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Musculoskeletal Disorders, Pain and Fatigue among String and Wind Music Students

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Abstract
Music students are more likely to get Musculoskeletal Disorders (MSDs), fatigue, and pain. However, limited studies compared MSDs, pain and fatigue between different types of musical instrument players. This study compared MSDs, pain, and fatigue among music students who play wind and string instruments. A cross-sectional study was conducted with a group of music students in one of the universities in Malaysia. No statistical differences in pain and fatigue were found, but more wind players experience MSD at the wrist and hand than string players. Therefore, students who play string instruments should be more watchful with MSD symptoms.

Keywords: Musical instruments, pain, fatigue, musculoskeletal disorder

1.0 Introduction

MSD are medical conditions that affect the body's nerves, tendons, muscles, and supporting systems associated with various areas. Prevalence of MSD was reported between 82% to 86% in a 12-month (Rotter et al., 2020) and ranging between 29% and 90% for lifetime pain (Silva et al., 2015). However, a recent study discovered that despite 80% of them suffering from MSD at some point in their lives, the majority (87%) of the musicians rated good health (Rousseau et al., 2021). Musicians perceive health and MSD as separate entities or that having MSD is part of the norm. MSD could be related to orchestral culture in which the injury is a sign of weakness, failure, and poor musicianship, forcing them to keep the situation to themselves rather than sharing it with their colleagues (Ackermann et al., 2017). Musicians seem to lack trust in the medical model as the model ignores the importance of playing the instruments among the musicians (Guptill, 2012; Wilson et al., 2014).

MSD, pain and fatigue among musicians are common medical problems. These impairments pay a toll on musicians' physical health, psychological, social, and financial (Kok et al., 2016). Due to the career's high physical and psychological demands, musicians are susceptible to various health issues such as MSDs, pain, and fatigue (Zaza, 1998). Physical and psychological factors were interconnected, leading to injury and music performance anxiety (Ackermann & Driscoll, 2010; Guptill, 2011). As the musicians suffer from psychological stress, it causes greater muscle tension, directly contributing to physical symptoms associated with MSD (Rietveld, 2013; Zander et al., 2010). Additionally, the type of musical instruments might contribute to MSDs, pain, and fatigue among musicians (Clemente et al., 2018), but the results are still inconclusive in the literature. Given that limited studies were conducted to compare MSDs, pain, and

fatigue among music students who play wind and string instruments in Malaysia, this study aimed to explore the issue. Specific objectives of the study were to investigate the prevalence of MSDs, pain and fatigue and to examine any differences in MSDs, pain and fatigue between music students who play string and wind instruments.

2.0 Literature Review
Musculoskeletal pain caused by performing musical instruments can lead to performance impairment, sick leave, and the prospect of a musician's career being interrupted prematurely (Steinmetz et al., 2015). Many musicians have suffered from MSD and overuse injuries disorder to the extent that 12% were recorded to leave the profession prematurely (Parry, 2003). This premature retirement is due to overuse and improper technique, poor posture, stress, and insufficient rest that contribute to ailments leading to musicians' careers on hold (Maric et al., 2019). Despite the consequences, musicians usually embrace their pain and continue to play, even when it worsens, because they feel like music is their reason for being rather than just an activity or occupation (Ting & Rocker, 2019). Even though most musicians were experiencing MSD, certain parts of the body were affected more commonly than the rest of the body parts. Several studies showed a consistency that the most affected body parts are the upper extremities (shoulder, wrist, hand, fingers, and thumb) and the vertebrae (neck, upper back, and lower back) (Baadjou et al., 2015; Davies, 2020; Lonsdale & Boon, 2016; Steemers et al., 2020). There were also studies conducted among music students, and they showed that the average monthly and annual prevalence faced by first-year music students was 1.9; 1.77 times higher than none music students (Ballenberger et al., 2018). Meanwhile, in Malaysia, about half of the music students (46.4%) had pain related to MSD to a point where 11.3% were distracted from performing; however, only 6.2% of them had to take significant rest time due to the pain (Lonsdale & Boon, 2016).

