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ORIGINAL ARTICLE

Prevalence of Work-Related Musculoskeletal Disorders among Dentists and Their Awareness with Ergonomics at Zagazig University Hospitals

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ABSTRACT

Background: Ergonomics is the science of adapting the job site to workload regarding the employees' capacities. There was a significant decline in the percentages of work-related Musculoskeletal disorders WMSDs among dental professionals upon following dental ergonomics strictly. This study was undertaken to assess the prevalence of work-related musculoskeletal disorders (WMSDs) among dentists working at Zagazig University

Methods: A cross-sectional study was done among the dentists working in Zagazig University Clinics (ZUCs). Dentists were (96) in number and were interviewed individually at ZUCs during their working time about the possible work-related risk factors that may influence them. In addition, they were asked about how they deal with awkward postures during work. Moreover, they were asked about self-reported WMSDs in the last 12 months. Furthermore, they were questioned about the presence or lack of precautionary measures at work for treating WMSDs.

Results: A higher prevalence of standing as a style of dental practice (48.9 %) was observed compared to sitting (21.9 %), while the alternative standing and sitting as a style of practice was 29.2 %%. In addition, 100% of participants did not know ergonomics and how to apply it in dental settings. The highest prevalence of WMSDs was 71.9 % complaining of lower back pain, neck stiffness, neck and shoulder pain, then 45.8% of elbows and wrists pain, 21.9% of finger stiffness, 12,5 % of numbness and tingling in the cervical region, 21.9 % of limitation of the shoulder movements and finally 12.5 % Deep venous thrombosis (DVT).

Conclusions: Alternative postures can significantly minimize WMSDs. Subsequently, we recommend the introduction of dental ergonomics in dental care practice and the dental students' curricula.

Keywords: Ergonomics; dental practice; dentists; Work Musculoskeletal disorders (WMSDs)

INTRODUCTION

The dental practice has to be done in a safe setting, which is the leading priority for the professionals in dental health care. Thus, it is exceptionally complicated for doctors while dealing with their patients in a narrow and cramped space; dental treatment manoeuvres are not easy while the patients are generally anxious and jumpy. This puts stress on the dentists' muscles together with their terrible postures [1]. Dental practitioners' work-related health problems are escalating issues, negatively affecting the whole quality of life [2]. Musculoskeletal disorders (MSDs) as defined by the WHO, "a disorder of the muscles, tendons, peripheral nerves or vascular system not directly resulting from an acute or instantaneous event (e.g., slips or falls)" [3].

As much as the job setting and the quality of the work are dramatically affected by these disorders, they can be called work-related. Nevertheless, there are further precipitating causes in its pathogenesis. Dental practitioners' most common WMSDs are back, neck, shoulder, and hand and wrist problems (carpal tunnel syndrome, Guyon's canal syndrome, de Quervain's disease, and trigger finger) [5]. To solve this problem, science introduces ergonomics, which deals with adapting the job site to workload regarding the employees' capacities [4]. There

was a significant decline in WMSDs among dental professionals when they strictly followed dental ergonomics [4].This study assessed the prevalence of work-related musculoskeletal disorders (WMSDs) among dentists working at Zagazig University.Our work objectives are t**o** determine the prevalence of work-related musculoskeletal disorders (WMSD) among dentists working at Zagazig university clinics, identify the contributing factors to this WMSD and assess the awareness of job ergonomics.

METHODS

This is a cross-sectional study done among all dentists working in Zagazig University Clinics (ZUCs). All data was collected from the middle of June to July 2019. All dentists working at ZUCs, including house officers, residents and staff members of any age and of both sexes, who agreed to be in the study were included in this study, excluding dentists with any medical problems relevant to MSD (arthritis, fracture, etc.) before starting the work. So a total sample of 96 ZUCs dentists fulfilling the inclusion criteria was included in our study. The author explained the purpose of the research to the dentists working in ZUCs and confirmed data confidentiality. Written informed consent was obtained from all participants.

The procedures followed the ethical standards of the responsible committee on human experimentation and were approved by the IRB (Institutional Review Board). The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for human studies.

