

MUSCULOSKELETAL DISORDERS AND ASSOCIATED FACTORS AMONG DENTAL TECHNICIANS

By

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Abstract

Introduction: Dental technicians are susceptible to musculoskeletal disorders (MSDs) as other dental professionals due to their regular tasks including manual labor or being physically demanding. **Aim of Work:** To assess the prevalence and possible associated factors of MSDs among dental technicians. **Materials and Methods:** This is a descriptive cross-sectional study among 107 postgraduate students of dental technicians at the Technical Health Institute, Mansoura, Egypt. Data were collected by a self-administered validated structured questionnaire based on previous studies. **Results:** About 72% of participants were found to suffer from MSDs. Low back pain (61.2%), neck stiffness (61.2%) and shoulder pain (51.5) were the most prevalent musculoskeletal complaints as reported by the participants. Age, work duration, body mass index (BMI), private job, physical work load and job strain are significant predictors of having MSDs. **Conclusion and Recommendations:** Dental technicians exhibited a significant incidence of work-related MSDs (WMSDs). The development of MSDs among dental technicians necessitates the implementation of comprehensive preventative interventions that address the combined effects of physical load, psychological load, personal characteristics, and occupational factors.

Keywords: Dental technician, Musculoskeletal Disorders, Risk factors and Neck pain.

Introduction

Musculoskeletal disorders (MSDs) affect 1.71 billion persons on a global scale, resulting in 17% of all years lived with a disability (YLDs) (Cieza et al., 2020). Meisha et al., 2019 noted that MSDs were the second most frequent disability in the global burden of disease (GBD) survey, after lower back pain. According to Anyfantis and Biska 2018, MSDs rank high among the most pressing issues in occupational health today. The International Labor Organization (ILO) has shown that MSDs are the second most prevalent kind of occupational sickness (Niu, 2010).

Conditions characterized by inflammation and degeneration of muscles, tendons, ligaments, joints, peripheral nerves, and supporting structures such as intervertebral discs are known as MSDs (Davey et al., 2019). Muscles, tendons, joints, and other soft tissues might experience pain, incapacity, or both as a result of or exacerbated by prolonged awkward or forced postures or motions (Morse et al., 2007).

MSDs are widespread among dental health care workers since the occupation demands fine motor skills and the careful use of tiny instruments (Al-Hourani et al., 2017; Chenna et al., 2022).

Due to the physically demanding nature of their employment, dental technicians suffer from MSDs like other members of the dental profession. By creating both permanent and removable prostheses in accordance with the dentist's instructions, dental technicians help their patients with their oral hygiene, aesthetics, speaking, and chewing (Adetiba, 2017).

Multiple variables contribute to the risk of MSDs among dental workers. According to Hayes et al., 2009, there are many ergonomic and physiological variables that contribute to MSDs in the dentistry profession. Important risk factors have been discovered, including very tight or uncomfortable postures, the use of high-frequency vibration instruments, and the repetition of various joint motions (El Hosseini et al., 2019).

There has been a shift in focus on the importance of stress and psychosocial variables in MSDs. The dental professionals are more likely to acquire MSDs if they experience high job demands and have less control over their work (Hakkanen et al., 2001; Deeney and O'Sullivan, 2009).

MSDs are a major problem in many different types of occupations, including dentistry offices. The risk is higher for

dentists and oral surgeons. Few studies have looked at WMSDs in dental technicians, in contrast to the large body of literature on WMSDs among dentists and dental assistants (Al-Hourani et al., 2017). It is regrettable that many dental practitioners fail to notice the first symptoms of MSDs and fail to consider the possible long-term effects (Maniar et al., 2023).

So, it is crucial to estimate the MSDs prevalence among dental technicians and identify the possible risk factors related to their occurrence.

Aim of Work

To assess the prevalence and possible associated factors of musculoskeletal disorders (MSDs) among dental technicians.

Specific objectives

This research was carried out
1- To determine the frequency and characteristics of MSDs.
2- To determine the potential contributing causes of MSDs.

Materials and Methods

Study design: Cross-sectional study with analytic component.

Place, and duration of the study:

The investigation was conducted at the Technical Health Institute, Mansoura, Egypt from January to March 2024.

Study sample: This research was carried out on dental technicians doing postgraduate studies at the Technical Health Institute in Mansoura, Egypt, specifically during the academic year 2023-2024.

