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Work-related musculoskeletal disorders among dental staff in south Malaysia

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ABSTRACT

The dental industry poses ergonomic health concerns, leading to work-related musculoskeletal disorders (MSD) among staff. This study aims to assess MSD incidence and related sociodemographic and occupational hazard factors among dental practitioners in Johor, Malaysia. A cross-sectional investigation in December 2022 included 382 dental officers from government and commercial sectors. Participants comprised 79.2% females, 72.3% Malays, 97.4% non-smokers, and 92.4% working in dental clinics. MSD was most prevalent in the neck, shoulder, and lower back regions. Logistic regression revealed higher neck pain probability among smokers and a positive association between back pain and standing while working. Poisson regression indicated an inverse relationship between exercise frequency and MSD pain occurrence. Regular physical activity correlated with lower body mass index (BMI) and reduced MSD pain. The study underscores the importance of ergonomic interventions and promoting exercise to prevent MSD and enhance the well-being of dental staff in Johor, Malaysia. Understanding the factors contributing to MSD among dental practitioners is crucial for implementing effective preventive measures and improving overall occupational health in the dental industry.

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1. INTRODUCTION

The musculoskeletal system encompasses a complex network of anatomical structures, including muscles, tendons, and ligaments, as well as bones, joints, and their respective supporting components. Musculoskeletal disorders (MSD) are defined as conditions that affect the musculoskeletal system, resulting in muscular pain or impairments [1]. These conditions can be caused by a single event or cumulative stress and can significantly impact an individual's ability to perform daily activities. MSD symptoms may comprise of sensations of discomfort, numbness, aching, and pain, which can potentially hinder routine activities of daily living. Research on self-reported MSD has indicated a significant occurrence rate among dental healthcare personnel [2]. To this day, the incidence of musculoskeletal pain remains notably elevated within this profession. The prevalence of musculoskeletal disease and pain among dental professionals in Western countries was investigated by Lietz *et al*. [3] through a meta-analysis of 30 studies published between 2005

and 2017. According to the authors' findings, the neck region appears to be the most affected area, as a reported 58.5% of dentists reported experiencing neck pain within the past 12 months. Besides that, the lumbar region was identified as the second most affected anatomical region, with 56.4% of dental professionals reporting its occurrence.

Ergonomic risk factors pertaining to work are a classification of risk factors associated with MSD. According to Chenna *et al*. [4] the three primary ergonomic risk factors are high task repetition, strong exertions, and prolonged uncomfortable postures. There exists a multitude of recurrent duties or occupations that are commonly regulated by predetermined hourly or daily output objectives. MSD may arise when there is a confluence of high task repetition. According to Punnett and Wegman [5] certain activities or tasks can expose the human body to substantial force loads. The intense physical activity requires substantial muscular exertion, leading to fatigue and potentially leading to the development of MSD [6]. When workers maintain an uncomfortable working position, the joints, muscles, and tendons surrounding the joints may experience an excessive amount of force. According to Smith *et al*. [7] this risk factor encompasses suboptimal work practises, substandard health practises, insufficient opportunities for relaxation and recovery, and inadequate dietary habits, physical fitness, and hydration. This classification encompasses employees who exhibit unfavourable work practises, insufficient lifting techniques, tobacco consumption, alcohol intake, obesity, inadequate periods of rest and recuperation, malnourishment, frequent dehydration, and a suboptimal level of physical fitness [8].