A questionnaire is used for data collection. Dentists were questioned using a pre-constructed semi-structured questionnaire. The questionnaire was adopted and modified from previous studies and was a valid and reliable tool for screening MSDs: this was proved by exploratory factor analysis on the main items of the questionnaire to evaluate its construction as the number of the factors was based on Eigenvalues (>1), and scree plot. The exploratory factor analysis achieved the maximum likelihood factor extraction method with the varimax rotation and Kaiser Normalization based on the correlation matrix. For the sociodemographic section and work experience questions, all items were loaded on one factor with factor loading ranging from 0.98 to -0.61 in table (3S). For section 2: MSDs in the upper region: all items were loaded on two factors with factor loading ranges from 0.98 to -0.61 table (4S). For section 2: MSDs in the upper region: all items were loaded on one factor with factor loading ranging from 0.41 to 0.94 table (5S). For section four: all items were loaded on one factor with factor loading ranges around 0.79 table (6S)

Also, we test the reliability by Cronbach alpha for internal consistency of the questionnaire. Its results (0.81) indicated close covariance between items of the questionnaire. See appendix

Based on the study objectives, we assessed the following: sociodemographic characteristics of dentists: age, educational level, working hours, patterns of dental practice. The possible work-related risk factors that may influence them. In addition, they asked about how they deal with awkward postures during work. Self-reported MSDs in the previous 12 months, as defined by the presence of pain, joint restriction, muscle cramps, tingling and numbness in the cervical region, upper limb, upper and lower back pain, and lower leg complaint, as shown in figure (1) [6].In addition, it was differentiated from medical MSD by asking about whether the symptoms either increased during workdays or by the end of the work shift and decreased on holidays.

The presence or lack of precautionary measures at work for MSDs treatment. In addition, they asked whether they sought medical advice or not to lessen the MSDs and whether they practised physical activities or took a relaxation period.

Each dentist was informed that he/she had the right to refuse to reply to the survey if they so wished and could withdraw from the study at any time.

Individual dentists were interviewed face-to-face at ZUCs during their working time from 10 a.m. to 1.30 p.m. Each interview took about 10 minutes.

Statistical analysis

The analysis was performed using SPSS Statistics 23.0 [7]. The data was summarized

using descriptive statistics. The χ^2 test (Fisher's exact) for the ratio comparison was used. Logistic regression analysis was carried out to identify the significant risk factors. The level of significance was considered at < 0.05

RESULTS

All dentists at Zagazig University Clinics (ZUCs) were (96) practitioners. Age distribution was 50 % male and 50 % female with a mean age of 29.9±10.4 while working experience in years was a minimum of 1 year and a maximum of 32 years. In addition, a higher prevalence of standing as a style of dental practice (48.9 %) was observed compared to sitting only (21.9 %), while the alternative of standing and sitting as a style of practice was 29.2 %% (table 1).

In figure (2), the highest prevalence of WMSDs was 71.9 % complaining of lower back pain, neck stiffness, neck and shoulder pain, then 45.8% of elbows and wrists pain, 21.9% of finger stiffness, 12,5 % of numbness and tingling in the cervical region, 21.9 % of limitation of the shoulder movements and finally 12.5 % DVT.

All dentists (0.0%) were aware of the proper positioning of the body and adjustments of the tools, chairs, and workstation to their body to avoid excessive body and awkward movements (ergonomics) and were practising physical exercises. On the other hand, about 33.3 % of dentists seek medical interventions in response to MSDs encountered during their clinic work. In comparison, dentists who practice the relaxation periods now and then during working hours were 37.5 % to relax their exhausted muscles (Fig.3).

A very highly statistically significant association was observed between the age group and hours of dental practice. We found that dentists in the age group (31-55 years old) were more working (> 6) hours daily. At the same time, dentists who were of age group (< 30 years old) were working for less number of hours (Table 2). working hours and WMSDs were very highly statistically associated were 52.2 % of dentists who had WMSDs practised 6 hours or more daily (Table 2). In addition, all older dentists (age group > 30 years old) had WMSDs (whole age group N=28), although the younger age had a higher prevalence of the WMSDs 59.4% with statistical significance (P<0.001***) than the older age group. Moreover, male dentists had a higher WMSDs prevalence than female dentists, with a statistically significant difference (69.6%vs 30.4% P<0.001***).

Table 3 demonstrates that years of experience and body posture were statistically associated. We found that most dentists with fewer years of experience (<6 years) were practising sitting alone, followed by standing (76.1%, 57.4 %, respectively). In addition, dentists with more than six years of experience were practising alternative sitting and standing instead of sitting posture or standing alone (100.0 % vs 42.5%, 23.8%, respectively). In addition, the prevalence of dentists with WMSDs was significantly associated with unfair practice; in the case of practising either sitting only or standing only (100.0, 100 %, respectively), while dentists who did the proper practice (alternative sitting and standing) were significantly higher than dentists who did either standing or sitting only (96.4%, P<0.001***).