Inclusion criteria: both sexes, working for at least one year, on duty and agree to participate in this study.
Exclusion criteria: Dental technicians with a history of musculoskeletal trauma, systemic disorders and pregnancy were excluded from this study.

Sample size: A convenience sample method was used to choose all registered postgraduate dental technician students from the Technical Health Institute. A total of 107 registered postgraduate dental technician students were selected for recruitment; 96.3% of the whole sample, 103 out of 107 participants (96.3%), were consistent attendees and successfully filled out the questionnaires.

Study Methods:

All the study participants were subjected to:

A- A self-administered, semi-structured questionnaire in Arabic to gather data in accordance with the standards set by earlier research including:

1. **Personal information and sociodemographic characteristics**, such as name, age, sex, marital status, place of residence, degree of education, and smoking history. By dividing the weight in kilograms by the square of the height in meters, the body mass index (BMI) was determined.

2. **Occupational history**, including job title, duration of employment, working hours per day, working days per week, frequency of breaks during work hours, and any ergonomic practices done by the dentist. Factors like as position, contract, shift, and private sector employment status determine whether an employee works at a university hospital or a hospital run by the Ministry of Health (MOH).

B- The Standardized Nordic questionnaire was used to evaluate musculoskeletal symptoms. This questionnaire contained closed-ended

questions regarding the presence or absence of pain, discomfort, or ache in nine different areas of the body: the neck, shoulders, elbows, wrists/hands, upper back, low back, one or both hips/thighs, one or both knees, and one or both ankles or feet. The assessment was conducted at any point in the past twelve months. For each area where people reported problems, researchers asked if the issues had been present for at least a week and whether they had impeded people from going to their regular job (at home or elsewhere) in the last twelve months (Kuorinka et al., 1987).

C- A measurement tool for Workload Physical demands, adapted from the **Dutch Musculoskeletal Questionnaire** (Hildebrandt et al., 2001). Repetitive motions, hunched or twisted backs, lengthy periods of sitting, standing, or walking, unpleasant positions, heavy arm positions, and vibrating tool usage were all included in the questions.

D- Job Strain Index as a means of measuring work strain proposed by Theorell et al. (1998). The psychological demands of the work were evaluated using a four-item ordinal scale, with each item having

five points and four possible responses. The total of these scores, with 5 being the lowest and 20 the greatest, is an index of psychological work demands. Similarly, decision latitude is evaluated using a 6-item indicator where a score of 6 indicates low decision latitude and a score of 24 indicates great decision latitude. Using the median score as the cutoff point, categories such as “High” and “Low” were established for decision latitude (18 for choice latitude and 13 for work demands) based on psychological job demands. High work expectations coupled with limited decision-making autonomy constitute job strain.

Consent

The study’s participants and the Technical Institute of Health management both gave their verbal approval. All participants were assured of the confidentiality and anonymity of their data, and their participation was entirely voluntary.

Ethical Approval

The Institutional Review Board

(IRB) of Mansoura Faculty of Medicine (number R.24.01.2453) gave its approval to the procedure.

Data Management

SPSS (IBM SPSS Statistics for Windows, Version 23.0. IBM Corp., Armonk, N.Y., USA) was used to analyze the collected data. Numbers and percentages were used to represent the qualitative characteristics. Means and standard deviations (SD) or medians (min-max) were used to represent quantitative variables once they were checked for normality distribution. Statistical significance tests were conducted using the appropriate methods. In bivariate analysis, binary variables were compared using chi-square tests. The independent factors of MSDs were predicted using binary stepwise logistic regression analysis, which took into account significant predictors from the bivariate analysis. We computed adjusted odds ratios (AOR) along with 95% CIs. The difference at P value < 0.05 was considered as significant.

Results

The mean age of the studied group was $33.98(\pm 8.84)$ and 53.4% are males. Most of them (75.7%) were diploma holders and 62.1% worked at Ministry of Health hospitals, 34% are smokers and 46.6% had a duration of employment for less than 10 years.

