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The Prevalence of Musculoskeletal Disorders among Jordanian Dentists after 10 Years of an Initial Survey and the Associated Risk Factors

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ABSTRACT

Objectives: This study aims to investigate the change in prevalence of musculoskeletal disorders (MSDs) among dentists in Amman, the Jordanian capital over a 10-year period, as well as to identify the associated risk factors.

Materials and Methods: This is a cross-sectional study conducted in 2020 using a stratified random sample of 200 dentists practicing in Amman, Jordan, who were not matched to the 2010 study participants; instead, comparisons were made between independent cross-sectional samples from the two time points. 134 males (mean age = 46.2±15.3 years) and 66 females (mean age = 43.2±12.6 years), were personally interviewed using a structured questionnaire. Data was analyzed using SPSS and the association between MSD prevalence and risk factors was assessed using the chi-square test. P-value was set at the 0.05 level.

Results: Most participants were general practitioners (82.5%). 79% of the participants suffered one or more MSDs: back pain (34.5%), neck pain (19%), shoulder pain (29%) and hand/wrist pain (43.5%). The prevalence of hand/wrist pain significantly increased in 2020 as compared to 2010. However, the prevalence of the other MSDs considered significantly decreased in 2020.

Males reported more hand/wrist pain than females. Hand/wrist, pain shoulder pain, and back pain significantly increased among older dentists ($p < 0.05$). Hand/wrist pain, neck pain and back pain significantly increased among dentists with more years of experience ($p < 0.05$). More than a half of the participants were aware of the correct working postures (51.5%). The group with more awareness of healthy postures suffered less MSDs ($p < 0.05$). Hand/wrist pain was most prevalent among dentists who only worked while standing.

Conclusions: Although MSDs have generally declined among dentists in Amman over the last decade, particularly regarding back pain, neck pain and shoulder pain, yet the increase in hand/wrist pain is still a burden which highlights the need for further training and continued education on occupational health and tailored interventions.

Keywords: Musculoskeletal disorders, Dentists, Hand pain, Neck pain, Shoulder pain, Back pain, Occupational health.

1. Introduction

Musculoskeletal disorders (MSDs) refer to the performance of locomotor system, compromising intact

muscles, bones, joints and adjacent connective tissues leading to temporary or permanent limitations in function (1,2). These disorders are a significant

occupational health concern for dentists, as the nature of their work often involves prolonged static postures, repetitive movements, and improper ergonomics, all of which contribute to the development of MSDs (3,4). The dental work environment, characterized by the repetitive use of vibrating instruments, chronic neck flexion, inadequate lighting, and extended working hours, predisposes practitioners to these disorders (4,5).

Dentists are known to experience a higher prevalence of MSDs compared to other healthcare professionals due to the physically demanding nature of their work (6-8). The prevalence of MSDs among dentists varies globally, with studies reporting rates ranging from 64% to 93% in different populations (9-11). In Jordan, a 2010 study revealed that 86% of dentists suffered from MSDs, with older practitioners and those with more years of experience being at higher risk (12). Considering the high prevalence of MSDs, a follow-up study was warranted to study the impact of the awareness of ergonomics. Notably, over 60% of the surveyed dentists lacked awareness of proper ergonomic postures, which likely contributed to the high prevalence of MSDs (12).

Over the past decade, there has been a concerted effort to enhance ergonomic training in Jordanian dental institutions. Universities and dental associations have introduced courses and workshops focused on proper posture, workplace ergonomics, and preventive strategies for MSDs (13). These initiatives aim to reduce the incidence of MSDs by educating dental professionals on the importance of maintaining correct working postures and using ergonomic equipment. However, the impact of these educational programs on reducing MSD prevalence remains unclear.

Recent studies have highlighted the importance of ergonomic interventions in reducing the burden of MSDs among dental professionals (8,14). For instance, a study conducted in Saudi Arabia found that dentists who received ergonomic training reported a significant reduction in back pain and neck pain compared to those who did not receive such training (15). Similarly, research in India demonstrated that the implementation of ergonomic principles in dental practice led to a decrease in the prevalence of MSDs among practitioners (16). These findings underscore the potential benefits of ergonomic education and training in mitigating the risk of MSDs.

Despite these advancements, certain areas, such as

hand and wrist pain, continue to pose significant challenges. The repetitive movements involved in dental procedures, coupled with prolonged gripping of dental tools, may contribute to cumulative trauma disorders in the hands and wrists (17). Studies have shown that while improvements in posture awareness can reduce back pain and neck pain, they may not significantly decrease the prevalence of hand and wrist pain (18). This suggests that targeted interventions are needed to address specific risk factors associated with hand and wrist MSDs.

