ASSESSMENT OF DEMOGRAPHICS AND UPPER EXTREMITY MUSCULOSKELETAL COMPLAINTS OF KEYBOARD INSTRUMENTALISTS IN BENIN CITY, NIGERIA

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Abstract
This study assessed the demographics and upper extremity musculoskeletal complaints (UE-MSKC) of keyboard instrumentalists in Benin City.
A cross-sectional study on 115 keyboard instrumentalists recruited via consecutive sampling. Participants' age and sex were obtained, while UE-MSKC was assessed with Maastricht upper extremity questionnaire. Descriptive statistics of frequency and percentage were use to summarized the data.
The participants were aged 18-39 years. Majority of the participants were males (81.7%). Majority (62.6%) have played keyboard instruments for 1-5 years, about a third (37.4%) have played for 1 hour without break, while over half (58.3%) played for 5 hours with breaks. A 12 month prevalence of UE-MSKC (98.3%) was found with neck pain being highly prevalent (86.1%). Right UE-MSKC was prevalent in the shoulder (61.7%), upper arm (62.6%), elbow (67.0%), lower arm (63.5%), wrist (63.5%), and hand (61.7%). Majority of the participants feel pain (53.9%) and fatigue (48.7%) immediately after playing. About a third of participants sought physician (31.3%) or physiotherapy service (29.6%). Keyboard instrumentalists in Benin City are male dominated and aged 18-39 years.
This study revealed a high prevalence of UE-MSKC in the neck, right wrist, right elbow and right hand of keyboard instrumentalists in Benin City.

Keywords: *Demographics, Musculoskeletal complaints, Keyboard instrumentalists*.

Introduction

Musculoskeletal disorders (MSDs) are injuries affecting muscles, nerves, ligaments, tendons, capsules, and bony structures caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions (National Institute for Occupational Safety and Health, 2024). Playing musical instruments,

especially those that require repetitive movements may result in a variety of musculoskeletal complaints. Keyboard instrumentalists, string players and guitarists were reported to have a high prevalence of MSDs (Egwuonwu et al., 2016). Keyboard instrumentalists are susceptible to musculoskeletal conditions (Yang, Fufa & Wolff, 2021). These conditions are often termed Playing-Related Musculoskeletal Disorders (PRMSDs). PRMSDs are defined as 'pain, weakness, numbness, tingling or other symptoms that interfere with the ability to play an instrument' (Shinde & Borkar, 2010).

Both professional pianists and non-professional piano players are at risk of PRMSDs, which include conditions related to mechanical strain with symptoms experienced as pain and loss of function (Allsop & Ackland, 2010). Although clinical presentations are widely varied, the PRMSDs that most acutely affect performance are localized to the wrist, forearms, and fingers (Takamizawa & Kenway, 2023). These disorders often limit the musicians' ability to play effectively and for extended periods. The reported lifetime prevalence of PRMSD affecting all musicians is 50% to 88% (Yang et al., 2021). PRMSDs prevalence was observed between 25.8% and 77.0% among keyboard musicians with a higher prevalence in wrists and hands (13.8%-65.8%), neck (9.8%-64.2%), and shoulders (9.8%-59.8%) (Amaral Corrêa et al, 2018).

The PRMSDs conditions suffered by keyboard instrumentalists include carpal tunnel syndrome, lateral epicondylalgia, trigger finger, and De Quervain's tenosynovitis (Ciurana Moñino et al., 2017). Carpal tunnel syndrome occurs when the median nerve is squeezed or compressed as it travels through the wrist causing numbness, tingling, and pain in the hand and forearm (American Academy of Orthopaedic Surgeons, 2022). Lateral epicondylitis, commonly referred to as tennis elbow, describes an overuse injury that occurs secondary to an eccentric overload of the common extensor tendon at the origin of the Extensor Carpi Radialis Brevis Tendon (Buchanan & Varacallo, 2023). Trigger finger, known as stenosing tenosynovitis, arises due to the repetitive use of the fourth finger and the thumb (Jeanmonod, Harberger & Tiwari, 2024). De Quervain tenosynovitis is a condition that involves tendon entrapment affecting the first dorsal compartment of the wrist (Satteson & Tannan, 2023). Although these described PRMSDs conditions are commonly associated with overuse, it is believed that other factors such as improper technique or poor conditioning could be causative agents (Allsop & Ackland, 2010).