Several studies reported that musicians mostly affected by MSD are string instrument players (Baadjou et al., 2016; Kok et al., 2018; Sousa et al., 2017). However, the studies were done only among bowed string instrument players. Upper-string players commonly afflicted the left shoulder (Kok et al., 2018). Meanwhile, violinists have different playing positions. While sitting, it is physiologically harder for violinists than standing, particularly sitting orientated to the right of the music stand compared to being at the left desk, which possibly strains the body and leads to the development of MSD (Spahn et al., 2014).On the other hand, back pain is the most prevalent complaint among contrabassists, as they must frequently bend their backs throughout the performance (Lee et al., 2013). Due to its weight, contrabassists are at risk of developing back injury. Other physical impacts that musicians most likely face are pain and fatigue. A study showed that string players were more likely to experience pain than wind players. However, wind players experienced higher pain intensity than string players, albeit the difference was not statistically significant (Sousa et al., 2017). Apart from that, the right hand and wrist are the most affected body parts for the instrumentalist of woodwinds (Kok et al., 2018). Music students were also not excluded from experiencing pain at a moderate level (Baadjou et al., 2015; Steemers et al., 2020). The nature of playing a musical instrument that involves repetitive movements may cause a musician to experience discomfort, pain, or injury during their life (Bellisle & Decker, 2017). A study among higher education students in the United Kingdom found that an average total score on Chalder Fatigue Scale (CFQ) was 13.2 ± 4.2, lower than that of professional musicians (Araújo et al., 2017).

3.0 Methodology

3.1 Study Design
A cross-sectional study using a survey design was conducted from December 2020 to April 2022. The cross-sectional design allowed the researcher to identify the prevalence and examine the differences in MSDs, pain, and fatigue among music students who play different musical instruments (Nayan et al., 2017). Besides, the design has several advantages, such as saving time and incurring a minimal cost. Ethical approval to conduct the study was obtained from UiTM Research Ethics Committee (reference no: REC/12/2020 (UG/MR/272).

3.2 Study Setting and Participants
Students from the Faculty of Music in one university in Malaysia were approached and invited to participate in this study. Participants were eligible to participate in this study if they were music students enrolled in a course requiring them to play winds or strings. In addition, their primary instrument must be a wind or string instrument, and they must be able to understand English to complete a set of questionnaires. Students who only play instruments for leisure and had a history of hand disorders or impairments due to specific illnesses, disorders, or diseases were excluded from this study.

3.3 Research Instruments
Data was collected using a set of questionnaires consisting of (i) demographic details, (ii) Nordic Musculoskeletal Questionnaires (NMQ), (iii) Numerical Rating Scale (NRS) and (iv) Chalder Fatigue Questionnaire (CFQ). NMQ was used to assess MSD symptoms. NMQ consist of 2 sections; however, only section one was used as per the aim of this study. Section one maps the body according to nine body parts: neck, shoulder, upper back, elbow, lower back, wrist/hand, hip/thighs, knees, and ankles/feet. The respondents were asked questions regarding any musculoskeletal problem in the past 12 months, past 12 months with prevented normal activity and seven days. NRS was used to assess pain levels at rest and while performing an activity (van Berckel et al., 2017). Lastly, CFQ was used to measure fatigue. CFQ consists of 11 total items with two fatigue domains, CFQ physical (items 1-7) and CFQ mental (item 8-11). These items were scored on a 4-point Likert scale, with a higher score indicating greater fatigue. NMQ, NRS and CFQ have adequate validity and reliability with the general population.

3.4 Data Collection Procedure

Data collection was done via an online survey using Microsoft Form (https://forms.office.com/), with questions written in English to maintain the validity and reliability of the instruments tool. The total number of string and wind students in each program was obtained from the student affairs department at the Faculty of Music via email. The online survey was forwarded to a student representative of each program in the Faculty of Music. The representative then disseminated the survey through WhatsApp as a medium to reach the potential participants. Participation in the study was voluntary. The participants consented to participate in the study if they completed the questionnaire. However, if they wished to withdraw from the study, they were allowed to contact the researchers, and their data would be removed from the analysis.

3.4 Data Analysis

The Statistical Package for Social Science (SPSS) version 25.0 software was used to analyse all the data. Prevalence of MSD, pain and fatigue was analysed descriptively. To compare differences in pain and fatigue between string and wind instrument players, an independent *t*-test or Mann-Whitney u-test will be used depending on the normality of the data. In addition, a Chi-square test was used to analyse the differences in MSD between the wind and string instrument players.