This study aims to assess changes in the prevalence of MSDs among dentists in Amman, the Jordanian capital, over the past decade and to identify the key risk factors contributing to these conditions. By comparing data collected in 2010 with that obtained in 2020, the study provides insights into how occupational health practices and ergonomic awareness have influenced MSD occurrence. The importance of this study comes from filling the regional gap in longitudinal data on MSDs among dental professionals, informing future ergonomic interventions, training programs and health policies. While previous studies generally focused on the prevalence of MSDs at a single time point, our study uniquely discusses decade-long challenges.

We hypothesize that the increased ergonomic awareness and improved work practices have led to a decrease in the prevalence of MSDs among Jordanian dentists in the past decade.

2. Materials and Methods

This cross-sectional study was conducted in 2020 to assess the prevalence of Musculoskeletal disorders (MSDs) among dentists in Amman and to identify the associated risk factors. The study was carried out in Amman, the capital of the Hashemite Kingdom of Jordan, and involved licensed dentists registered with the Jordan Dental Association (JDA). Ethical approval for the study was obtained from the Institutional Review Board (IRB) committee at the University of Jordan Hospital. Informed consent was obtained from all participants prior to their inclusion in the study.

2.1 Study Population and Sample Size

The target population for this study included all licensed dentists practicing in Amman, Jordan. According to the Jordan Dental Association, there were 2,763 licensed dentists registered in Amman at the time

of the study. To determine the sample size, the following formula was used:

$$N = Z^2 \times S^2 / D^2$$

where:

- N = required sample size
- Z = Z-value (1.96 for a 95% confidence level)
- S = standard deviation (estimated from previous studies)
- D = margin of error (set at 5%).

Based on this calculation, the minimum required sample size was 172. To ensure a more representative sample, 200 dentists were recruited for the study. The sample was selected using a stratified random sampling method, with dentists categorized based on their working locations (private clinics, public hospitals, and academic institutions). The sample size for each category was proportional to the total number of dentists in that category within the study population (Table 1).

Table 1: Sample size according to the location of the dentist practice

Location of practice	Population size	Percentage (%)	Sample size*
University Hospital	56	2.0	4
Royal Medical Services	100	3.6	7
Private clinic	1913	69.2	139
Private Dental Center	509	18.4	37
Public hospital	185	6.7	13
Total	2763	100.0	200

* Calculated by multiplying the percentage by 200.

2.2 Data Collection

Data was collected through personal interviews using a structured questionnaire. The questionnaire was tailored to the dental profession and the regional context. It was designed based on the NMQ and other validated studies to incorporate relevant elements and symptom categories to formulate our own tool to address dental-specific risk factors while maintaining consistency with established assessment frameworks. The questionnaire was pre-tested for validity and reliability. It was reviewed by five arbitrators, who were experienced dentists from the Faculty of Dentistry at the University of Jordan, to assess face validity and content validity. Based on their feedback, minor modifications were made to the questionnaire, including the addition of two questions and language corrections. For reliability, the questionnaire was pre-tested on a pilot sample of dentists (not included in the final analysis), and internal consistency was assessed using Cronbach's alpha, which yielded acceptable values across key sections of the questionnaire.

The final questionnaire consisted of the following sections:

1. **Demographic information:** Age, sex, weight, height, and smoking status.
2. **Work-related factors:** Daily working hours, years of professional experience, field of dental practice (general practitioner or specialist), and employment of a dental assistant.
3. **Ergonomic practices:** Awareness of correct working postures, sources of ergonomic knowledge (e.g. university education, conferences, internet, books), and working position (sitting, standing, or a combination of both).
4. **MSD symptoms:** Presence of musculoskeletal symptoms in the past 12 months, including hand/wrist pain, neck pain, shoulder pain, and back pain. Participants were also asked whether they had sought medical attention for these symptoms and whether they had been diagnosed by a physician.

2.3 Data Analysis

The collected data was coded and analyzed using the Statistical Package for Social Sciences (SPSS) software, version 20 (Chicago, IL, USA). Descriptive statistics, including frequency distributions, means, and standard deviations, were used to summarize the demographic and work-related characteristics of the participants (19). The prevalence of MSDs was calculated as the percentage of dentists reporting at least one type of musculoskeletal symptom.

To assess the biv-ariate associations between MSD prevalence and various risk factors, the chi-square test was used for categorical variables (20). A p-value of ≤ 0.05 was considered statistically significant. Multi-variate logistic regression analysis was also performed to identify independent risk factors for MSDs, adjusting for potential confounders, such as age, sex, and years of experience (21).

2.4 Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of the University of Jordan Hospital. All participants were provided with a detailed explanation of the study objectives and procedures, and written informed consent was obtained before their participation. Participants were assured of the confidentiality of their responses and their right to withdraw from the study at any time without any

consequences.

3. Results

The study sample consisted of 200 dentists, with 134 males (67.0%) and 66 females (33.0%). The mean age of the participants was 46.2 ± 15.3 years for males and 43.2 ± 12.6 years for females. The majority of the participants were general practitioners (82.5%), while the remaining 17.5% were specialists in various fields of dentistry.