Despite the evidence in the literature on upper extremity musculoskeletal complaints (UE-MSKC) among keyboard instrumentalists in other parts of the world, there are relatively little or no studies in African context, especially studies examining UE-MSKC in Nigeria. This hiatus in knowledge gap on what characterize the PRMSDs among keyboard instrumentalists in the local domain is significant given the plethora of musicians in Nigeria who may be users of keyboard instruments. Providing data on the demographics and UE-MSKC of keyboard instrumentalists in local context could enhance its public health importance among users and mitigate its prevalence. Hence, this study was designed to assess the demographics and UE-MSKC of keyboard instrumentalists in Benin City.

Research questions

1. What is the demographic of keyboard instrumentalists in Benin City?
2. What is the prevalence of UE-MSKC among keyboard instrumentalists in Benin City?

3. What is the nature, pattern of referral and job constraints of UE-MSKC in keyboard instrumentalists in Benin City?
4. What posture do keyboard instrumentalists in Benin City adopt when playing keyboard instruments?

Methodology

The study was a cross-sectional design that recruited participants via consecutive sampling technique. Inclusion criteria were keyboard instrumentalists engaged in regular performance and practice in the past 1 year aged 18 years and above, while exclusion criteria were individuals with history of significant musculoskeletal injuries or disorders affecting the hands, wrists, arms, shoulders and low back. Also, individuals who used assistive devices while playing the keyboard and those who were unable to speak and understand English language were excluded from the study. The sample size for this study was determined using Cochran (1977) formula for unknown population. The formula is defined as: $n=Z^2p(1-p)/e^2$, Where: n = initial sample size, Z = Z-score corresponding to the desired confidence level (1.96 for a 95% confidence level), p = estimated proportion of the population (0.88 is used to maximize variability) and e= margin of error (set at 0.05). Thus, n = ((1.96)2 (0.88) (0.12)) / (0.05)2 = 162. However, a total of 115 participants were readily available for the study. Ethical approval for the study was obtained from the Health and Research Ethics Committee of the Edo state ministry of health prior to data collection. Thereafter, participants were approached for participation in the study. Informed consent was secured from all participants. Data was collected from consenting participants with the Maastricht Upper Extremity Questionnaire (MUEQ). The recruitment process entailed outreach to churches and local music schools. The MUEQ was self-administered, although the researcher was available to answer any question regarding the questionnaire from the participants and the questionnaire was collected the same day after completion**.** The Maastricht questionnaire was used to assess the musculoskeletal complaints of the keyboard instrumentalist. The MUEQ is one of the best assessment tools for UE-MSKC that considers workplace and psychosocial factors. Its validity and reliability have been measured and confirmed across countries (Mohammadi et al., 2020). It comprised of different sections. Section A: This sought information on participants' socio-demographics (age, gender), anthropometrics (height, weight and BMI), years of experience, daily and weekly use of keyboard instruments. Section B: This assessed the physical setup of the instrumentalist's workstation. Section C: This obtained the specific body postures adopted during playing. Section D: This evaluated the instrumentalist's control over their practice routine and playing environment. It included questions about how much autonomy they have in deciding how to perform their tasks, manage their practice time, and solve any problems that arise during practice. Section E: This sought information on the physical and mental demands placed on the instrumentalist. Section F: This assessed the instrumentalist's ability to take breaks during practice sessions. Questions examined whether they plan breaks, alternate their posture, or take sufficient rest periods to relieve physical strain. Section G: This evaluated the physical environment where the instrumentalist practices, focusing on factors such as comfort, noise levels, air quality, and lighting. Section H: This investigated specific musculoskeletal complaints experienced by keyboard instrumentalists over the past year. It covered various body regions that are commonly affected by playing, including the neck, shoulders, upper arms, elbows, lower arms, wrists, hands, and the

low back. The instrumentalist was asked to indicate whether they have experienced pain in any of these areas and to specify the affected side (left, right, or both). Section I: This section examined the symptoms that develop specifically after playing the keyboard. It included questions about pain, fatigue, stiffness, numbness, weakness, and swelling in the upper body and low back. The IBM SPSS version 25 was used for data analysis. Descriptive statistics of frequency and percentages were used to summarize data.

