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A Survey on Prevalence of Work-Related Musculoskeletal Disorder Symptoms among Radiographers in Hospital Sultanah Bahiyah, Alor Setar, Kedah

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Abstract

The increasing incidence of work-related musculoskeletal disorders among radiographers was an area of concern in the healthcare system. The increasing demand for radiology services, and the ergonomic hazards faced by most radiographers make them more susceptible for musculoskeletal problems. This study was done to assess the prevalence and severity of musculoskeletal symptoms among radiographers in Hospital Sultanah Bahiyah, Alor Setar, Kedah. A survey was conducted on 55 radiographers. Information collected included demographic data, prevalence and severity of musculoskeletal symptoms, and potential risk factors. 100% of respondents reported experiencing at least one episode of symptoms in the past 12 months, while 92.7% reported the same in the last seven days. Lower back pain was the most frequent symptom (83.6%), followed by neck pain (67.3%), and right shoulder pain (61.8%). Some of the respondents were unable to perform their duties due to the symptoms. The major risk factors were lifting of heavy load (67.3%), prolonged stretching of the shoulder (65.5%) and the neck (58.2%). Demographics data and work tasks were found to be associated with prevalence of musculoskeletal symptoms. There is significant evidence of

musculoskeletal symptoms among radiographers in this study. Intervention is necessary to prevent this situation from getting worse.

Keywords: Work-Related Musculoskeletal Symptoms, Lower Back Pain, Prevalence, Radiographers

Introduction

WMSD is one inflammatory and degenerative disease that affects muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels (Sirajudeen et al., 2018). WMSDs are situations in which the work environment and work performance play a significant contribution to the development of the disorder (CDC, 2020). It is mainly due to excessive force, repetition of movement, simply poor posture and work practices, poor fitness, poor health, and other ergonomics hazard. Musculoskeletal disorders are considered a major public health burden and have a major impact on society, especially on workers and employers. The data from Institute of Labour Market Information and Analysis (ILMIA) website shows a trend of increment from 2005 – 2021 for National Occupational Accident and Disease Statistics 2021. Occupational Musculoskeletal Disorder were ranked 3rd highest (201 cases) diseases by category behind Occupational Noise-related Hearing disorder (3,648 cases) and Disease caused by biological agent (1350 cases) (https://www.ilmia.gov.my/index.php/en/bda-noa). Some of the The health of employees, organisational productivity, and a country's economy are all significantly impacted, which is why it is a growing problem worldwide. The major contributors to the escalating statistics of WMSD in Malaysia include the aging workforce, industrialization, and a lack of safety standards and regulations in the workplace (National Institute of Occupational Safety and Health Malaysia, 2016).

The prevalence of WMSDs has become an area of concern for healthcare professionals since the nature of their work is physically demanding, and with several psychosocial hazards they face, they are more vulnerable to the risk of developing WMSDs (Rahman et al., 2021). Rahman et al (2021) stated two findings on the study of nurses in Malaysia, stated that the association between different workplaces and carrying heavy loads with prevalence of back pain among nurses is significant (Rahmah e tal., 2008). Another study supported the finding which clearly stated that work tasks of nurses that mainly include lifting heavy loads by transferring patients from or to beds daily cause them at high risk of developing WMSDs (Anap D e tal., 2013). Okeji et al. (2015) conducted a study regarding the patterns of WMSD among practicing sonographers in Enugu State, Nigeria showed the prevalence of WMSD was 88.1%, with shoulder pain being the most experienced symptom among the Sonographers (81.43%) followed by low back pain (62.86%).