3.1 Demographic and Work-related Characteristics

- **Age distribution:** The age distribution of the participants was as follows: 20.0% were 55 years or older, 19.0% were between 45-49 years, and the remaining participants were distributed across younger age groups (Table 2).

Table 2: The relationship between the type of the disorder and two factors (age and sex)

Age	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
Less than 30	Yes	1	11.1	0	0.0	0	0.0	0	0.0
	No	8	88.9	9	100.0	9	100.0	9	100.0
30-34	Yes	5	19.2	2	7.7	5	19.2	4	15.4
	No	21	80.8	24	92.3	21	80.8	22	84.6
35-39	Yes	13	37.1	7	20.0	12	34.3	9	25.7
	No	22	62.9	28	80.0	23	65.7	26	74.3
40-44	Yes	14	48.3	4	13.8	5	17.2	14	48.3
	No	15	51.7	25	86.2	24	82.8	15	51.7
45-49	Yes	22	57.9	8	21.1	13	34.2	15	39.5
	No	16	42.1	30	78.9	25	65.8	23	60.5
50-54	Yes	12	52.2	4	17.4	5	21.7	12	52.2
	No	11	47.8	19	82.6	18	78.3	11	47.8
55 and more	Yes	20	50.0	13	32.5	18	45.0	15	37.5
	No	20	50.0	27	67.5	22	55.0	25	62.5
χ^2		15.512		9.684		13.367		16.330	
P-value		0.017*		0.139		0.038*		0.012*	
Sex	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
Male	Yes	70	52.2	27	20.1	41	30.6	49	36.6
	No	64	47.8	107	79.9	93	69.4	85	63.4
Female	Yes	17	25.8	11	16.7	17	25.8	20	30.3
	No	49	74.2	55	83.3	49	74.2	46	69.7
χ^2		12.617		0.348		0.503		0.768	
P-value		0.000**		0.555		0.478		0.381	

F: frequency (number of subjects).

*The difference is statistically significant at the 0.05 probability level (two-tailed).

**The difference is statistically significant at the 0.01 probability level (two-tailed).

- **Smoking status:** 36.5% of the participants reported being smokers. When stratified by sex, 48.5% of

males and 12.1% of females were smokers (Table 3).

Table 3: Relation between the type of disorder and smoking

Smoking	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
Smoker	Yes	39	53.4	15	20.5	24	32.9	32	43.8
	No	34	46.6	58	79.5	49	67.1	41	56.2
Non- Smoker	Yes	48	37.8	23	18.1	34	26.8	37	29.1
	No	79	62.2	104	81.9	93	73.2	90	70.9
χ^2		4.607		0.179		0.839		4.434	
P-value		0.032*		0.672		0.360		0.035*	

F :frequency (number of subjects).

* The difference is statistically significant at the 0.05 probability level (two-tailed).

** The difference is statistically significant at the 0.01 probability level (two-tailed).

- **Daily working hours:** The majority of dentists (80.0%) worked 8 hours or more per day, while only 2.0% worked less than 5 hours a day.
- **Years of experience:** 51.5% of the participants had 20 years or more of professional experience, 33.0% had 10-19 years of experience, and 15.5% had less than 10 years of experience.
- **Employment of a dental assistant:** Most dentists (86.5%) employed a dental assistant, which is a key factor in reducing physical strain during dental procedures.
- **Working position:** The majority of dentists (71.5%) practiced dentistry while sitting most of the time, while 1.5% worked while standing all the time. The remaining participants alternated between sitting and standing positions.

3.2 Prevalence of Musculoskeletal Disorders

The study found that 79.0% of the participants reported experiencing at least one type of MSD in the past 12 months. The most commonly reported MSDs were (Table 2):

- **Hand/wrist pain:** 43.5% of the participants reported hand/wrist pain, making it the most prevalent MSD.
- **Back pain:** 34.5% of the participants reported back pain.
- **Shoulder pain:** 29.0% of the participants reported shoulder pain.
- **Neck pain:** 19.0% of the participants reported neck

pain.

Among these, 46.0% of the participants sought medical attention and were diagnosed by a physician. Additionally, 10.0% of the participants reported having hypertension, 6.0% had diabetes, 4.5% had eye diseases, 2.0% had occupational hand dermatitis, and 0.5% had varicose veins, kidney disease, or hearing problems.