Data Analysis and Findings

Table 1.0: Respondents' playing characteristics (n = 115)

No	Items	Frequencies (n)	Percentage
1.	**Gender**		
	Male	94	81.7
	Female	21	18.3
2.	**No of keyboard instrument played**		
	1 instrument	22	19.1
	2 instruments	62	53.9
	3 instruments	21	18.3
	4 instruments	10	8.7
3.	**No of Keyboard instrument currently played**		
	1 instrument	110	95.7
	2 instrument	5	4.3
4.	**Years of playing**		
	1 – 5years	72	62.6
	6 – 10 years	35	30.4
	11 years and above	8	100.0
5.	**No of days of playing in a week**		
	2 days	16	13.9
	3 days	29	25.2
	4 days	34	29.6
	5 days and above	36	31.3
6.	**Hours per day without breaks**		
	1 hours	43	37.4
	2 hours	27	23.5
	3 hours	19	16.5
	4 hours	15	13.0
	5 hours and above	11	9.6
7.	**Hours per day plus Breaks and overtime**		
	1 hour	3	2.6
	2 hours	12	10.4
	3 hours	16	13.9
	4 hours	17	14.8
	5 hours and above	67	58.3

The Table presents the demographics of all participants in the study. A response rate of 100% was obtained for the distributed questionnaire. The participants

were aged 18 to 39 years and majority 94 (81.7) were males. Majority of the respondents were males (81.7%). Most participants reported playing two keyboard instruments (53.9%), while majority (95.7%) currently play one instrument. In terms of playing years, majority (62.6%) of participants have been playing for 1–5 years, 30.4% for 6–10 years, while only 7% have over 11 years. The number of days' participants practice in a week varies, with 31.3% practicing 5 days or more, while practice durations of 3 days and 4 days were reported by 25.2% and 20.6% of respondents, respectively. Participants practice hours were more in 1 hour per day (37.4%) than 2 hours (23.5%), 3 hours (16.5%), and 4 hours (13%), respectively. However, in addition of break time and overtime to practice hours, over half (58.3%) of the respondents spend more than 5 hours practicing per day.

Research question - What is the prevalence of UE-MSKC among keyboard instrumentalists in Benin City?

Table 1.1: Prevalence of musculoskeletal complaints in the neck and upper extremity of respondents (n = 115)

No	Items	Frequency (n)	Percentage (%)
1.	**Neck**		
	There is pain	99	86.1
	No pain	16	13.0
2.	**Shoulder**		
	No pain	17	14.8
	Pain on left	18	15.7
	Pain on right	71	61.7
	Pain on both sides	9	7.8
3.	**Upper arm**		
	No pain	18	15.7
	Pain on left	19	16.5
	Pain on right	72	62.6
	Pain on both sides	6	5.2
4.	**Elbow**		
	No pain	14	12.2
	Pain on left	20	17.4
	Pain on right	77	67.0
	Pain on both sides	4	3.5
5.	**Lower arm**		
	No pain	21	18.3
	Pain on left	18	15.7
	Pain on right	73	63.5
	Pain on both sides	3	2.6
6.	**Wrist**		
	No pain	8	7.0
	Pain on left	21	18.3
	Pain on right	73	63.5
	Pain on both sides	13	11.3
7.	**Hand**		
	No pain	17	14.8
	Pain on left	19	16.5
	Pain on right	71	61.7
	Pain on both sides	8	7.0

Table 1.1 indicates the prevalence of UE-MSKC among participants. Ninety nine participants representing 86.7% reported experiencing pain. In the shoulder, the highest percentage (61.7%) was reported on the right side, followed by 15.7% on the left side, 14.8% and 7.8% experiencing pain on both sides. For the upper arm, 62.6% reported pain on the right, 16.5% on the left, and 5.2% on both sides. In the elbow region, 67% experienced pain on the right, 17.4% on the left, and 3.5% pain on both sides. In the lower arm, pain on the right side was mostly reported at 63.5%, followed by 15.7% on the left side, and 2.6% experiencing pain on both sides. For the wrist, 63.5% reported pain on the right, 18.3% on the left, and 11.3% pain on both sides. Finally, for the hand, 61.7% reported pain on the right, 16.5% on the left, and 7% experiencing pain on both sides.