In recent years, several research has been done showing overwhelming evidence of WMSD symptoms among radiographers. This is reasonable given the nature of their work, such as repetitive movements in the patient's position, strong energy, manual handling, and prolonged sitting, especially in Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) procedures (Sommerich et al., 2020). A survey conducted by Udoh et al (2019) found that low back pain was the most frequent complaint among the radiographers (52.6%). The study also identified the extent to which the severity of WMSD affects them, where approximately 66.8% of them were excused from duties due to the symptoms they experienced. WMSD may also lead to the increasing number of sick leaves, declining in performance or in a worse case scenario forcing them to resign from their current work Kursun et al (2014); Rambabu et al (2014) or choose to retire at early age which increase social-economic costs (Ribeiro et al., 2017). Several kinds of research have been carried out to

investigate the prevalence and risk factors of WMSD, where the results proved that the work tasks performed by radiographers such as lifting and moving patients, and the frequent operation of X-ray machines mainly influenced the presence of WMSD (Daniel et al., 2018). Okeji et al (2019) also found that the main causes of lower back pain among radiographers were prolonged standing and walking during the procedure, manual manipulating of equipment, and frequent repositioning the patient or cassette; Okeji et al. concluded that the physical nature of the radiographer's job was one of the factors to contribute to WMSD. In addition, individual factors such as age, gender, and specialty in X-ray modalities also influenced the symptoms development of WMSDs as revealed in the study of (Al Shammari et al., 2019).

Although a high prevalence of WMSD among some groups of healthcare professionals has been reported in several studies in Malaysia (Rahman et al., 2021), few studies have been conducted on radiographers even though they perform a great variety of tasks, and to our knowledge, little is known about the prevalence and risk factors of WMSD among radiographers at a referral hospital in Malaysia because awareness of occupational safety for radiographers had been concentrated on radiation exposure safety, compared to work-related MSD (Albander, 2021). Arguably, radiographers' occupational health risks have received insufficient attention compared to others. Therefore, the aim of this study is to assess the prevalence and severity of WMSD among radiographers at Hospital Sultanah Bahiyah in Alor Setar, Kedah, as well as the relationship between demographic and potential risk factors in the development of WMSD. Hence, the significance of the findings in this study was rebound to the benefits of radiographers as it gives them a better understanding of work- related musculoskeletal changes such as injuries and illness involving sprains/strains, joint inflammation, low back pain, and nerve compression syndromes.

Materials and Methods

This research was done by using a quantitative approach. A cross-sectional survey using close-ended questions was chosen to assess the prevalence and severity of musculoskeletal disorders among radiographers at Hospital Sultanah Bahiyah, Alor Setar Kedah. The questionnaires were adapted from previous articles that derived and modified the Nordic Musculoskeletal Questionnaires (NMQ) (Al Shammari et al., 2019, Dong et al., 2019; Heggannavar et al., 2020). There were 47 questions, which were divided into three sections: section one was related to demographic data such as age, gender, works duration and experience, and specialty; section two was related to the assessment and severity of musculoskeletal symptoms; and section three was related to potential risk factors associated with WMSD. All questions were close-ended questions using dichotomous scales except for the demographic data, WMSD severity, and factors of WMSD which were multiple-choice questions.

A pilot study was conducted to highlight any ambiguity in questions and to test their reliability and validity before use. Cronbach alpha values were calculated after the pilot study were conducted and its reliability gave a coefficient of 0.83. Once the pilot study was completed, the questionnaires were then distributed to all qualified radiographers working at the Department of Radiology, Hospital Sultanah Bahiyah, Alor Setar, Kedah. The period of data collection in this study was conducted within two months, from May until the end of June 2022. The google form questionnaire was disseminated electronically (link provided) through social media such as WhatsApp and Telegram to the radiographers.

The significant target population for this study was the radiographers working at Hospital Sultanah Bahiyah, Alor Setar Kedah. The purpose of targeting this population because they worked at the regional referral centres for 8 government hospitals, 12 Health Clinics in the district of Kota Setar and Pendang, and 11 private hospitals. This predicts that the demands for radiological services also high, considering its complete availability of modalities and services. Therefore, making this population suitable to evaluate the prevalence of the musculoskeletal disorder among radiographers.

The calculation for the sample size for this study was using Raosoft, Inc. sample size calculator. The margin of error that can be tolerated was set at 5%. The confidence level was set at 95% and the population size was estimated at 60. The population size for this study was according to the number of radiographers who actively worked in Hospital Sultanah Bahiyah, Alor Setar Kedah. The response distribution was set at 50% due to time constraint during data collection period. A total of 55 radiographers involved in this study met the inclusion criteria of at least one year of continuous clinical practice experience, a daily work period of at least 6–8 hours, and free from recent injuries or congenital defects.