4.0 Findings

4.1 Demographic Characteristics

The total population of music students in the Faculty of Music was 262. However, only 103 participants with a 39% respondent rate from 6 different programs completed the survey. The gender distribution of the participants of men and women was 63(61.6%) and 40(38.4%), respectively, with the age range between 18 to 27 years old (median 20.0, mean 20.8). The participants were dominated by right-handed (n=91, 88.4%), and the remaining were left-handed (n=12, 11.6%). The diploma and degree levels were 67(65.1%) and 9(34.9%), respectively. For years of experience and hours of playing daily, the median was 4.0(6.0) and 2.5(2.0), respectively. Some participants played multiple instruments; however, only their main instrument was noted for analysis. The two instrument groups, string and wind, had 69 (67.4%) and 34(32.6%) participants, respectively. String instrument players majority were guitarist (n=31, 36.0%) while wind instrument players were flutist (n=11, 12.8%). Table 1 shows the demographic characteristics of the participants in this study.

Table 1. Demographic characteristics of participants

Demographics		Frequency (n)	Percentage (%)	Mean ± SD/Median (IQR)
Age		-	-	20 (3)
Years of experience		-	-	5.3±4.1
Hour of Playing Daily		-	-	3.0±1.9
Gender	Man	63	61.6	-
	Woman	40	38.4	-
Hand dominant	Right	91	88.4	-
	Left	12	11.6	-
Course level	Diploma	67	65.1	-
	Degree	36	34.9	-
Instrument	String	69	67.4	-
	Wind	34	32.6	-

SD= Standard Deviation, IQR- Interquartile Range

4.2 Prevalence of MSD, Pain and fatigue

Table 2 shows MSD prevalence according to body parts and level of pain and fatigue among the music students. The prevalence was divided into three durations: NMQ in the past 12 months, NMQ in the past 12 months with prevented normal activity, and NMQ in Past 7 days. In each duration, nine body parts were noted to measure the prevalence. For the past 12 months, the most common MSD was neck region with prevalence of 72.2% (n=74) followed by shoulder (68.1%, n= 70) and upper back (65.3%, n=67). However, the upper back (54.1%, n=55) region appeared as the most common MSD body part in the past 12 months with prevented normal activity, followed by the wrist and hand (51.4%, n=53) and then both neck and lower back with the same prevalence (45.9%, n=47). The most common body parts affected by MSD in the past seven days were the shoulder, lower back and both neck and upper back, with a prevalence of 53.1% (n=54), 40.6% (n=42) and 37.5% (n=39), respectively. The median and IQR for Pain at rest and during the activity were 1(4) and 4(4), respectively. The median and IQR for physical and mental fatigue were 7.5(6.25) and 5.0(2.00). For the total fatigue score, the mean and SD were 13.71 ± 5.73.

Table 2. Prevalence of MSD, pain and fatigue among music students

Variables	Median (IQR)/Mean ± SD	12-M (%)	12-M PNA (%)	7-D (%)
Pain at rest	1 (4)	-	-	-
Pain during activity	4 (4)	-	-	-
Physical fatigue	7.5 (6.25)	-	-	-
Mental fatigue	5.0 (2.00)	-	-	-
Total fatigue score	13.71 ± 5.733	-	-	-
MSD (Body Parts)				

Body Part		12-M	12-M PNA	7-D
Neck	-	72.2	45.9	37.5
Shoulder	-	68.1	40.5	53.1
Elbow	-	40.3	37.8	25.0
Wrist/hands	-	55.6	51.4	28.1
Upper back	-	65.3	54.1	37.5
Lower back	-	47.2	45.9	40.6
Hip/tights	-	20.8	18.9	21.9
One or both knee	-	20.8	18.9	21.9
One or both ankle/feet	-	25.0	27.0	28.1

12-M= MSD in past 12 Months
12-M PNA= MSD in Past 12 Months with prevented normal activity
7-D= MSD in Past 7 Days

4.3 The differences in MSD, Pain and Fatigue between string and wind instrument players

A Pearson's chi-square test was used to find the association between instrument type and MSD. The test was only significant at the wrist and hand area in the past seven days χ^2 (1, N = 103) = 5.33, p= 0.02 with more winds (21%, n=7) players compared to strings (5.2%, n=3) player were affected. Cohen's effect size index was 0.57, which can be considered large. MSD problems at the other body parts and duration were not significantly associated with the type of instruments, as shown in Table 3.