As a routine aspect of their professional duties, dentist staff are required to maintain a static posture of their head, neck, shoulders, and other anatomical regions. In the present scenario, dental professionals are susceptible to experiencing MSD, psychological stress, fatigue, cumulative trauma disorder, and occupational health risks [9]. Sustained and uncomfortable bodily positions that involve the rotation or forward bending of the head, neck, and torso towards one side can lead to the strengthening and contraction of the muscles on the side of the intended movement, while simultaneously causing the weakening and elongation of the opposing muscles. Muscles that are under stress, overextended, or weakened are susceptible to ischemic or necrotic conditions. Under typical circumstances, damaged tissues undergo a process of restoration during periods of rest. Regrettably, in dentistry, the inadequate recuperation period for muscles often results in muscle necrosis, as the pace of damage exceeds that of restoration. According to Al-Rawi *et al*. [10] the phenomenon ultimately culminates in the emergence of MSD. The rising prevalence of MSD has led to reduced efficiency, premature retirement, and a surge in sick leave among dental professionals. As a result, there was a rise in the awareness of global MSD [11]. Multiple research studies have indicated an inverse correlation between the prevalence of MSD and the number of years of experience [12]. According to Shams-Hosseini *et al*. [13] it has been asserted that dentists acquire expertise through clinical practise and modify their occupational stance to prevent any potential pain or discomfort. This implies that dental students may manifest indications of MSD as early as their initial years of education. Furthermore, major occupational risk variables include repetitive force, mechanical stressors, posture, vibration, cold temperature, and extrinsic stress [14]. Although there have been numerous studies on MSD globally, there have been few focused on dental staff in Johor, Malaysia. The objective of this investigation was to determine the prevalence of MSD and the potential correlation between sociodemographic factors and MSD among dental officers in Johor, Malaysia.

2. RESEARCH METHOD

This research is a cross-sectional study that was carried out in December of 2022 untill February 2023. Prior to the initiation of the study, informed consent was obtained from the participants. The study's participants were recruited from dental staff employed in both public and private sectors located in state of Johor, Malaysia. The sample size was determined using OpenEpi software, which utilized current statistical data to estimate the total number of dental personnel. In the absence of pre-existing evaluations, a cautious estimate of 50% was used. A sample size of 380 was found to be the minimum requirement to attain a 95% confidence interval with a 5% margin of error. The decision for increasing the sample size was taken in expectation of a considerable rate of response to the online survey. The participants were administered the nordic musculoskeletal questionnaire and provided with instructions to independently complete the questionnaire. The nordic musculoskeletal questionnaire is a questionnaire that is self-administered and self-validated [15]. It is commonly utilised in occupational health settings for the purpose of assessing and screening musculoskeletal problem symptoms. As a tool for assessing and tracking musculoskeletal symptoms, it exhibits high levels of reproducibility and sensitivity. The questionnaire was comprised of two distinct sections. The initial segment encompassed demographic data. The subsequent section of the questionnaire aims to ascertain the prevalence of musculoskeletal symptoms such as discomfort, pain, and ache across different anatomical regions. The data were analysed using the statistical package for the social sciences (IBM SPSS statistics version 25.0). The Chi-square statistic was used to examine the relationship between groups. The Poisson regression technique was utilised to examine the relationship between the

incidence of musculoskeletal pain and sociodemographic factors. Using negative binomial regression, the association between exercise and, gender and exercise, and musculoskeletal pain (yes/no) was determined. The participants were provided with an introductory page that explicitly stated their right to withdraw from the survey at any point in time. Furthermore, their consent was mandatory prior to their participation. The collection of internet protocol (IP) addresses of the participants was not undertaken. The principal investigator was granted access to the survey account to ensure the safeguarding of participants' identities and privacy.

3. RESULTS AND DISCUSSION

The demographics of the 382 dental staff who participated in the study are presented in Table 1, The dental clinic employs most of the staff, specifically (92.4%), with a predominance of female participants. Most participants identified as Malay (72.3%) and reported being non-smokers (91.6%). As per the report, a mere 49.2% of the participants successfully attained a degree or higher. Additionally, (48.4%) of the participants were identified as dental officers. Furthermore, the study found that a significant proportion of the participants (63.4%) held sitting job roles, while most of the participants (58.1%) were classified as overweight based on their body mass index (BMI) category.