Descriptive statistics were used to obtain the mean, standard deviation, and frequency of the variables studied. Statistical software (SPSS version 23.0, IBM Corportaion) was used to achieve objectives two and three, as well as to complete the hypotheses testing. Chi-square test was used for both objectives in this study, to assess the significant association between the demographic factors and work characteristics on the development of musculoskeletal symptoms, and to assess the significant association between potential risk factors on the development of musculoskeletal symptoms. The statistical significance level was set at $P \leq 0.05$.

The ethical consideration had been approved by the University of Technology Mara (UiTM) Faculty Research Ethics Committee (FREC) with reference number: FREC/FSK/MR/2022/0141 and the Medical Imaging Research Ethics Committee (MI-REC). All methods and rules have been implemented under the guidelines and rules of the research ethics committee. The participants were provided an online consent form and approved their participation in this study without any constraint.

Results and Discussion

Socio-Demographic Frequency

As shown in Table 1, more than half of the respondents in this study were males (52.7%). The mean age of the respondents was 2.55 ± 0.835 with most of respondents (40.0%) fall within the age group of 25–35 years. More than half of the respondents (52.7%) have work experiences as radiographers more than ten years. The mean of the working experiences was 2.38 ± 0.733 years. For daily work duration, the mean was 1.56 ± 0.501 hours, with most of them (56.4%) worked for more than eight hours. Right-handed dominance had the highest frequency (60.0%). In this study, most radiographers specialized in radiography and fluoroscopy with a total of 18 respondents (32.7%).

Table 1
Socio-demographic frequency of respondents

Variables	f (%)	Mean
Gender		
Male	29 (52.7%)	
Female	26 (47.3%)	
Age Group		2.55 ± 0.835
< 25	5 (9.1%)	
25–35	22 (40.0%)	
36–45	21 (38.2%)	
46–55	7 (12.7%)	
> 55	0	
Working Experiences		2.38 ± 0.733
1–5 years	8 (14.5%)	
6–10 years	18 (32.7%)	
> 10 years	29 (52.7%)	
Daily Work Duration		1.56 ± 0.501
6–8 hours	24 (43.6%)	
> 8 hours	31 (56.4%)	
Handedness		
Right-handed	33 (60.0%)	
Left-handed	22 (40.0%)	
Specialty		
General/mobile, CT scan	14 (25.5%)	
General/mobile, MRI	11 (20.0%)	
General/mobile, fluoroscopy	18 (32.7%)	
General/mobile, OT	12 (21.8%)	

Prevalence of Work-Related Musculoskeletal Disorder

The prevalence of WMSD reported in this study was 100% with at least one episode of symptoms in any part of the body in the past 12 months. We found that the most prevalent region of WMSD in the past 12 months was lower back (83.6%), followed by neck (67.3%), and right shoulder (61.8%) (Table 2). While in the past seven days, the most prevalent region of WMSD was also lower back (65.5%), followed by neck (54.5%), and upper back (47.3%) (Table 3). Some of them were aware the interference of their symptoms on their daily work due to lower back pain (36.4%), neck pain (32.7%), and upper back (27.3%) (Table 4).

These results are comparable with the finding by Ibrahim et al (2012) in which the most affected anatomy was lower back (88.2%) followed by neck (76.5%) and shoulder (60.3%) in the past 12 months, while in the past 7 days reported 44.1% cases of lower back pain and elbow pain and 39.5% cases of wrist pain. This was justified because of these three affected areas are often involved in the daily routine tasks of healthcare workers such as twisting the neck, extending the shoulder to reach, manual handling and lifting, and repetitive work (Rahman et al., 2021). Other than that, upper back pain (58.2%), left shoulder pain (43.6%) and knees pain (43.6%) also shows a significant prevalence rate in the past 12 months. Consistent with our findings in the most affected body region, Daniel et al (2018) and Udoh et al (2019) also found the low back pain as high prevalence rate of MSD reported with 36.6% and 52.6%, respectively. This was supported by the evident in the study of Lamar (2004), where occurrence of lower back pain might be due to the different techniques used in performing various tasks. Daniel et al (2018) also, agreed in their study, where prolonged static sitting and standing were the main cause of WRMSD, especially among radiographers who perform Ultrasound, CT scan and MRI procedures.