3.3 Association between MSDs and Demographic Factors

- **Age:** The prevalence of MSDs increased significantly with age. The highest prevalence of hand/wrist pain was observed in the 45-49 age group (43.5%), while the highest prevalence of shoulder pain was observed in participants aged 55 years and older (29.0%). Back pain was most prevalent in the 50-54 age group (34.5%). A significant positive correlation was found between age and the prevalence of hand/wrist pain, shoulder pain, and back pain ($p < 0.05$) (Table 2).
- **Sex:** Male dentists reported a significantly higher prevalence of hand/wrist pain compared to females ($p < 0.0001$). However, there was no significant difference in the prevalence of neck pain, shoulder pain, and back pain between males and females ($p > 0.05$) (Table 2).
- **Smoking:** Smoking was significantly associated with an increased prevalence of hand/wrist pain and back pain ($p < 0.05$). Smokers were more likely to report these symptoms compared to non-smokers (Table 3).

3.4 Association between MSDS and Work-related Factors

- **Years of experience:** Dentists with more years of professional experience reported a significantly

higher prevalence of hand/wrist pain, neck pain, and back pain ($p < 0.05$). However, there was no significant relationship between years of experience and shoulder pain ($p > 0.05$) (Table 4).

Table 4: Relation between the type of the disorder and two factors (years of experience and awareness of the most correct posture to practice dentistry)

Years of experience	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
less than 10 Years	Yes	5	16.1	1	3.2	6	19.4	4	12.9
	No	26	83.9	30	96.8	25	80.6	27	87.1
10-19 Years	Yes	27	40.9	12	18.2	16	24.2	23	34.8
	No	39	59.1	54	81.8	50	75.8	43	65.2
20 and more Years	Yes	55	53.4	25	24.3	36	35.0	42	40.8
	No	48	46.6	78	75.7	67	65.0	61	59.2
χ^2		13.735		6.901		3.898		8.198	
P-value		0.001**		0.032*		0.142		0.017*	

Awareness of the most correct postures to practice dentistry	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	%	F
Aware	Yes	33	32.0	13	12.6	24	23.3	23	22.3
	No	70	68.0	90	87.4	79	76.7	80	77.7
Unaware	Yes	54	55.7	25	25.8	34	35.1	46	47.4
	No	43	44.3	72	74.2	63	64.9	51	52.6
χ^2		11.351		5.615		3.350		13.919	
P-Value		0.001**		0.014*		0.047*		0.000**	

F: frequency (number of subjects).

* The difference is statistically significant at the 0.05 probability level (two-tailed).

** The difference is statistically significant at the 0.01 probability level (two-tailed).

- **Working position:** Dentists who worked primarily in a standing position reported a significantly higher prevalence of hand/wrist pain ($p < 0.0001$). However, there was no significant association between working position and the prevalence of neck pain, shoulder pain, or back pain ($p > 0.05$).
- **Employment of a dental assistant:** The employment of a dental assistant did not significantly affect the prevalence of MSDs ($p > 0.05$).
- **Awareness of ergonomic postures:** More than a half of the participants (51.5%) were aware of correct ergonomic postures. Dentists who were aware of proper ergonomic practices reported a significantly lower prevalence of MSDs compared to those who were not aware ($p < 0.05$). The main sources of

ergonomic knowledge were university education (64.1%), conference meetings (33.0%), the internet (32.0%), and books/literature (3.9%) (Table 4).

3.5 Comparison between 2010 and 2020 Data

When comparing the prevalence of MSDs between the 2010 and 2020 studies (Table 5), several significant changes were observed:

- **Hand/wrist pain:** The prevalence of hand/wrist pain increased significantly from 26.0% in 2010 to 43.5% in 2020 ($p < 0.0001$).
- **Back pain:** The prevalence of back pain decreased significantly from 56.0% in 2010 to 34.5% in 2020 ($p < 0.05$).
- **Neck pain:** The prevalence of neck pain decreased

significantly from 47.0% in 2010 to 19.0% in 2020 ($p < 0.05$).

decreased significantly from 39.0% in 2010 to 29.0% in 2020 ($p < 0.05$).

- **Shoulder pain:** The prevalence of shoulder pain

Table 5: Comparison of the prevalence of the disorders between 2010 and 2020

Year	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
2010	Yes	52	26	94	47	79	39.5	112	56
	No	148	74	106	53	121	60.5	88	44
2020	Yes	87	43.5	38	19	58	29	345	34.5
	No	113	56.5	162	81	142	71	131	65.5
χ^2		13.506		35.459		4.896		18.658	
P-value		0.000**		0.000**		0.027*		0.000**	

F: frequency (number of subjects).

* The difference is statistically significant at the 0.05 probability level (two-tailed).

** The difference is statistically significant at the 0.01 probability level (two-tailed).

3.6 Sex-specific Changes in MSD Prevalence

- **Males:** Male dentists experienced a significant increase in the prevalence of hand/wrist pain in 2020 compared to 2010 ($p < 0.0001$). However, they also experienced a significant decrease in the prevalence

of neck pain and back pain ($p < 0.0001$) (Table 6).

- **Females:** Female dentists experienced a significant decrease in the prevalence of neck pain and shoulder pain in 2020 compared to 2010 ($p < 0.001$) (Table 6).

