of the five brass players, three reported most problems in their left shoulder and upper arm, and upper back. There was only one percussionist as a participant who reported having pain in the lower back, and right and left lower limb. (Table 3).

TABLE 3. Prevalence of PRMPs by anatomical site and instrument group

Anatomical Site	Upper strings (*n*=16)	Lower strings (*n*=3)	Woodwind (*n*=5)	Brass (*n*=5)	Percussion (*n*=1)	Total* *n*=30 (%)
Right forearm and elbow	3	2	1	-	-	6 (20)
Neck	5	1	1	-	-	7 (23)
Right shoulder and upper arm	9	3	2	1	-	15 (50)
Right wrist and hand	7	3	3	-	-	13 (43)
Left forearm and elbow	-	-	2	-	-	2 (7)
Left shoulder and upper arm	10	-	2	2	-	14 (47)
Left wrist and hand	9	-	1	1	-	11 (37)
Lower back	8	1	1	1	1	12 (40)
Upper back	6	2	1	2	-	11 (37)
Right lower limb	-	-	-	1	1	2 (7)
Left lower limb	1	1	-	-	1	3 (10)
Head, face, lips	-	-	-	-	-	-
Stomach	-	-	-	1	-	-

*Results of the total sample (n=30) and percentage

Pain Intensity and Pain Interference Scores

The total mean scores for the PRMP group for pain intensity was 16.35 (SD 6.62) and pain interference 20.90 (SD 9.98) (Table 4). A multivariate analysis of variance between the groups with PRMP and without PRMPs revealed no significant difference in pain intensity and pain interference in full-time and part-time musicians. In the PRMP group there were no significant differences in pain intensity between male and female nor between instrument group.

Table 4. Pain Intensity and Pain Interference Summary for the PRMP Group by Gender, Full-time/Part-time, and Instrument Group

	Pain Intensity	Pain Interference
Total PRMP group	16.35 (6.62)	20.90 (9.98)
Gender		
Male (n=13)	14.08 (6.07)	20.25 (11.13)
Female (n=17)	18.35 (6.03)	21.35 (9.42)
Full-time	16.46 (6.60)	21.46 (7.91)
Part-time	16.96 (6.23)	20.44 (11.65)
Instrument group (full-time + part-time)		
Upper strings	16.00 (5,69)	19.65 (9.26)
Lower strings	24.00 (3.59)	20.75 (8.77)
Woodwinds	13.75 (7.89)	24.75 (17.98)
Brass	14.25 (4.78)	22.50 (6.35)
Total	16.59 (6.28)	20.90 (9.98)

A risk analysis was conducted to determine whether being a full-time or part-time musician puts an individual at significant risk of developing musculoskeletal pain. The analysis suggested that the risk of developing pain-related symptoms was 1.5 times higher among full-time musicians than in the part-time musicians. However, the results of the Chi-square test suggested that this effect was not significant: $\chi 2\ (1) = 1.8$, $p = .179$.

DISCUSSION

Lifetime prevalence

The lifetime prevalence of PRMPs in this sample of South African professional musicians is 76.4% indicating that the majority of full-time and part-time orchestral musicians experience PRMPs that impacted their performance at some point in their career. The result concurs with many recent studies that report a lifetime prevalence of between 57 to 89%.[5,15,30,31,32]

1-Year Prevalence of PRMPs

The overall 1-year PRMP prevalence rate is 49%. Full-time musicians report a 59.3% 1-year prevalence rate and part-time musicians 42.3%. These rates are similar to other studies that

show prevalence rates of 52% and 41%.[3,33] A meta-analysis by Bragge et al.[34] reports prevalence rates ranging from 26% to 93%. These results are nonetheless alarming in that almost half of professional orchestral musicians are playing with pain defined as “affecting playing capacity” to “disabling pain” that interferes with their performance at some point during their careers.