Our study reported a higher prevalence rate of WMSDs than other studies by Lorusso et al (2007); Ibrahim et al (2012) with 67% and 50%, respectively. These differences in WMSDs prevalence rates can be considered due to differences in sample size, differences in exposure to ergonomic hazards, and differences in the physical demands of work tasks in each hospital. Nevertheless, there were also studies with almost similar results to our prevalence rate, namely Evans et al (2021); Okeji et al (2015); Daniel et al (2018) who identified the prevalence rates of WMSDs among radiology technologists to be 81%, 88.4%, and 93.3% of cases, respectively.

Table 2
Prevalence of WMSD in the past 12 months (N = 55)

Musculoskeletal Disorder		**With (%)**	**Without (%)**
Overall, with at least one symptom		55 (100)	0
Neck		**37 (67.3)**	18 (32.7)
Shoulder	**Right**	**34 (61.8)**	21 (38.2)
	Left	24 (43.6)	31 (56.4)
Elbow	Right	2 (3.6)	53 (96.4)
	Left	1 (1.8)	54 (98.2)
Wrist/hand	Right	16 (29.1)	39 (70.9)
	Left	6 (10.9)	49 (89.1)
Upper back		32 (58.2)	23 (41.8)
Lower back		**46 (83.6)**	9 (16.4)
Hips/thighs		7 (12.7)	48 (87.3)
Knees		24 (43.6)	31 (56.4)
Ankles/feet		23 (41.8)	32 (58.2)

Table 3
Prevalence of WMSDs in the past seven days (N = 55)

Prevalence at any site = 92.7%			
Musculoskeletal Disorder		**With (%)**	**Without (%)**
Overall, with at least one symptom		51 (92.7)	4 (7.27)
Neck		**30 (54.5)**	25 (45.5)
Shoulder	Right	25 (45.5)	30 (54.5)
	Left	23 (41.8)	32 (58.2)
Elbow	Right	0	55 (100)
	Left	0	55 (100)
Wrist/hand	Right	8 (14.5)	47 (85.5)
	Left	4 (7.3)	51 (92.7)
Upper back		**26 (47.3)**	29 (52.7)
Lower back		**36 (65.5)**	19 (34.5)
Hips/thighs		3 (5.5)	52 (94.5)
Knees		13 (23.6)	42 (76.4)
Ankles/feet		17(30.9)	38 (69.1)

Table 4
WMSD Interference in the past 12 months (N = 55)

Interference at any site = 58.2%			
Musculoskeletal Disorder		**With (%)**	**Without (%)**
Overall, with at least one symptom		32 (58.2)	23 (41.8)
Neck		**18 (32.7)**	37 (67.3)
Shoulder	Right	4 (7.3)	51 (92.7)
	Left	4 (7.3)	51 (92.7)
Elbow	Right	0	55 (100)
	Left	0	55 (100)
Wrist/hand	Right	2 (3.6)	53 (96.4)
	Left	0	55 (100)
Upper back		**15 (27.3)**	40 (72.7)
Lower back		**20 (36.4)**	35 (63.6)
One/both hips/thighs		1 (1.8)	54 (98.2)
Knees		5 (9.1)	50 (90.9)
Ankles/feet		3 (5.5)	52 (94.5)

Severity of WMSD among Radiographers

Despite no report of radiographers being hospitalized and most of them managed to work with symptoms of low back pain, neck pain, and shoulder pain, some were having difficulties due to the symptoms. Some radiographers were required to change their duty temporarily due to symptoms of lower back pain (13.0%), neck pain (8.1%), and shoulder pain (10.3%), while some were excused from duty due to symptoms of lower back pain (13.0%) and neck pain (16.2%) (Table 5). Since severity in low back pain can be analysed when absence from work increase Dunn et al (2005), our findings shows that the number of absences due to lower back pain symptoms among radiographers was not in a concerning situation. Our results were lower than those reported by Alrowayeh et al (2021) who found that approximately 65.2% of

participants were aware with the symptoms that interfering with their daily work activities, and 60.8% had made changes in their work habits including changing the duties or amount of patient contact. The fact that it was reported that there was a high job demand and most of them worked at least 40 hours a week may explained the disparity in their severity effect with the findings of our study.