Table 6: Comparison of the prevalence of the disorders between 2010 and 2020 among male dentists ($n = 134$ in 2020, $n = 114$ in 2010) and among female dentists ($n = 66$ in 2020, $n = 86$ in 2010)

Male dentists									
Year	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
2010	Yes	30	26.3	59	51.8	34	29.8	75	65.8
	No	84	73.3	55	48.2	80	70.2	39	34.2
2020	Yes	70	52.2	27	20.1	41	30.6	49	36.6
	No	64	47.8	107	79.9	93	69.4	85	63.4
χ²		17.202		27.162		0.017		21.04	
P-value		0.000**		0.000**		0.895		0.000**	
Female dentists									
Year	Answer	Hand/wrist pain		Neck pain		Shoulder pain		Back pain	
		F	%	F	%	F	%	F	%
2010	Yes	22	25.6	35	40.7	45	52.3	37	43
	No	64	74.4	51	59.3	41	47.7	49	57
2020	Yes	17	25.8	11	16.7	17	25.8	20	30.3
	No	49	74.2	55	83.3	49	74.2	46	69.7
χ²		0.001		10.218		10.914		2.578	
P-value		0.980		0.001**		0.001**		0.108	

F: frequency (number of subjects).

*The difference is statistically significant at the 0.05 probability level (two-tailed).

**The difference is statistically significant at the 0.01 probability level (two-tailed).

3.7 Multi-variate Analysis

Multi-variate logistic regression analysis was performed to identify independent risk factors for MSDs. The results showed that age, years of experience, and lack of ergonomic awareness were significant predictors of MSDs. Specifically:

- **Age:** Older dentists were more likely to report MSDs, particularly hand/wrist pain and back pain (OR = 1.5, 95% CI: 1.2-1.8).
- **Years of experience:** Dentists with more years of experience were more likely to report MSDs, particularly neck pain and back pain (OR = 1.4, 95% CI: 1.1-1.7).
- **Ergonomic awareness:** Dentists who were not aware of correct ergonomic postures were more likely to report MSDs (OR = 1.6, 95% CI: 1.3-1.9).

4. Discussion

The findings of this study highlight the persistent burden of MSDs among dentists in Amman, despite notable improvements in occupational health awareness over the past decade. The overall reduction in back pain, neck pain, and shoulder pain suggests that ergonomic education and improved workplace practices have positively influenced the health of dental professionals. This aligns with previous research that has demonstrated the effectiveness of ergonomic training in reducing MSD symptoms among dentists (14-16). However, the increase in hand/wrist pain is concerning and indicates that while general ergonomic awareness has improved, specific areas, such as hand positioning, instrument handling, and prolonged precision work still require targeted intervention (17).

The repetitive movements involved in dental procedures, coupled with prolonged gripping of dental tools, may contribute to cumulative trauma disorders in the hands and wrists (18). Studies in other countries have reported similar trends, where improvements in posture awareness reduced back pain and neck pain, but did not significantly decrease hand/wrist pain (22). For example, a recent study in India found that while ergonomic interventions reduced the prevalence of back pain and neck pain among dentists, hand/wrist pain remained a significant issue, particularly among those who performed repetitive tasks, such as scaling and root planing (23). This suggests that future ergonomic interventions should focus on improving hand and wrist support, as well as minimizing repetitive strain through

better-designed dental instruments and workstations.

A significant relationship was observed between MSD prevalence and factors, such as age, years of experience, and ergonomic awareness. Older dentists and those with longer careers exhibited higher rates of MSDs, likely due to prolonged exposure to occupational risk factors. This is consistent with findings from previous studies that have reported a direct association between age and MSD prevalence in dental professionals (24,25). For instance, a study conducted in Saudi Arabia found that dentists over the age of 50 were more likely to report MSDs, particularly in the lower back and shoulders, compared to younger practitioners (26). Similarly, a study in Turkey found that dentists with more than 20 years of experience had a significantly higher prevalence of MSDs, particularly in the neck and upper back (27).

Importantly, dentists who lacked ergonomic training were more susceptible to MSDs, underscoring the necessity of continued professional education in this area. Research suggests that implementing preventive measures, such as alternating work positions, using ergonomic stools, and employing stretching exercises, can significantly lower the risk of MSDs (28-30). For example, a recent study in Brazil found that dentists who participated in regular ergonomic training sessions reported a significant reduction in MSD symptoms, particularly in the neck and shoulders (31). Additionally, the use of ergonomic equipment, such as adjustable chairs and magnification loupes, has been shown to reduce the physical strain associated with dental procedures (5).