Research question - What is the nature, pattern of referral and job constraints of musculoskeletal complaints in keyboard instrumentalists in Benin City?

Table 1.2: Nature, pattern of referral and job constraints of musculoskeletal complaints in the upper extremity of respondents (n = 115)

No	Items	Category	Frequency (n)	Percentage (%)
1.	I feel pain as soon as I finish playing	Yes	62	53.9
		No	53	46.1
2.	I feel pain as soon as I finish playing but it goes with rest	Yes	60	96.8
		No	2	3.2
3.	I feel fatigue after playing	Yes	56	48.7
		No	59	51.3
4.	I feel fatigue after playing and it goes with rest	Yes	54	98.2
		No	1	1.8
5.	I feel stiffness in my finger	Yes	50	43.5
		No	65	56.5
6.	I feel stiffness in my finger but it goes with rest	Yes	49	98.0
		No	1	2.0
7.	I feel numbness in my finger	Yes	1	0.9
		No	114	99.1
8.	I feel numbness in my finger which continues after rest	Yes	1	100
		No	0	0
9.	I feel tingling sensation in my finger	Yes	1	0.9
		No	114	99.1
10.	Tingling in my finger continues after play	Yes	1	100
		No	0	0
11.	Had complaints in the past year	Yes	113	98.3
		No	2	1.7
12.	Referred to Physician	Yes	36	31.3
		No	79	68.7
13.	Referred to Physiotherapy	Yes	34	29.6
		No	81	70.4
14.	I have lost job because of pain	Yes	4	3.5
		No	111	96.5
15.	I was absent from work because of pain	Yes	2	1.7
		No	113	98.3
16.	Pain hinders me while playing	Yes	7	6.1
		No	108	93.9
17.	Pain hinders me during leisure	Yes	5	4.3

		No	110	95.7
18.	My complaint is due to past accident	Yes	2	1.7
		No	113	98.3

The musculoskeletal complaints of all participants are presented in Table 1.2. Sixty-two (53.9%) participants of the respondents reported feeling pain immediately after playing keyboards, though nearly all (96.8%) stated that the pain subsides with rest (Table 3). Fatigue after playing was experienced by 48.7% of respondents, with 98.2% noting that it goes away with rest (Table 3). Also in Table 3, finger stiffness was reported by 43.5% of respondents, with 98% of those affected stated that rest alleviates the stiffness. Numbness in the fingers was rare, occurring in only 0.9% of respondents, and persisted even after rest. Similarly, tingling sensations in the fingers were reported by 0.9% of respondents and also continued after playing.

Most (98.3%) respondents reported musculoskeletal complaints in the past year. However, only 31.3% were referred to a physician, and 29.6% to Physiotherapist (Table 3). Despite the prevalence of pain, only 3.5% lost their job due to pain, 1.7% were absent from work because of it, pain hinder 6.1% during playing, while playing and 4.3% during leisure activities (Table 3).

Research question - What posture do keyboard instrumentalists in Benin City adopt when playing keyboard instruments?

Table 1.3: Respondents' body posture while playing the keyboard instrument (n = 115)

No	Items	Frequencies (n)	Percentage (%)
1.	**I keep a good playing posture**		
	Always & Often	102	88.7
	Sometimes	12	10.4
	Seldom & Never	1	0.9
2.	**I sit for long hours in one position**		
	Always & Often	105	91.3
	Sometimes	6	5.2
	Seldom & Never	4	3.5
3.	**I play for more than two hours per day**		
	Always & Often	23	20.0
	Sometimes	84	73.0
	Seldom & Never	8	7.0
4.	**I take awkward posture**		
	Always & Often	17	14.7
	Sometimes	67	58.3
	Seldom & Never	31	27.0
5.	**I perform repetitive tasks**		
	Always & Often	29	25.2
	Sometimes	47	40.9
	Seldom & Never	39	33.9
6.	**Playing is physically exhausting**		
	Always & Often	10	8.7
	Sometimes	48	41.7
	Seldom & Never	57	49.6
7.	**My arms & forearms are aligned**		
	Always & Often	21	18.2
	Sometimes	58	50.4
	Seldom & Never	36	31.3
8.	**My head is bent**		
	Always & Often	19	16.5
	Sometimes	53	46.1
	Seldom & Never	43	37.4
9.	**Head is twisted towards the left or right**		
	Always & Often	12	10.5
	Sometimes	56	48.7
	Seldom & Never	47	40.9
10.	**Trunk is twisted towards the left or right**		
	Always & Often	9	7.8
	Sometimes	62	53.9
	Seldom & Never	44	38.0
11.	**My trunk asymmetrical**		
	Always & Often	11	9.6
	Sometimes	42	36.5
	Seldom & Never	62	53.9