Table 3. Differences in MSD between string and wind instrument players

Body Parts	Duration	Instruments Type		χ^2 (df)	P-value
		String n (%)	Wind (%)		
Neck	12-M	42(60.3)	21(60.7)	0.001(1)	0.97
	12-M PA	13(19.0)	7(21.4)	0.07(1)	0.79
	7-D	10(13.8)	5(14.3)	0.004(1)	0.95
Shoulder	12-M	40(58.6)	18(53.6)	0.20(1)	0.66
	12-M PA	12(17.9)	6(17.9)	0.005(1)	0.94
	7-D	13(19.0)	7(21.4)	0.07(1)	0.79
Elbow	12-M	23(32.8)	10(35.7)	0.07(1)	0.79
	12-M PA	10(13.8	6(21.4)	0.81(1)	0.37
	7-D	6(8.6)	4(10.7)	0.10(1)	0.75
Wrist/hands	12-M	32(46.6)	16(46.4)	0.001 (1)	0.99
	12-M PA	13(19.0)	10(28.6)	1.01(1)	0.31
	7-D	4(5.2)	7(21.4)	5.33(1)	0.02*
Upper back	12-M	42(60.3)	15(42.9)	2.33(1)	0.13
	12-M PA	15(22.4)	9(25.0)	0.07(1)	0.79
	7-D	1013.8)	5(14.3)	0.004(1)	0.95
Lower back	12-M	29(41.4)	12(35.7)	0.25(1)	0.62
	12-M PA	12(17.2)	9(25.0)	0.72(1)	0.40
	7-D	11(15.5)	5(14.3)	0.02(1)	0.88
Hip/tights	12-M	13(19.0)	5(14.3)	0.29(1)	0.59
	12-M PA	6(8.6)	2(7.1)	0.06(1)	0.81
	7-D	5(6.9)	4(10.7)	0.37(1)	0.54
One or both knee	12-M	11(15.5)	7(21.4)	0.46(1)	0.50
	12-M PA	5(6.9)	4(10.7)	0.37(1)	0.54
	7-D	4(5.2)	5(14.3)	2.10(1)	0.15
One or both ankle/feet	12-M	12(17.2)	10(28.6)	1.47(1)	0.23
	12-M PA	7(10.3)	5(14.3)	0.29(1)	0.59
	7-D	7(10.3)	4(10.7)	0.003(1)	0.96

12-M= MSD in the past 12 Months
12-M PNA= MSD in the Past 12 Months with prevented normal activity
7-D= MSD in Past 7 Days

A Mann-Whitney u-test indicated that were no significant difference in pain score at rest between the strings (Mean Rank = 41.04, n = 69) and wind instrument players (Mean Rank = 48.59, n = 34) U = 669.50, z = -1.40, p = 0.16. There was also no significant difference in pain during activity between the strings (Mean Rank = 40.25, n = 69) and winds instruments players (Mean Rank = 50.23, n = 34) u = 623.50, z = -1.75, p = 0.08. An independent t-test was used to find differences in mental fatigue and total fatigue score, and Mann- Whitney u test was used to find differences in physical fatigue. There was no significant difference in physical fatigue between string (Mean Rank = 43.01, n = 69) and wind instrument players (Mean Rank = 44.52, n = 34) U = 783.50, z = -0.26, p = 0.79. Similarly, there was also no significant difference in mental fatigue between string (M=4.86, SD=1.94) and wind instrument (M=5.04, SD=2.20), 95% CI (-1.10, 0.75)), t (84) = -0.37, p=0.71 as well as CFQ Total scores between string instrument (13.24, SD= 5.99) and wind instrument player (14.68, SD=5.14), 95% CI (-4.06, 1.18), t (84) = -1.09, p=0.28. Table 4 shows the differences in pain and fatigue between string and wind instrument players.