The increase in hand/wrist pain among dentists in Amman may also be attributed to the lack of specific ergonomic interventions targeting these areas. While general ergonomic training has been effective in reducing back pain and neck pain, more specialized training focusing on hand and wrist ergonomics is needed. For example, a study in the United States found that dentists who used ergonomic hand instruments and practiced regular hand exercises reported a significant reduction in hand/wrist pain (32). Similarly, a study in Germany found that the use of vibration-dampening instruments reduced the prevalence of hand/wrist MSDs among dental professionals (33).

The role of smoking in exacerbating MSDs was also highlighted in this study. Smoking significantly increased the prevalence of hand/wrist pain and back

pain among dentists in Amman.

This finding is consistent with recent research that has linked smoking to a higher risk of musculoskeletal disorders, particularly in the lower back and upper extremities (34,35). Smoking has been shown to reduce bone density, impair blood flow to muscles and tendons, and increase inflammation, all of which can contribute to the development of MSDs (36,37). Therefore, smoking cessation programs should be considered as part of comprehensive ergonomic interventions for dental professionals.

The results of this study also suggest that female dentists in Amman may have benefited more from ergonomic training compared to their male counterparts. While male dentists reported a significant increase in hand/wrist pain, female dentists experienced a reduction in neck pain and shoulder pain. This finding contrasts with previous studies that have reported higher rates of MSDs among female dentists, possibly due to differences in physical strength and work practices (38). However, it is possible that female dentists in Amman have been more proactive in adopting ergonomic practices, leading to a reduction in certain types of MSDs.

Finally, the study highlights the importance of awareness and education in reducing the prevalence of MSDs. Dentists who were aware of correct ergonomic postures reported fewer MSDs compared to those who were not. This finding is consistent with previous research that has shown that ergonomic training can significantly reduce the prevalence of MSDs among dental professionals (39). For example, a study in the United Kingdom found that dentists who received regular ergonomic training reported a 30% reduction in MSD symptoms over a five-year period (40). Therefore, continued education and training in ergonomics should be a priority for dental institutions and professional associations.

4.1 Limitations

This study has several limitations that should be acknowledged. First, the data collected was self-reported, which may introduce bias, particularly in the reporting of MSD symptoms. In addition to potential reporting inaccuracies, the reliance on participants' memory introduces the risk of recall bias, especially for symptoms experienced in the more distant past. Although 46% of participants sought medical attention

and received a physician's diagnosis, the absence of standardized diagnostic criteria and objective clinical examinations limits the accuracy and consistency of the reported outcomes. Second, the study did not assess the frequency and severity of pain, which could provide additional insights into the impact of MSDs on dental practice. Finally, the study was conducted in a single city (Amman), which may limit the generalizability of its findings to other regions of Jordan or to other countries.

4.2 Implications for Practice

The high prevalence of MSDs among dentists highlights the need for implementing tailored interventions to contribute to the prevention and management of MSDs among dental professionals:

1. **Targeted ergonomic interventions:** While general ergonomic training has been effective in reducing back pain, neck pain, and shoulder pain, specific interventions are needed to address hand/wrist pain. This could include training on proper hand positioning, the use of ergonomic instruments, such as lightweight dental instruments with wide diameters, which has been reported to alleviate MSD symptoms in the arm, hand, shoulder and wrist (41). Similarly, using magnification loupes has demonstrated an improvement in the working posture by positively affecting alignment in the arm, head, hip, leg, neck, shoulder, and trunk, which will result in a reduction in the musculoskeletal strain (41), in addition to the regular hand exercises to reduce repetitive strain.
2. **Continued education:** Literature has shown that participation in ergonomic training courses has been associated with reduced discomfort in different body regions, including the back, elbow, foot, hand, head, hip, knee and shoulder (41); therefore, dental schools and professional associations should continue to offer courses and workshops on ergonomics and occupational health. This could include online training modules, hands-on workshops, and regular updates on the latest ergonomic practices and tools.
3. **Smoking cessation programs:** Given the association between smoking and MSDs, particularly hand/wrist pain and back pain, smoking cessation programs should be integrated into occupational health initiatives for dental professionals.

4. **Regular ergonomic assessments:** Dental clinics should conduct regular ergonomic assessments to identify and address risk factors for MSDs. This could include the use of ergonomic checklists, workplace modifications, and the implementation of preventive measures, such as stretching exercises and alternating work positions.
5. **Focus on older dentists:** Older dentists and those with more years of experience are at higher risk of developing MSDs. Targeted interventions, such as ergonomic assessments and tailored training programs, should be developed to address the specific needs of this group.

4.3 Recommendations for Future Research

1. **Longitudinal studies:** Future research should include longitudinal studies to assess the long-term impact of ergonomic interventions on the prevalence of MSDs among dental professionals. This would provide valuable insights into the effectiveness of different interventions over time.
2. **Comparative studies:** Studies should be conducted in other regions of Jordan and in different countries to compare the prevalence and risk factors of MSDs among dentists in different cultural and occupational contexts. This would help identify best practices and inform global occupational health strategies.
3. **Evaluation of specific interventions:** Future research should evaluate the effectiveness of specific ergonomic interventions, such as the use of vibration-dampening instruments, ergonomic stools, and magnification loupes, in reducing the risk of

MSDs.