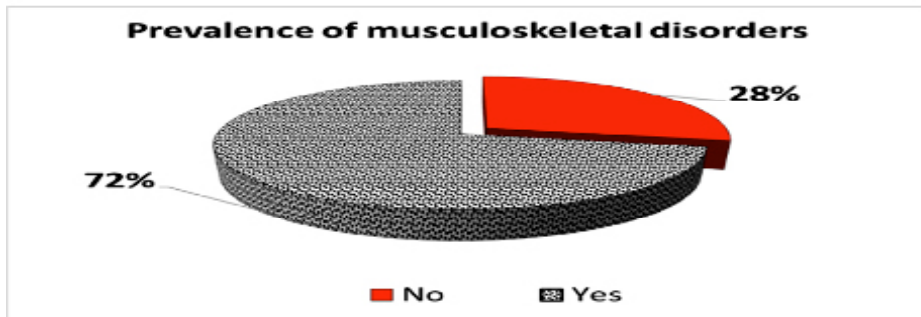


Figure (1): Prevalence of MSDs among dental technicians.

Figure (1) showed that about three quarter of the participants suffered from MSDs (72%).

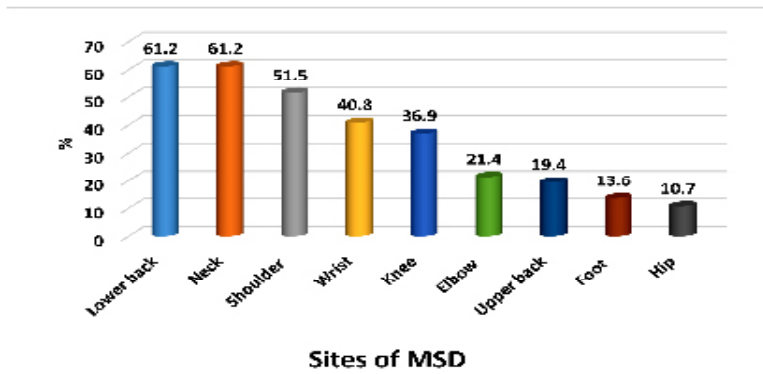


Figure (2): Anatomical distribution of musculoskeletal complaints among dental technicians.

Low back pain , neck stiffness and shoulder pain were the most prevalent musculoskeletal complaints, as reported by the participants (61.2%),(61.2%) and (51.5%) respectively.

Table (1): Association between musculoskeletal disorders (MSDs) in the past 12 months, personal and job characteristics among dental technician.

Risk factors	Total number No =103	MSD				Test of significance	Crude Odds ratio	95%CI
		NO (No =29)		Yes (No =74)				
		No	%	No	%			
Personal characters								
Age group/								
years	58	28	48.3	30	51.7	X ² =26.56		
<35	45	1	2.2	44	97.8	P<0.001*		
≥35								
Sex								
Male	55	12	21.8	43	78.2	X ² =2.34	1.96	0.822-
Female (r)	48	17	35.4	31	64.6	P=0.126	1	4.69
BMI								
classification								
Under weight	3	1	33.3	2	66.7	X ² =41.78 P=0.001*		
Normal	45	27	60.0	18	40.0			
Overweight	33	0	0.0	33	100.0			
Obese	22	1	4.5	21	95.5			
Job characters								
Work place								
University	39	7	17.9	32	82.1	X ² =3.23 P=0.072	2.39	0.911-
Ministry of Health (r)	64	22	34.4	42	65.6		1	6.29
Working								
duration/ years								
<10	48	23	47.9	25	52.1	v ² =19.06 P=0.001*		
≥10	55	6	16.7	49	83.3			
Hours / day								
Mean ±SD	8.64±1.98	7.72±1.81		9.0±1.94		t=3.06 P=0.003*	1.48	1.12-1.94

X²: Chi squared test.

t:Student t test.

*: Statistically significant (p<0.05).

Table (1): Table 1 showed that the prevalence of MSDs was significantly higher among the group of dental technicians aged over 35 years, overweight and obese individuals compared to those with a normal weight, participants who had a work experience of 10 years or more, long working hours, smokers and who are working in the private sector (the results of the last 2 items were not tabulated). Although there was a higher incidence of MSDs among male compared to female, the difference didn't reach a significant level.

Table(2): Physical and psychological risk factors associated with musculoskeletal disorders (MSDs) among dental technician.