Table 1. Sociodemographic of participants

Variable		Frequency/ (%)	Mean/STD
Workplace	Hospital	29 (7.6)	0.92 (0.265)
	dental clinic	353 (92.4)	
Gender	Male	70 (18.3)	0.82 (0.387)
	Female	312 (81.7)	
Race	Malay	276 (72.3)	0.6 (1.062)
	Chinese	29 (7.6)	
	Indians	31 (8.1)	
	Others	46 (12)	
Education level	SPM/STPM/certificate	110 (28.8)	1.2 (0.86)
	Diploma	84 (22)	
	Degree and above	188 (49.2)	
Job category	Dental officer	185 (48.4)	0.91 (1.117)
	Dental surgery assistant	119 (31.2)	
	Dental specialist	6 (1.6)	
	Dental therapist	72 (18.8)	
Smoking status	Smoker	32 (8.4)	0.97 (0.16)
	Nonsmoker	350 (91.6)	
BMI	Normal	112 (29.7)	1.3 (0.86)
	Overweight	221 (58.1)	
	Obesity	47 (12.2)	
Frequency of exercise	Once a week	223 (58.4)	0.9 (1.229)
	Three times a week	58 (15.2)	
	5 times a week	16 (4.2)	
	Never exercise.	85 (22.3)	
Working position	Standing	140 (36.6)	0.63 (0.482)
	Sitting	242 (63.4)	

The data presented in Figure 1 displays the percentage variance in musculoskeletal pain experienced by dental professionals across 11 distinct locations. The prevalent regions of MSD were identified as the neck (63%), shoulder (62%), and lower back (62%). The area with the lowest percentage was the thigh, accounting for (28.7%) of the total. Table 2 displays the results of the logistic regression analysis performed to examine the association between sociodemographic factors and the prevalence of musculoskeletal pain among dental personnel. The likelihood of experiencing neck pain was found to be (1.786) times higher among smokers. Furthermore, it was observed that there was a positive correlation between the occurrence of back pain and the likelihood of standing during work, with an odds ratio of (1.59). There is a positive correlation between musculoskeletal pain in the neck and having an abnormal BMI, with an odds ratio of (1.03). The findings of a poison regression model are presented in Table 3, which aimed to investigate the correlation between age, gender, exercise frequency, and the total number of musculoskeletal among the participants. The Chi-square likelihood ratio indicates that the overall model is statistically significant with a p-value of less than 0.01. The findings suggest that there exists a negative correlation between the incidence of musculoskeletal pain and exercise frequency. This implies that an increase in exercise frequency is associated with a reduction of (1.121) in musculoskeletal pain. Table 4 indicates that a statistically significant

association was observed between the frequency of exercise and both musculoskeletal pain and BMI, as determined through binomial regression analysis. The findings of the study indicate an inverse relationship between physical activity and BMI, with physically active individuals exhibiting lower BMI values ($p<0.01$).