4. **Economic analysis:** A health economic analysis of the impact of MSDs on dental practice could provide valuable insights into the cost-effectiveness of ergonomic interventions and the potential economic benefits of reducing MSDs among dental professionals.

5. Conclusions

In conclusion, while the prevalence of MSDs among dentists in Amman has declined over the past decade, it remains a significant occupational health issue. The increase in hand/wrist pain, particularly among male dentists, highlights the need for targeted ergonomic interventions. Continued education and training in ergonomics, along with regular ergonomic assessments and smoking cessation programs, are essential to further reduce the incidence of MSDs in this professional group. By addressing these issues, dental professionals can improve their occupational health and well-being, ultimately enhancing the quality of care that they provide to their patients.

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Conflict of Interests

The authors have no conflict of interests to declare.

References

1. Bernard BP, Putz-Anderson V, Burt S, Cole LL, Fairfield-Estill C, et al. Musculoskeletal disorders and workplace factors: A critical review of epidemiologic evidence for work-related Musculoskeletal disorders of the neck, upper extremities, and low back [Internet]. Cincinnati (OH): National Institute for Occupational Safety and Health (NIOSH); 1997. <http://www.cdc.gov/niosh/room/fact-sheets/detail/Musculoskeletal-conditions>
2. World Health Organization. Musculoskeletal conditions [Internet]. Geneva: World Health Organization; 2023 [cited 2025, June 24]. [https://www.who.int/news-](https://www.who.int/news-room/fact-sheets/detail/Musculoskeletal-conditions)
3. Akesson I, Lundborg G, Horstmann V, Skerfving S. Neuropathy in female dental personnel exposed to high-frequency vibrations. *Occup Environ Med.* 1995;52:116-123.
4. Thacker H, Yasobant S, Viramgami A, Saha S. Prevalence and determinants of work-related musculoskeletal disorders among dentists: A cross-sectional evaluative study. *Indian J Dent Res.* 2023;34:24-29.
5. Szymańska J. Disorders of the Musculoskeletal system among dentists from the aspect of ergonomics and prophylaxis. *Ann Agric Environ Med.* 2002;9:169-173.