Point-prevalence of PRMPs

The point-prevalence for the current study was 30%, which is somewhat lower than prevalence rates reported in other studies of between 50% and 61%[30,33] however, closer to the 36.6% reported in orchestral musicians in Scotland.[36] The results of the current study can best be compared to the studies by Berque et al. who made use of the MPIIQM.[37] Both full-time and part-time musicians in South Africa are under much psychosocial strain given the precarious work environment, financial uncertainty, and finding other ways to make a living through ad hoc jobs such as teaching. While studies of freelance classical musicians elsewhere have found that financial insecurity is associated with increased anxiety[37-40] there is no to date no such research in the South African context.

Despite the relatively small sample, the current study showed that female musicians are at higher risk for developing PRMPs. These findings are consistent with other studies.[2,14,33,36,42,43] Moreover, females indicated more often than they experience pain in four or more regions, with higher pain intensity than males. This finding corresponds with other research that also found that women experienced pain in more regions than men, with higher pain intensity ratios.[32,44] Similar to many previous studies,[6,10,32,45] the group that experiences pain is on average five years younger than the group with no pain with a mean age of 39. This finding could be explained by the fact that the PRMP group included more female players, fewer years of playing experience, more playing hours per week. Fishbein et al.[14] found that injury in orchestral players peaked at 35, citing the reason that injury rates decline over time is possibly due to an increased tolerance for problems as musicians resign themselves to problems. However, more recently, Kenny and Ackermann[2] report that musicians in the age range 41-50 experience pain more frequently and more severe compared to younger and older players.

Furthermore, several studies have shown that playing load in the number of hours playing per week has been associated with PRMPs.[7,46,47] The current study showed a significant difference in total hours of playing week between the groups, and that the group that experiences pain has an average of six hours more playing time per week. These findings

suggest that full-time musicians spend more hours per week in a playing environment, resulting in increased workload leading to proneness for injury.

Prevalence by anatomical site and instrument group

In concurrence with numerous studies that have explored the location of PRMDs in professional orchestras, [3,15,25,32,36,] the current study showed that upper strings experienced the most problems in the upper limbs and neck. The body areas most affected were the left shoulder, upper arm, left wrist, and hand for the upper strings, and the right shoulder, upper arm, right wrist and hand, and upper back for the low string players. There are several reasons upper strings report more pain than other instruments, one of which is the amount of time spent playing over time, compared with wind players who start their instrument much later and cannot spend as much time playing due to embouchure restrictions. Nyman et al.[17] found that strings typically have a much heavier workload in terms of repertoire requirements in the orchestra compared to the other instrument groups, carrying the bulk of the playing load. Furthermore, the asymmetric nature of the upper strings place much strain on posture, and combined with many playing hours and poor posture,[17] could exacerbate problems. If one includes the potential impact of stress, anxiety, and tension as a result of psychosocial and affective factors, the combination of elements could explain the higher PRMPs in this population.

Similar to previous studies the upper strings reported the most problems and the brass players reported the lowest prevalence of complaints. While the leading trends in injury sites varied between instrument groups they agreed with other studies. The small sample size within the PRMP group did not allow for statistical tests to be carried out and therefore deserves further investigation.

Pain intensity and Pain interference

There has been no other epidemiological study on professional orchestra musicians in South Africa that has made use of the MPIIQM. The MPIIQM is a self-report instrument specifically designed to measure musculoskeletal pain, pain interference, and the impact of pain on psychosocial and affective constructs. This study, therefore, heeds the call from various researchers to use validated questionnaires to measure pain and its impact on musicians' performance.[5,25,48] The composite mean pain intensity score (four pain items) revealed low to moderate pain intensity (M 16.3, SD1.12). These scores are similar to Berque et al.[26] with a mean score of 12.4 (SD 22). The results are also similar to pain intensity scores (low to