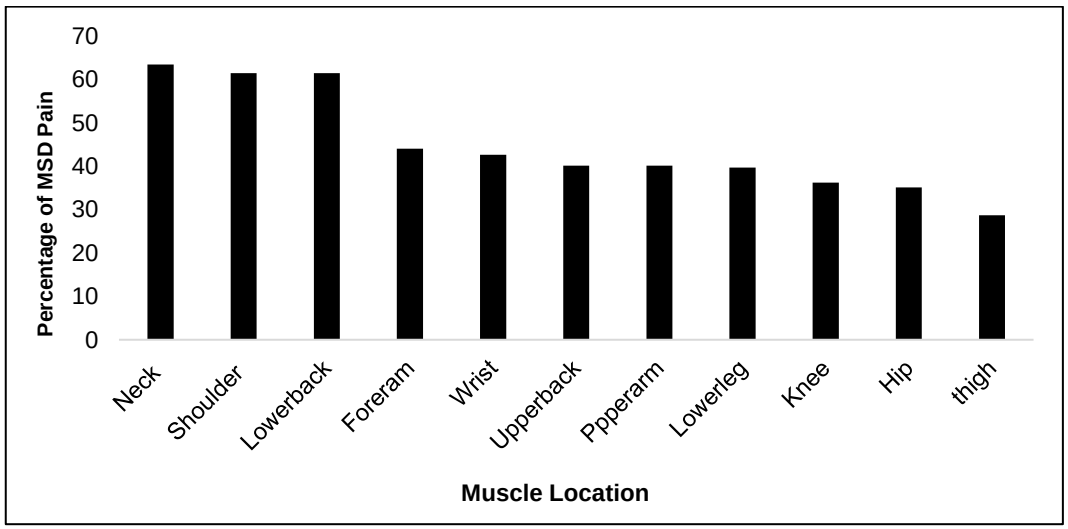

Figure 1. Location of musculoskeletal pain among dental staff

Table 2. Association between sociodemographic and common musculoskeletal pain

Variables		Frequency	Neck pain			Shoulder pain			Backpain		
			Pain	OR	p-value	Pain	OR	p-value	Pain	OR	p-value
Duration of work	<10 years	284 (74.3%)	230 (74.6%)	0.861 (0.486-1.5170)	0.605	224 (75.4%)	0.732 (0458-1.337)	0.368	224 (75.7%)	0.269 (0.436-1.262)	0.742
	>10 years	98 (25.7%)	77 (25.1%)			73 (24.6%)			72 (24.3%)		
Smoking status	Yes	32 (8.4%)	7 (2.3%)	1.786 (1.451-3.075)	0.01	5 (1.7%)	3.650 (1.031-12.920)	0.033	8 (2.7%)	0.847 (0.179-4.114)	0.857
	No	350 (91.6%)	300 (97.7%)			292 (98.3%)			288 (97.3%)		
Gender	Male	70 (18.3%)	51 (16.6%)	1.703 (0.934-3.106)	0.09	41 (13.8%)	3.233 (1.853-5.641)	0.007	49 (16.6%)	1.629 (0.912-2.908)	0.097
	Female	312 (81.7%)	256 (83.4%)			256 (86.2%)			247 (83.4%)		
Workplace	Hospital	29 (7.6%)	29 (9.4%)	1.270 (1.203-1.340)	0.06	26 (8.8%)	0.381 (0.113-1.292)	0.109	28 (9.5%)	0.113 (0.15-0.840)	0.09
	Dental clinic	353 (92.4%)	278 (90.6%)			271 (91.2%)			268 (90.5%)		
Age	<40 years	320 (83.8%)	262 (85.3%)	0.586 (0.313-1.096	-0.86	252 (84.8%)	0.714 (0.385-1326)	0.285	256 (86.5%)	0.455 (0.252-0.818)	0.08
	>40 years	60 (16.2%)	45 (14.7%)			45 (15.2%)			40 (13.5%)		
Exercise	Yes	298 (77.8%)	239 (77.9%)	0.356 (0.412-0.523)	0.09	230 (77.4%)	0.922 (0.513-1.659)	0.787	234 (78.5%)	1.277 (0.730-2.232)	0.391
	No	85 (22.2%)	68 (22.1%)			67 (22.6%)			63 (21.2%)		
Position during working	Standing	140 (36.6%)	122 (39.7%)	1.479 (1.269-1.853)	0.08	111 (37.4%)	0.868 (0.523-1.440)	0.583	117 (39.5%)	1.559 (1.328-1.950)	0.001
	Sitting	242 (63.4%)	185 (60.3%)			186 (62.6%)			179 (60.5%)		
BMI	Normal	112 (29.4%)	99 (35.3%)	1.03 (0.563-1.885)	0.01	110 (28.9%)	0.566 (0.352-0.652)	0.095	120 (31.5%)	0.232 (0.152-0.452)	0.056
	Not Normal	268 (70.5%)	281 (73.9%)			270 (71.1%)			260 (68.4%)		