The posture adopted by participants while playing keyboard instruments are presented in Table 1.3. Most (73.9%) of the respondents sit for long hours in the same

position (Table 4). The majority (73.0%) of respondents "sometimes" play for more than two hours daily, with 20.0% always and often doing so (Table 4). More than half (58.3%) of respondents "sometimes" take awkward postures while playing (Table 4). More than a third (40.9%) of the respondents "sometimes" performs repetitive tasks during playing sessions (Table 4). Playing the keyboard was reported as "sometimes" physically exhausting by 41.7% of participants (Table 4). About half (46.1%) of the respondents said they sometimes bend the head while playing keyboard and 48.7% said the head is twisted to the left or right while playing the keyboard (Table 4). The trunk is twisted in more than half (53.9%) of the respondents.

Discussion

The age range of participants suggests that most of the keyboard instrumentalists in Benin City are relatively young adults. This demographic might have a certain level of physical endurance, but could also be prone to developing musculoskeletal issues due to repetitive motions or poor ergonomics during extended practice sessions. That the participants were young adults suggests that the onset of musculoskeletal complaints may begin earlier in one's career, potentially due to habits formed early on in their playing. This finding is consistent with the report of Egwuonwu et al. (2016) who reported age range of 17 to 45 years among string instrumentalists in a Nigerian population. Also, the finding of a high male representation (81.7%) aligns with the observation that keyboard playing may be more commonly practiced by men in this region. Asakitikpi (2018) reported that the Nigerian music industry is male dominated because of the traditional role of the woman in the society, hence, could explain why they are more male keyboard instrumentalists than females in this present study. However, this finding contrasts the report of Pak and Chesky (2001) who reported higher proportion of female keyboard instrumentalists than males among a population of undergraduate students in Texas, United States.

The finding that the majority of participants reported playing one or two keyboard instruments suggests that the keyboard instrumentalists are well-grounded and committed to their craft. This is consistent with research indicating that musicians often develop expertise by focusing on a limited number of instruments, which allows for more dedicated practice and skill refinement (Macnamara & Maitra, 2019). A majority of the respondents have been playing for 1–5 years, indicating a relatively young or early-career population of keyboard instrumentalists in the study area. This demographic highlights the risk of developing musculoskeletal issues early in life, which may lead to the chronicity of such complaints and ultimately impact their physical health and career longevity. Early intervention through preventive education and ergonomic strategies is therefore crucial and could be especially effective in mitigating these risks in this group as recommended by Zaza (1998).

Also, the participants' demographics that the frequency of practice varies, with a notable portion of participants practicing five or more days per week, and substantial percentages practicing 3 to 4 days weekly warrants some attention. This high frequency indicates a strong commitment to skill development but also increases the risk of overuse injuries, especially when practice is combined with inadequate rest or improper technique (Kenny & Ackermann, 2015). Repetitive strain from frequent playing without sufficient recovery time can contribute significantly to

musculoskeletal complaints among musicians. A previous study on keyboard instrumentalists found that the occurrence of overuse syndrome symptoms in keyboardists increases with 72% when the time spent playing the instrument increases (Newmark & Lederman, 1987). That majority of the participants in this present study play for 1 hour daily without break and 5 hours daily with breaks for 3 to 4 days a week could signal a risk factor for UE-MSKC. Studies have demonstrated that the hours spent playing an instrument is a factor in the frequency of musculoskeletal injuries experienced by the players (Brandfonbrener, 1990; Manchester & Flieder, 1991). However, in addition of break time and overtime to practice hours, over half of the respondents spend more than 5 hours practicing per day. This extended duration is a crucial insight despite the fact that the nominal practice time may seem moderate; the actual physical demand on the upper extremities may be considerably higher. This highlights the importance of duration of play when evaluating musculoskeletal complaints and injury risk among keyboard instrumentalists.