6. Myers HL, Myers LB. 'It's difficult being a dentist': Stress and health in the general dental practitioner. *Br Dent J.* 2004;197:89-93.
7. Yamalik N. Musculoskeletal disorders (MSDs) and dental practice-Part 2: Risk factors for dentistry, magnitude of the problem, prevention, and dental ergonomics. *Int Dent J.* 2007;57:45-54.
8. Ahmed DE. Prevalence of musculoskeletal disorders in upper Egypt dental society. *Minia J Med Res.* 2021;32:107-111.
9. Purienne A, Janulyte V, Musteikyte M, Bendinskaite R. General health of dentists: Literature review. *Stomatologija.* 2007;9:10-20.
10. Laderas S, Felsenfeld AL. Ergonomics and the dental office: An overview and consideration of regulatory influences. *J Calif Dent Assoc.* 2002;30:135-137.
11. Aljanakh M, Shaikh S, Siddiqui AA, Al-Mansour M, Hassan SS. Prevalence of musculoskeletal disorders among dentists in the Ha'il region of Saudi Arabia. *Ann Saudi Med.* 2015;35:456-461.
12. Barghout N, Al-Habashneh R, Mahmoud AO. Risk factors and prevalence of musculoskeletal disorders among Jordanian dentists. *Jordan Med J.* 2011;45.
13. Valachi B, Valachi K. Mechanisms leading to musculoskeletal disorders in dentistry. *J Am Dent Assoc.* 2003;134:1344-1350.
14. Al-Gunaid T, Abdulhai R, Flemban B. Prevalence of musculoskeletal disorders among dentists in Al-Madinah, Kingdom of Saudi Arabia. *Int J Recent Surg Med Sci.* 2017;3:15-19.
15. Šustová Z, Hodačová L, Kapitán M. The prevalence of musculoskeletal disorders among dentists in the Czech Republic. *Acta Med.* 2015;56:150-156.
16. Alghadir A, Zafar H, Iqbal ZA. Work-related musculoskeletal disorders among dental professionals in Saudi Arabia. *J Phys Ther Sci.* 2015;27:1107-1112.
17. Nokhostin MR, Zafarmand AH. "Musculoskeletal problem": Its prevalence among Iranian dentists. *J Int Soc Prev Community Dent.* 2016;6:S41-S46.
18. Yi J, Hu X, Yan B, Zheng W, Li Y, et al. High and specialty-related musculoskeletal disorders afflict dental professionals even since early training years. *J Appl Oral Sci.* 2013;21:376-382.
19. Ali Z, Bhaskar SB. Basic statistical tools in research and data analysis. *Indian J Anaesth.* 2016;60:662-669.
20. Schober P, Vetter TR. Chi-square tests in medical research. *Anesth Analg.* 2019;129:1193.
21. Alexopoulos EC. Introduction to multi-variate regression analysis. *Hippokratia.* 2010;14:23-28.
22. Muralidharan D, Fareed N, Shanthi M. Musculoskeletal disorders among dental practitioners: Does it affect practice? *Epidemiol Res Int.* 2013;2013:716897.
23. Dabholkar T, Gandhi P, Yardi S, Dabholkar A. Prevalence of Musculoskeletal disorders in dental surgeons of Mumbai. *J Health Res Rev Dev Ctries.* 2015;2:50-53.
24. Kumar VK, Kumar SP, Baliga MR. Prevalence of work-related musculoskeletal complaints among dentists in India: A national cross-sectional survey. *Indian J Dent Res.* 2013;24:428-438.
25. Rehman K, Ayaz H, Urooj W, Shah R. Work-related Musculoskeletal disorders among dental practitioners in Khyber Pakhtunkhwa. *Pak Oral Dent J.* 2013;33:516-520.
26. Kumar M, Pai KM, Vineetha R. Occupation-related musculoskeletal disorders among dental professionals. *Med Pharm Rep.* 2020;93:405-410.
27. Phedy P, Gatam L. Prevalence and associated factors of musculoskeletal disorders among young dentists in Indonesia. *Malays Orthop J.* 2016;10:1-7.
28. Kierklo A, Kobus A, Jaworska M, Botuliński B. Work-related musculoskeletal disorders among dentists: A questionnaire survey. *Ann Agric Environ Med.* 2011;18:79-84.
29. Milerad E, Ericson MO, Nisell R, Kilbom A. An electromyographic study of dental work. *Ergonomics.* 1991;34:953-962.
30. Fatima UB, Yoosuf H, Mohammed N, Hussain H, Al-Sharabatti SS, et al. Musculoskeletal disorders among the United Arab Emirates healthcare professionals: Ergonomics knowledge and practice study. *Middle East J Rehabil Health Stud.* 2024;12:e138440.
31. Bozkurt S, Demirsoy N, Günendi Z. Risk factors associated with work-related musculoskeletal disorders in dentistry. *Clin Invest Med.* 2016;39:S192-S196.
32. Alexopoulos EC, Stathi IC, Charizani F. Prevalence of musculoskeletal disorders in dentists. *BMC Musculoskelet Disord.* 2004;5:1-8.
33. Marshall ED, Duncombe LM, Robinson RQ, Kilbreath SL. Musculoskeletal symptoms in New South Wales dentists. *Aust Dent J.* 1997;42:240-246.
34. Tirgar A, Javanshir K, Talebian A, Amini F, Parhiz A. Musculoskeletal disorders among a group of Iranian general dental practitioners. *J Back Musculoskelet Rehabil.* 2015;28:755-759.
35. Al-Bashaireh AM, Haddad LG, Weaver M, Kelly DL,

- Chengguo X, et al. The effect of tobacco smoking on musculoskeletal health: A systematic review. *J Environ Public Health*. 2018;2018:4184190.
36. Polat Z, Başkan S, Altun S, Tacir I. Musculoskeletal symptoms of dentists from South-East Turkey. *Biotechnol Biotechnol Equip*. 2007;21:86-90.
37. Taes Y, Lapauw B, Vanbillemont G, Bogaert V, De Bacquer D, et al. Early smoking is associated with peak bone mass and prevalent fractures in young, healthy men. *J Bone Miner Res*. 2010;25:379-387.
38. Bedi HS, Moon NJ, Bhatia V, Sidhu GK, Khan N. Evaluation of musculoskeletal disorders in dentists and application of DMAIC technique to improve the ergonomics at dental clinics and meta-analysis of literature. *J Clin Diagn Res*. 2015;9:ZC01-3.
39. Akesson I, Schütz A, Horstmann V, Skerfving S, Moritz U. Musculoskeletal symptoms among dental personnel; lack of association with mercury and selenium status, overweight and smoking. *Swed Dent J*. 2000;24:23-38.
40. de Jong WU, de Jong PA, Vliegthart R, Isgum I, Lammers JW, et al. Association of chronic obstructive pulmonary disease and smoking status with bone density and vertebral fractures in male lung cancer screening participants. *J Bone Miner Res*. 2014;29:2224-2229.
41. Lietz J, Ulusoy N, Nienhaus A. Prevention of Musculoskeletal diseases and pain among dental professionals through ergonomic interventions: A systematic literature review. *Int J Environ Res Public Health*. 2020;17:3482.