Table 3. Poison regression model, relationship between musculoskeletal pain with age, gender, and exercise

Independent variables	Coefficient B	Standard error B	WALD	OR
Intercept	1.046	0.111	88.771	2.846 (2.290-3.536) *
Age	-0.11	0.0032	11.059	0.989 (0.983-0.996)
Gender	-0.61	0.0607	0.931	0.943 (0.837-1.062)
Exercise frequency	-0.02	0.567	0.129	-1.121 (1.013-1.140) *

(*) *p* value <0.01

Table 4. Binomial regression for exercise (as dependent variable), musculoskeletal pain and BMI

Independent variables	Coefficient B	Standard error B	WALD	OR
Intercept	-1.315	0.325	0.985	0.362 (0.965-3.233)
Musculoskeletal pain	0.069	0.271	0.065	1.072 (1.060-1.823)
BMI	-0.269	-0.244	9.282	-2.106 (1.304-2400) *

(*) p-value <0.01

This study examined the prevalence of MSD in Johor dental officers and associated sociodemographic characteristics. The findings indicate that most of the participants experienced discomfort in the neck, shoulder, and lower back regions. The study conducted by Alade and Osagbemiro [16] in Nigeria yielded comparable findings, indicating a significant prevalence. Numerous studies conducted in various countries, including Malaysia, Brazil, Italy, and Canada, have identified lower back MSD as the prevailing issue [17]. In contrast to the occurrence of back pain amidst dentists in Finland was significantly lower, measuring at 28% [18]. Various factors may contribute to MSD affecting the spine, such as muscle strains, postural muscle weakness leading to instability, reduced spinal joint flexibility, and degenerative or herniated disc conditions. According to Šustová *et al.* [19] research indicates that neck pain can be attributed to the overuse of static stretching and sustained muscle activity of the sternocleidomastoid or trapezius muscles. Most dental procedures necessitate that dental technicians maintain non-ergonomic body postures for extended periods of time and perform repetitive motions in a stationary working position. The process of trimming prostheses necessitated technicians to sustain a prolonged posture of spinal flexion, thereby exerting significant strain on their back. This could potentially result in lower back and neck discomfort. Following a study conducted by Bryndal *et al*. [20] in Poland, dental staff may experience neck pain due to various occupational factors. These factors include a fast-paced work environment, repetitive movement patterns, inadequate recovery time, weightlifting, poor posture, mechanical pressure, flexion, torsion, vibrations, and exposure to low temperatures. According to Table 2, there exists a correlation between smoking and shoulder pain. A dose-response relationship has been reported in certain cases, and several prospective studies have indicated that smoking habits can serve as a predictor of episodes of incident MSD [21]. Comparable results have been documented in a limited number of other inquiries. According to a study conducted by Brage and Bjerkedal [22] musculoskeletal pains, including those in the back, neck, upper limb, lower limb, and at multiple sites, were reported with greater frequency by individuals who currently smoke or have previously smoked, as compared to those who have never smoked. This observation was made after controlling variables such as age, gender, comorbidity, mental distress, and physical demands of work. Various hypotheses have been put forward to account for the correlation. According to Schneider *et al*. [23] smoking has the potential to induce disc herniation via coughing and cause pathological modifications in the intervertebral disc by affecting its nutrition or mineral composition. An alternative hypothesis is that smoking exerts a pharmacological influence on the perception of pain. The association may be subject to confounding due to physical occupational activities that are prevalent among smokers, or due to neuropsychological or sociocultural factors that vary between individuals who smoke and those who do not [24].