Furthermore, this study revealed a high prevalence of UE-MSKC in the neck, right wrist, right elbow and right hand of key board instrumentalists. These findings align with Amaral Corrêa et al. (2018), who reported a high prevalence of musculoskeletal pain among keyboard musicians, particularly in the wrists and hands (13.8–65.8%) and neck (9.8–64.2%). However, the 86.1% neck pain reported in this study exceeds the upper range of 64.2% reported by Amaral Corrêa et al. (2018), likely reflecting unique challenges such as inadequate ergonomic resources and improper training in Benin City. The finding of this study of prevalence UE-MSKC on the right could be due to the fact that majority of the participants were right handed, which although was not assessed in this study. More interesting is the report of a large proportion of the participants that they feel pain and fatigue as soon as they finish playing, while 98.3% reported pain in the past year. These findings is consistent with the report of Egwuonwu et al. (2016) that observed 81.7% 12 month prevalence of musculoskeletal pain , and could explain the long term effects of playing keyboards on the musculoskeletal system of keyboardists. However, these pains were found to be relieved in majority of the participants with rest, thereby echoing the need for observing rests with keyboard play. Although only a third of the participants sought the services of a physician or physiotherapists for their pain indicating the need for creating awareness among keyboard instrumentalists on the role of physiotherapists and physicians in mitigating musculoskeletal pain. Both physiotherapist and physician care are necessary in mitigating musculoskeletal pain (Marks et al., 2017; Matifat et al., 2019).

Additionally, a majority of participants reported bending their necks and twisting their wrists while playing. This finding is consistent with Ohlendorf et al. (2017), who identified poor posture as a leading cause of chronic pain among musicians. The static muscle strain resulting from sustained awkward postures places excessive mechanical stress on joints and soft tissues, increasing the risk of overuse injuries. Also, the findings of dominance of right-side complaints may corresponds to the frequent use of the dominant hand in playing, particularly for tasks requiring repetitive motion and sustained force. Similar findings were reported by Kok et al. (2016), who observed higher musculoskeletal complaints in musicians' dominant hands due to prolonged use during performances and practice. The study supports the recommendation by Chi et al. (2021) to consider ergonomically scaled keyboards for

individuals with smaller HS to minimize physical strain and enhance performance. It is essential for keyboard players to adopt proper ergonomic practices when playing. This includes adjusting seating, keyboard height, and hand positioning to reduce strain on the musculoskeletal system. Players should also consider using supportive accessories like wrist rests or adjustable chairs. Musicians should be educated on the importance of maintaining good posture and the risks of musculoskeletal disorders. Incorporating regular exercises that strengthen or stretches the muscles of the upper body as applicable could mitigate the risk of injury.

However, the non-inclusion of psychological dimension of UE-MSKC may be a limitation in this study as it warrants attention because of the psychosocial dimension of pain. Stress and performance pressure are known to exacerbate physical symptoms (Ballenberger, Moller & Zalpour, 2018). Addressing both the physical and mental well-being of musicians is therefore critical for effective prevention and management of MSDs.

Conclusion

In conclusion, most of the keyboard instrumentalists in Benin City are young adults with very high proportion of males. Majority of them play one or two keyboard instruments indicating that they are well-grounded and committed to their craft. At least, a substantial percentage of the keyboard instrumentalists practice for 3 to 4 days per week, which though may indicate a strong commitment to skill development, but also increases the risk of overuse injuries.

Also, a high prevalence of UE-MSKC exists in the neck, right wrist, right elbow and right hand of keyboard instrumentalists in Benin City, while majority of them bend the neck and twist the wrist while playing.

Recommendation

This study recommends the need for ergonomic and preventive education among keyboard instrumentalists in Benin City. Given that most of the keyboard instrumentalists were young adults and that they practice routinely, there is a strong case for introducing ergonomic training, regular breaks, and possibly physiotherapy awareness to reduce UE-MSKC and prevent long-term injury risk.

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