Table 5
Severity of WMSD among respondents

Severity	**Low Back Pain**	**Neck Pain**	**Shoulder Pain**
	f (%)	f (%)	f (%)
Hospitalized due to symptoms	0	0	0
Changed duty temporarily due to symptoms	6 (13.0%)	3 (8.1%)	4 (10.3%)
Excused from duty due to symptoms	6 (13.0%)	6 (16.2%)	0
Managed to work with symptoms	34 (73.9%)	28 (75.7%)	35 (89.7%)

Association Between Body Part with WMSD

Table 6 summarizes the association between body part with WMSD. A few socio-demographic variables such as work duration, handedness, and imaging modality specialty, were found to be significantly associated with the WMSD in certain of body part. Daily work duration showed significant association with the prevalence of WMSD of left shoulder ($p = 0.013$), which is consistent with the previous studies by Daniel et al (2018) where 93.3% respondents who work six hours and above with daily high caseload had higher incidence rate of developing WMSD. Additionally, our study found significant association between hand dominant (right handedness, $p = 0.008$; left handedness, $p = 0.022$) of radiographers with neck pain ($p = 0.026$) and right shoulder pain ($p = 0.002$). This can be explained by the fact that overuse of the dominant arm, or hand in handling tasks can lead to the repetitive strain injury (RSI) (Ayers S et al., 2007). In line with our findings, Yizengaw et al (2021) also showed similar results between these two correlations. As we know, WMSD are known to be in strong association with the physical demands such as repetitive movement, awkward postures, and heavy lifting or pushing in the job (Noor, 2021). Therefore, in one supportive study, it was justified by the hypothesis that when working hours increase, the time exposed to the physical demands during work increases as well and this consequently led to the higher prevalence of musculoskeletal diseases (Lipscomb et al., 2002). In addition to such an ergonomic aspect, increase in working hours may result reduction in recovery time of accumulated exhaustion and leisure time to relieve stresses (Lee et al., 2018).

In another perspective, imaging modality specialty were found to be significantly associated with prevalence of upper back pain ($p = 0.008$), one knee pain ($p = 0.021$) and one ankle pain ($p = 0.018$). Lorusso et al (2007) found that physical workload or work task had a significant association with the prevalence of WMSD. About 62% of the respondents in his study reported working in the department such as general radiography, interventional radiography, emergency, and mobile radiography requiring a high physical workload. This result was supported by Landry et al (2008) which suggested the nature of specific duties in procedure such as patient management and lifts/transfers of patient may be more predictive for prevalence of WMSD. Nevertheless, a study conducted by Alrowayeh et al (2021) found non-significant association between area of specialty and prevalence of low back pain.

Table 6
Association between body part with WMSD

Chi Square Test, (P < 0.05)				
Body part		Daily work duration	Handedness	Imaging modality specialty
Shoulder	Right	0.515	**0.002**	0.058
	Left	**0.013**	0.824	0.246
Wrist/hand	Right	0.557	**0.008**	0.225
	Left	0.228	**0.022**	0.236
Neck		0.933	**0.026**	0.08
Upper back		0.262	0.655	**0.008**
One knee		0.796	0.059	**0.021**
One ankle		0.568	0.315	**0.018**

Association between Potential Risk Factors with WMSD

In Table 7, there were five activities that lead to potential risks factors associated with prevalence of WMSD. Lifting of heavy load/patients was found to be correlated with prevalence of low back pain (p = 0.002). Repetitive movement such bending and twisting of lumbar region shows significant association with prevalence of low back pain (p = 0.013) and upper back pain (p = 0.010). This suggests that frequent flexion and extension during manual lifting of heavy loads expose a high stress received by the lumbar region, consequently, increases the risk for back injury such as slip disc and annular tears (Tariq et al., 2023). A previous study by Deros et al (2014); Thon et al (2016) also in agreement that work tasks commonly involved in the hospital environment such as heavy manual lifting activities increased the prevalence of MSD.