The present investigation demonstrates a direct association between sitting and the occurrence of musculoskeletal discomfort in the back region. This study aligns with the findings of [25], which indicated that dentists who maintained a seated posture experienced greater intensity of lumbar spine pain. In a study conducted by Rafeemanesh *et al*. [26] the relationship between job postures and MS disorders in dentists was investigated. The findings indicated that the greatest risk of developing MSD symptoms was associated with maintaining balance in a standing position during surgery. The results are corroborated study by Batham and Yasobant [27] which indicated that assuming a standing work posture is a potential hazard for experiencing discomfort in the knees and feet. Several authors have provided suggestions regarding the utilisation of dental loupes to ensure proper alignment of the lumbar spine in recent times. According to Dixon *et al*. [28] the appropriate selection, calibration, and utilisation of dental loupes have been linked to a reduction in neck and lower back pain, as they facilitate the maintenance of healthier postures among dentists. In contrast, a study conducted by Gent *et al*. [29] reported no significant difference in the prevalence of MSD between dentists who primarily worked in a seated position and those who alternated between sitting and standing positions.

A significant correlation was observed between engagement in physical activity and the occurrence of musculoskeletal pain. The present discovery aligns with a prior investigation conducted on Norwegian navy personnel, wherein it was observed that there existed an inverse correlation between physical activity and MSD [30]. Research by Singh and Andersson [31] proposes that a comprehensive exercise regimen incorporating intensive aerobic conditioning and targeted strengthening of the back and leg muscles can effectively reduce the incidence of low back pain. Research by Mustard *et al*. [32] assert that the prevention of low back pain is achievable through the maintenance of flexible and strong leg, back, and hip muscles. In a similar vein, findings from research investigations indicate that consistent engagement in physical exercise may have a direct impact on mitigating the severity of back pain, consequently averting disability associated with back pain [33]. The present study revealed a significant correlation between MSD and BMI. The deduction is analogous to the one discovered in a study conducted on military veterans, wherein it was observed that participants with a higher BMI experienced a greater intensity of pain [34]. The study conducted by Nag *et al*. [35] revealed a significant correlation between BMI and musculoskeletal symptoms in the low back, knees, ankles, and feet. According to Bihari *et al*. [36] the condition of being overweight or obese imposes an extra burden on the musculature of the human body, thereby elevating the likelihood of developing MSD. According to Tirgar *et al*. [37] the prevalence of MSD was found to increase over an 11-year period in individuals who were overweight or obese. An elevated BMI is positively linked to an increased risk of developing metabolic syndrome, a group of illnesses that include obesity, hyperglycemia, and hypertriglyceridemia, according to Manaf *et al*. [38].

4. CONCLUSION

The present study has concluded that there exists a noteworthy correlation between sociodemographic factors and MSD among dental officers in Johor. The research revealed a significant incidence of musculoskeletal discomfort in the neck, shoulder, and back regions. The study revealed that smoker subjects exhibited a greater susceptibility to neck pain, whereas assuming a standing posture during work was associated with an elevated probability of shoulder pain. There was a positive correlation observed between abstaining from physical exercise and the occurrence of neck pain. The efficacy of regular physical activity in decreasing the prevalence of MSD and BMI has been established. The research emphasises the significance of advocating for physical activity and ergonomics in the workplace as a preventive measure against MSD among dental practitioners.

The study's results suggest that dental staff in Johor ought to partake in routine physical activity to mitigate the incidence of musculoskeletal discomfort and uphold a desirable BMI. Therefore, it is advisable for dental staff to prioritize regular exercise as a preventive measure. Additionally, it has been recommended that dental clinics and hospitals incorporate ergonomic measures, including but not limited to scheduled intervals for rest, provision of adjustable chairs and tables, and provision of adequate training on proper posture, as a means of reducing the incidence of MSD among their personnel. The study underscores the necessity for additional investigations to ascertain the frequency of MSD among dental practitioners in different geographical locations and to assess the efficacy of interventions aimed at mitigating their incidence.

The limitations of this study pertain to the utilisation of self-reported data obtained via a questionnaire. This data encompasses demographic information and musculoskeletal symptoms, which may be susceptible to recall bias or misinterpretation. An additional constraint was the research was carried out on dental personnel in Johor, Malaysia, thereby potentially constraining the applicability of the results to other demographic groups or geographical areas.

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