Risk Factors	Total number No=103	MSD						Test of significance	Crude Odds ratio (95%CI)
		NO (No =29)		Yes (No=74)					
		No	%	No	%				
Bent twist awkward pattern		62	10	16.1	52	83.9	$X^2=11.14$ P=0.001*	4.49 (1.80-11.19)	
Repetitive movement		94	23	24.5	71	75.5	$X^2=7.23$ P=0.007*	6.17 (1.42-26.68)	
Excess arm elevation		57	5	8.8	52	91.2	$X^2=23.71$ P=0.001*	11.35 (3.83-33.57)	
Uncomfortable position		72	12	16.7	60	83.3	$X^2=15.61$ P=0.001*	6.07 (2.37-15.55)	
Long stand sit		60	14	23.3	46	76.7	$X^2=1.65$ P=0.199	1.76 (0.740-4.19)	
Vibrating tools		72	14	19.4	58	80.6	$X^2=8.97$ P=0.003*	3.88 (1.56-9.69)	
Job strain									
NO (r)		64	24	37.5	40	62.5	$X^2 =7.29$	1	
Yes		39	5	12.8	34	87.2	P=0.007*	4.08 (1.40-11.85)	

X²: Chi squared test.

*: Statistically significant (p<0.05).

Table (2) displayed that the several physical risk factors, including bent or twisted awkward patterns, repetitive movement, uncomfortable positions, excessive arm elevation, and the use of vibrating tools, significantly increased the risk of MSDs among the participants ($p < 0.05$). Additionally, job strain was also found to significantly increase the risk of MSDs among the participants ($p < 0.05$).

Table (3): Predictors of musculoskeletal disorders among the studied dental technicians.

Predictors	β	P value	Adjusted Odds ratio	95% CI
Age/ years	0.210	0.001*	1.23	1.09-1.39
Residence				
Urban (r)				Reference group
Rural	1.26	0.027*	3.52	1.16-10.75
BMI (Kg/m ²)	0.396	0.001*	1.49	1.19-1.85
Smoking				
Non(r)	1.78	0.037*	6.61	Reference group
Smokers				1.15-37.8
Work duration /years	0.116	0.087	1.12	0.983-1.28
Hours / day	0.284	0.127	1.33	0.922-1.91
Extra job				
NO (r)	1.58	0.014*	4.89	Reference group
Yes				1.38-17.33
Job strain				
NO (r)	1.59	0.014*	4.94	Reference group
Yes				1.39-17.59
Bent twist awkward pattern	2.205	.002*	9.067	2.32-35.41
Repetitive movement	1.646	.085	5.186	.79-33.78

Excess arm elevation	1.886	.004*	6.592	1.81-23.98
Uncomfortable position	1.190	.055	3.287	.97-11.08
Vibrating tools	.138	.823	1.148	.34-3.85
Overall % predicted =80.6%				

r: Reference group

*: Statistically significant (p<0.05).

In Table (3) binary logistic regression analysis was used to assess the predictors of MSDs among the studied dental technicians and illustrated that ; increase age one year increases risk of MSDs by 1.23 more time (OR :1.23 , 95%CI :1.09-1.39) , rural residence increase risk by 3.52 more times than urban (OR :3.52, 95%CI : 1.16-10.75) , increased BMI (Body Mass Index) by one kg/m² increase risk by 1.49 more times (OR:1.49 ; 95% CI:1.19-1.85), smoking increases risk by 6.61 more times than non-smoking (OR:6.61 , 95% CI:1.15-37.8), presence of extra-job increase risk by 4.89 more times (OR:4.89 , 95%CI:1.38-17.33), using one type only of personal protective equipment increases risk by 4.6 (OR :4.6 , 95%CI:1.5-14.09), presence of job strain increases risk by 4.94 (OR :4.94 , 95%CI :1.39-17.59), presence of bent or twisted awkward pattern increase risk by 9.07 (OR :9.07 , 95%CI :2.32-35.41) , presence of excess arm elevation increases risk by 6.59 (OR:6.59 , 95%CI :1.81-23.98) , low decision latitude increases risk by 3.23 more times than high(OR:3.23 , 95% CI:1.36-8.32).The presence of the previous ten factors can predict 80.6% of occurrence of MSDs .

Discussion

Despite a large number of researches on the frequency and causes of MSDs due to occupational exposure, there remained some important gaps in our understanding of some dental procedures. Finding out how common MSD symptoms are among Egyptian dental technicians and if there are any relation to factors specific to their occupation was the driving force for this research.

About 72% of the studied dental technicians reported MSDs in the previous twelve months (Figure 1). These results were in line with a research on dental technicians in Jordan and found that all participants reported WMSDs in at least one body part in the last 12 months (Al-Hourani et al., 2017).