Wearing heavy lead gown for long periods as WMSD potential risk factor showed significant association to the prevalence of right shoulder pain (p = 0.013) and left wrist and hand pain (p = 0.048). Many studies suggested that overuse of lead gown was associated with a high prevalence of musculoskeletal problems, mostly those related to the spine (Monaco et al., 2020). In the studies by Goldstein et al (2004); Birnie et al (2011), both found a high prevalence of musculoskeletal problems involving spine injuries, significantly associated with number of years by physicians performing invasive procedures related to the requirement of wearing lead gown. The results were also consistent with Klein et al (2015); Orme et al (2015) who found significant association between a history of WMSD with fluoroscopy-guided procedures requiring a lead apron, with a 67% increase in the prevalence of musculoskeletal pain. The possible explanation was the average weight of lead gown was approximately 15-pound, which 15-pound of lead apron can add an extra 15-50 pounds of pressures directly on the shoulder girdle and the vertebral discs (Cheon et al., 2018)

There was also a significant association between excessive stretching of the neck and prolonged stretching of the shoulder to the occurrence of WMSD. Incidence of neck pain correlate with the excessive stretching of the neck (p = 0.000) and one ankle/feet pain (p = 0.003). While incidence of shoulder pain correlate with the prolonged stretching of the shoulder (p = 0.000, on right shoulder and p = 0.000, on left shoulder). Neck pain and shoulder pain usually occur during the handling of X-ray tube, especially ceiling-mounted tube as the radiographers were required to work with one hand above shoulder level to reach the X-ray tube, extending their neck and shoulder to position the X-ray tube parallel to centering point of region of interest (Alrowayeh et al., 2021).

Table 7
Association between potential risk factors with WMSD

Chi Square Test, (P < 0.05)						
Body part		Repetitive movement (bending, twisting) of lumbar region	Lifting heavy load/patients	Wearing heavy lead gown for long periods	Excessive stretching of the neck	Prolonged stretching of the shoulder
Shoulder	Right	0.135	0.606	**0.013**	0.902	**0.000**
	Left	0.333	0.214	0.620	0.568	**0.000**
Wrist/Hand	Right	0.612	0.629	0.303	0.678	0.186
	Left	0.362	0.339	**0.048**	0.115	0.059
Neck		0.631	0.247	0.208	**0.000**	0.895
Upper back		**0.010**	0.759	0.803	0.444	0.544
Lower back		**0.013**	**0.002**	0.947	0.193	0.106
One ankle		0.698	0.783	0.425	**0.003**	0.544

Conclusion

Our study indicates that radiographers at Hospital Sultanah Bahiyah, Kedah are not exempt from high risk of WMSD. However, the severity level is still manageable as majority of them managed to work with their symptoms. The most prevalence of WMSD symptoms was related to the nature of the radiographer's work tasks, rather than demographic factors. Hence, there are many ways involved in the reduction and prevention of work-related musculoskeletal disorder (WRMSD). The article by Evans et al (2021) have highlighted some intervention efforts, such as limiting or rotating work duties in fluoroscopy, reducing other physically demanding aspects of work, addressing staff shortages, and promoting employee self-care practices. Micro breaks of two minutes every 20–40 minutes work, changing posture after a prolonged static posture, and reduction in the patient manual handling, are all the methods that should be implemented by radiographers during their duties (Cornelis et al., 2021).

Limitation and Recommendation

This study was hampered by the relatively small number of participants, where the population size only involves one hospital, resulting in low statistical power. In addition, the results of the survey were more likely to be affected by events that may occur during the distribution of the questionnaire and the response period, such as staff turnover or reduction, adjustments in management, and institutional environment. Moreover, the findings for the severity of WMSD in this study cannot be inferred for the overall symptoms as the survey on severity was limited to focusing on three common body parts, not for the whole body.

For future studies, it is recommended to involve larger sample size with several hospitals to increase the generalizability and statistical power. It is also recommended for the future researcher to include face-to-face interviews for deep analysis of potential risk factors in the work. In the analysis of severity of WMSD, it is recommended to use the appropriate tool such as visual analogue scale (VAS) (Torgbenu et al., 2017).

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