Table 4. Differences in pain and fatigue between wind and instrument player

Variables	Mean ± SD /Median (IQR)		t stats (df)/ z stats	Mean diff (95% CI)	*p*-value
	Strings (n=69)	Winds (n=34)			
Pain at rest	0.00 (4.00)	2.50(4.00)	-1.-1.40	-	0.16

Pain during activity	4.00 (3.00)	5.50(3.00)	-1.75	-	0.08
Physical fatigue	7.00(6.25)	8.00(7.50)	-0.26	-	0.79
Mental fatigue	4.86±1.94	5.04±2.20	-0.37(84)	-0.17(-1.10, 0.75)	0.71
Total fatigue score	13.24 ± 5.99	14.68 ± 5.14	-1.09(84)	-1.44 (-4.06, 1.18)	0.28

5.0 Discussion

This study aimed to identify the prevalence of MSD, pain and fatigue among music students. Additionally, this study aimed to examine the differences in MSD, pain and fatigue between music students who play different instruments, namely wind and string. In this study, MSD prevalence was measured using NMQ. The most affected body parts are the upper extremities and vertebrae. These findings are consistent with previous studies that reported the most affected body parts were the shoulder, wrist or hand, neck, upper back, and lower back (Baadjou et al., 2015; Davies, 2020; Lonsdale & Boon, 2016; Maric et al., 2019; Steemers et al., 2020). Due to the intensity of activities and repetitive motions, these body parts are susceptible to MSD. The pain level faced by music students was mild to moderate, with mild pain at rest and moderate during activity. This finding was similar to the previous study, which reported a moderate pain level among music students (Baadjou et al., 2015; Steemers et al., 2020). Unfortunately, limited studies have recorded the pain level at rest in a population related to musicians. Therefore, the result could not be compared. The median of physical fatigue was 7.5 out of 21, while mental fatigue was 5 out of 12 possible scores, which indicated low fatigue levels for both components. The current study showed an average fatigue total score of 13.71 ± 5.733, similar to the previous study (13.2 ± 4.2) conducted among higher education music students in the United Kingdom (Araújo et al., 2017). The study also reported that the fatigue level among music students was lower than professional musicians. However, this interpretation shall be carefully made as it was done in another country, where else in Malaysia, a study among professional musicians and music students is not yet available. Music students have low fatigue levels maybe because they are still young and energetic, have good focus and are cognitively active even though their activities are intense and competitive as professional musicians.

This study showed that only one body part significantly differed in MSD, the wrist and hand in the past seven days. The winds instrument player experienced more MSD symptoms than the strings instrument player. This finding was aligned with the previous study, which also found the wrist to be the most affected body part for the instrumentalist of woodwinds (Kok et al., 2018). The current study did not show significant differences in the rest of the body parts and duration between the two instrument types. However, some previous studies reported that MSD was more likely affected by strings players than winds players (Kok et al., 2018; Sousa et al., 2017). It should be noted that the literature was taken from a survey among orchestra musicians only. Therefore, it does not include guitarists in the strings instrument group. However, the guitarists were the majority of participants in the current study. We also found that wind instrument players experienced higher pain intensity and fatigue than string instrument players. However, the finding did statistically significant. This finding was also identical to the previous study, which reported that wind players showed higher pain intensity and fatigue than string players (Sousa et al., 2017). Since the prevalence of MSD is relatively higher among music students, a few implications are derived from this study. First, comprehensive ergonomic assessments and education/training should be provided to the students to resolve this issue. Second, early intervention on this issue is also essential as a proactive strategy to find early signs of MSD and prevent it from happening. Lastly, music students should be provided with ergonomics education and training to minimise the risk of MSD, pain, fatigue and other discomfort conditions.

6.0 Conclusion and Recommendations

In conclusion, this study suggests that the types of music instruments may influence MSDs level among music students. Those playing wind instruments are more likely to have MSDs, especially in wrist and hand areas. The most affected body parts by MSD are the upper extremities and vertebrae areas. This study highlights the need to provide comprehensive ergonomic assessments, early intervention of MSD risks, and education and training on ergonomics to music students to prevent MSD, pain, fatigue and other discomfort conditions. Despite that, this study has several limitations. The response rate was relatively low, most of the participants in the study came from string instrument players, and it was conducted at one university only. Thus, the study's results should be cautiously made and could not be generalised to a wider population. Therefore, a more extensive study involving multiple universities offering music courses in Malaysia is required.

Acknowledgement

Paper Contribution to Related Field of Study

This study provides additional evidence on MSDs, fatigue, and pain among music students in Malaysia. In addition, this study indicates that the type of musical instruments contributes to the risk of developing MSD symptoms. For example, those playing wind instruments are more likely to have MSDs, especially wrist and hand areas.

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