moderate) from other studies with scores ranging from 3.7 and 4.8 out of 10, however, these studies did not specify what they were measuring .[15,25,32,36] There is still a paucity of studies focusing on pain intensity among professional musicians.[37] There is overwhelming evidence that females experience pain differently from males, and generally, prevalence rates are higher among women.[49-51] Pieretti et al.[52] found gender differences in pharmacological therapy and non-pharmacological pain interventions. The reasons that males and females modulate pain differently are attributed to the complex interaction of genetic, anatomical, physiological, neuronal, hormonal, psychological, and social factors. Pieretti et al. conclude that biological factors such as sex hormones are the main mechanisms that explain differences in pain responses. LeResche[50] found that in general females are more likely to report pain in multiple body areas. Our results are in line with LeResche, and similar to Berque et al.,[37] we found that female musicians reported more pain in three or more sites than males.

The overall pain interference score (which measures the impact of pain on playing function and mood) is 20 (out of 50) which is moderate in comparison with Berque et al.,[37] who revealed a lower score of 15.2 (SD 12.39). The mean score for pain interference includes the two affective interference items and the three activity interference items. There are no other composite scores for pain interference available from other orchestra studies.

Factors that may impact the prevalence of injury of South African musicians are training, culture, work health and safety policy, and access to adequate medical care and music-specific health practitioners. Health literacy may also play a role. To date, only one university music department includes a compulsory health literacy and occupational health course for undergraduate musicians. The working environment is challenging for professional musicians. There are currently only two professional orchestras in South Africa that employ musicians full-time. Several orchestras around the country employ professional players on a part-time basis, however, they do not have the funds nor infrastructure to sustain full-time salaries. Ineffective financial management and governance issues have plagued South African orchestras for some time, resulting in job losses and subsequently placing musicians under severe financial pressure and stress. Furthermore, South African musicians do not have access to affordable medical insurance nor specialized medical care, resulting in musicians either not reporting problems to appropriate medical specialists, or leaving problems untreated because of the cost implication.

The study acknowledges several limitations. The overall response rate was low (35%) which could reflect selection bias which affected the reported prevalence rate. The small sample size of the PRMP group is a limitation to the study, particularly regarding the subgroups for

instrument type and full-time and part-time players. The finding that upper string players are most affected by injury needs to be explored in more detail, particularly to find out whether there are differences in injury types between first and second violins and viola players. A larger sample of wind players is required to understand individual differences between woodwind and brass players. Paarup et al.[34] for example concluded that woodwinds are less affected by PRMPs since their instruments are not as heavy as brass instruments. However, Sousa et al.[30] did not find a difference in pain intensity between these groups. A further limitation that must be acknowledged is that the MPIIQM has not been cross-culturally adapted for the South African population. However, the internal reliability of the instrument was robust and all the participants, proficient in English, did not have any problems understanding the item in the questionnaire.

Future research should consider exploring the biomechanical and psychosocial differences between freelance and full-time musicians more closely to understand the impact of lack of job security, financial stress, and job security on injury. The causality of complaints needs to be explored in much more detail to ascertain to what extent injury is a result of playing the instrument or the result of psychosocial and affective factors. Future studies could also focus on the impact of the lack of specialized medical care and support systems, and access to musculoskeletal treatment on injury rates among musicians in SA.

Conclusion

This is the first study to explore PRMPs and pain intensity and pain interference in full-time and part-time South African professional orchestral musicians and contributes toward the geographical differences and prevalence impact of MSS in musicians. The results confirm that PRMPs are highly prevalent among full-time and part-time professional orchestral musicians and suggest that both full-time and part-time orchestral musicians are particularly at risk for PRMPs. This finding is worrying since opportunities for full-time professional employment in South African orchestras are dwindling. These results point to the necessity for specialized therapeutic and preventive strategies, as well as the need for specialized skills addressing governance issues, to address in the performing arts sector to ensure a stable and sustainable working environment for all professional and aspiring professional orchestral musicians in South Africa.

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