Also El Hosseini et al. (2019) found that 66.7% of Egyptian dental practitioners had MSDs. This was also consistent with the prevalence detected in several other countries, such as Pakistan (87%), India (89.6%), and Saudi Arabia (77.9%) (Aljanakh et al., 2015; Younis et al., 2022; Chalker et al., 2023).

Dentistry is a very focused and

exacting profession that might be a contributing factor for MSD. Younis et al. (2022) found that the frequency of MSD among dental professionals remained high, notwithstanding the improvements achieved in dental technology and equipment. Because of the physical demands of their work, dental technicians are more likely to suffer from MSDs as any other member of the dental profession (Adetiba, 2017).

The most prevalent types of discomfort over the past year among the studied group were lower back (61.2%) and neck (61.2%) followed by shoulder (51.5%) and wrist (40.8%) (Figure 2). This was in accordance with a study conducted in the United Arab Emirates which reported a high prevalence of work-related musculoskeletal disorders among dentists. The most affected body regions by WMSDs were the neck (58.8 %), lower back (55.4%) followed by shoulders (50.7%) (Hussein et al., 2022).

Additionally, a previous study conducted in Egypt on dental staff indicated that the neck and shoulder areas were the most frequently affected regions (66.5% and 61.8%), respectively, followed by the lower back (59.3%) (El Hosseini et al., 2019).

The most prevalent sites of WMSDs pain among dental practitioners from Saudi Arabia were the lower back (85%) and neck (84.6%), according to a study done by Meisha et al., 2019.

Furthermore, according to a research carried out in India, the most common types of pain were neck pain (64.7%), lower back pain (55.9%), shoulder pain (43.1%), and upper back pain (42.2%) (Thacker et al., 2023).

A meta-analysis and systematic review of Western dentistry experts done by (Lietz et al., 2018), the neck was the most afflicted region of the body, followed by the lower back, shoulders, and upper back. We found that these results likely to be in agreement with our own.

Two possible causes for these health problems are the rising demand for cosmetic lab-fabricated prostheses and the associated increase in workload, and the persistently incorrect sitting position, which puts pressure on the spine and supporting tissues (Samat et al., 2011).

The dental technicians' work posture, which involved the flexion of the cervical vertebrae, is a likely explanation for neck MSDs. They

maintain this position for long period of time, resulting in their neck being in a forward position. Abnormal vertebral flexion may induce MSDs in the back, and dental technicians may favor this posture for an extended duration (Adetiba, 2017).

The results of the present study indicated that dental technicians who worked for long periods of time had a higher prevalence of WMSDs (Table 1). This finding was consistent with the work conducted in Pakistan by Zahoor et al., 2017 and in India by Thacker et al., 2023 that found a statistically significant relationship between WMSDs and prolonged work duration. Furthermore, Shekhawat et al. (2020) reported that a statistically significant association was observed between years of practice and MSDs in a study conducted in Puducherry, India ($P = 0.032$); which supported our findings.

Nevertheless, a research conducted in Iran found that the long working hours of dentists were an insignificant factor in WMSD. Iranian dentists are believed to have avoided strenuous work and extended working hours, as well as maintaining a more favorable working posture during dental procedures (Nokhostin and Zafarmand, 2016).

Longer years of practice and extended working hours were regarded as significant risk factors for MSDs among dental technicians. The additional time spent at work with an abnormal working posture during dental procedures results in increased pressure and the development of complex pain (Younis et al., 2022).

In the current study, the dental technicians who performed bent or twisted awkward posture, excess arm elevation, repetitive movement, uncomfortable position for a prolonged period, and use vibrating tools were at increased risk of developing WMSDs (Table 2). Both bent and twisted awkward posture (AOR=9.067) and excess arm elevation (AOR=6.592) were the major ergonomic predictors of WMSDs (Table 3).

This was in harmony with a study conducted in India, which determined that dental professionals who are required to perform continuous inspections, frequent-bended elbow joints, perform repetitive motions, tasks that involve waist twisting are at an increased risk of developing MSDs (Thacker et al., 2023).

Furthermore, Batham and Yasobant, 2016 on their work on work-

related musculoskeletal disorders among dentists in Bhopal, India; detected that tasks that involved repetitive movements (OR = 1.11) and sustained muscle contraction activity (OR = 1.12) were regarded as significant risk factors for the development of MSDs .

WMSDs are the result of prolonged, unilateral excessive stresses on joints, muscles, and nerves, as well as the vibration of instruments, the elevation of arms, and the prolonged maintenance of an awkward static position during dental procedures (Chaudhary et al., 2021; Montinaro et al., 2022).

The binary logistic regression analysis conducted in the preset study demonstrated that dental technicians who were older (AOR=1.23) were more likely to have WMSDs (Table 3). This was in agreement with the findings of (Younis et al., 2022), who reported that dental personnel with a higher age were more likely to have WMSDs. Eventually, older dental technicians experience convoluted pain as a result of the increased time they spend in their work, which places them under more strain (Alogaibi et al., 2018).

Against the results of the current work, a study conducted on Jordanian dental technicians detected a high

prevalence of MSDs among younger technicians (Al-Hourani et al., 2017). This could be attributed to the lack of experience in the field and the insufficient knowledge of dental procedures among the younger dental professionals (Kawtharani et al., 2023).

Also, the binary logistic regression revealed that dental technicians with a higher BMI (AOR=1.49) were more likely to have WMSDs (Table 3), which was consistent with the findings of Thacker et al. (2023) who reported a statistically significant result between MSDs and BMI among dentists. The study suggested a strong relationship between increase weight and back discomfort.

But these findings were in contrast to a study conducted on dental personnel in Jeddah, Saudi Arabia by Algaibi et al. (2018), who found no significant relationship between MSDs and BMI

The substantial link between greater BMI and MSDs suggests that heavy-weight people may experience increased mechanical strain on the spine due to the compressive stress on the lumbar spine components during labor. Furthermore, obesity-related proinflammatory pathway activation,

leading to elevated cytokine and acute-phase reactant production, which may cause discomfort in obese persons (Younis et al., 2022).

The results of the present study indicated that dental technicians who worked for extended periods of time had a higher prevalence of WMSDs (AOR=1.33) (Table 3). This finding is consistent with the work conducted in Pakistan (Zahoor et al., 2017). Nevertheless, a research conducted in Iran found that the long working hours of dentists were an insignificant factor in WMSD. Iranian dentists are believed to have avoided strenuous work and extended working hours, as well as maintaining a more favorable working posture during dental procedures (Nokhostin and Zafarmand, 2016).

In the present investigation, work duration was a significant predictor of WMSDs (AOR=1.12) (Table 3), which was consistent with a study conducted in India that found a statistically significant relationship between WMSDs and work duration (Thacker et al., 2023). Furthermore, Shekhawat et al. (2020) reported that a statistically significant association was observed between years of practice and MSDs in a study conducted in Puducherry (P =

0.032); which supported our findings.

Longer years of practice and extended working hours were regarded as significant risk factors for MSDs among dental technicians. The additional time spent at work with an abnormal working posture during dental procedures results in increased pressure and the development of complex pain (Younis et al., 2022).

From a psychological perspective, dentistry was thought to need a great deal of concentration and task management. The present research found that work strain, which is defined as having high job expectations and poor job control, is a strong predictor of WMSDs (AOR=4.94) (Table 3).

High work demands and insufficient job control were shown to be significant risk factors for the development of MSDs ($p < 0.05$) in prior research done in Egypt by Hosseini et al., 2019, which was similar with our findings. In a similar vein, Bongers et al. (2002) found that dentists who reported high levels of work demand were more likely to suffer from MSDs. They concluded that when work demands are high, it leads to more muscular tension and less symptom management abilities.

Additionally, Amiri and Behnezhad's systematic review and meta-analysis, 2020; identified job strain as a risk factor for physical health and an increase in the likelihood of MSDs. The findings indicated that job strain was a risk factor for MSDs at a rate of 1.62.

Conclusion

The dental technicians under investigation exhibited a high prevalence of MSDs. The shoulder and wrist were the most affected body regions, followed by the neck and lower back. Several personal and professional characteristics, as well as physical and psychosocial burden, are significantly correlated with MSDs.

Recommendations

The development of MSDs necessitates the implementation of comprehensive preventative interventions that address the combined effects of physical load, psychological load, personal characteristics, and occupational factors. Dental technicians should employ preventive techniques that decrease the onset of WMSDs. WMSDs may be mitigated by keeping proper posture, including frequent breaks and rest periods throughout work, engaging in con-

sistent physical activity, and enhancing the work environment.

Study Limitations: The present investigation was conducted on a limited scope within a specific institute. Consequently, in order to ascertain the prevalence of WMSDs among dental technicians on a national scale, large-scale studies are necessary. Additional research that employs a prospective design is advised.

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Conflict of interest

None

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