The logistic regression analysis indicates that the probability of WMSDs among male dentists increased more markedly than in females, yet not statistically significant. Also, the probability of WMSDs among ZUCs dentists who have worked for six years or more increased markedly compared to those with fewer years of experience, although not statistically significant (Table 4).

Table (1): Socio-demographic data among the studied group.

Characteristics	Dentists (N=96)	
Sex	**NO**	**%**
Male	48	50.0
Female	48	50.0
Age (Years)		
<30	68	70.8

Characteristics	Dentists (N=96)	
30-50	25	26.0
>50	3	3.1
Working Experiences in Years 0-5	68	70.8
>5	28	29.2
Working hours (Hours/day)		
4-6	60	62.5
>6	36	37.5
Type of dental practice		
Sitting	21	21.9
Standing	47	48.9
Both	28	29.2

Table (2): Socio-demographic, work characteristics and WMSDs among ZUCs dentists.

Working hours	Age groups(N=96)		χ^2	P-value
		Age group <30 years (N=68)	Age group 31-55 years (N=28)		
		NO (%)	NO (%)		
	<6 Hours	60(88.2)	0(0.0)	FE test	0.001***
	6+ hours	8 (11.8)	28 (100.0)		
	WMSD (N=96)				
Hours of practice		Positive(N=69)	Negative (N=27)		
		NO (%)	NO (%)		
	< 6 Hours	33(47.8)	27(100.0)	FE test	0.001***
	6+ hours	36(52.2)	0(0.0)		
	<30	41(59.4)	27(100.0)	FE test	0.001***
Age group (years old)	31+55	28(40.6)	0(0.0)		
Gender	Male	48(69.6)	0(0.0)	FE test	0.001***
	Female	21(30.4)	27(100.0)		

FE test: Fisher Exact test

Table (3): work-related musculoskeletal disorders (WMSDs), working experiences in years and dentists position during practice

Item	Dental Practice (N=96)				χ^2	P-value
Working Experiences in Years		Sitting(N=21)	Standing(N=47)	Both(N=28)		
		NO (%)	NO (%)	NO (%)		
	< 6 years	16 (76.1)	27 (57.4)	0 (0.0)	34.1	0.001***
	6 +years	5 (23.8)	20 (42.5)	28 (100.0)		
WMSDS	No	0 (0.0)	0 (0.0)	27 (96.4)	91.3	0.001***
	Yes	21 (100.0)	47 (100.0)	1 (3.6)		

Table (4): Multivariate logistic regression analysis for the most predictor variables of work-related musculoskeletal disorders among ZUCs dentists.

Potential Predictors	B	SE	P-value	AOR	CI	
Hours of practice						
< 6 Hours (RC)	-2.4	15866.1	1.000	0.1	0.0	--
6+ hours						
Age group (years old)						
<30	-20.8	7595.7	0.9	0.0	0.0	--
31+55 (RC)				.		
Gender						
Male	18.7	4910.5	0.9	136643580.8	0.0	--
Female (RC)						
Years of experience						
<6 years (RC)	3.7	15507.5	1.000	41.9	0.0	--
≥ 6 years						
Dental Practice						
Sitting	-20.5	7056.998	.998	0.0	0.0	
Standing	-19.3	7056.9	0.9	0.0	0.0	---
Alternative sitting and standing (RC)						

AOR: Adjusted Odds ratio
RC: Reference category

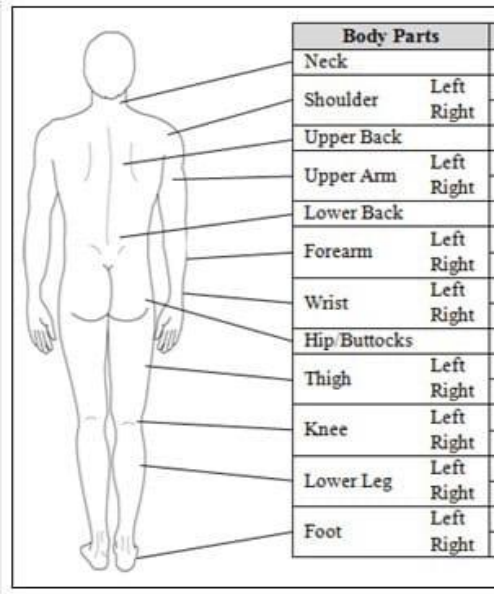

Figure (1): Human body parts affected with WMSD (6).

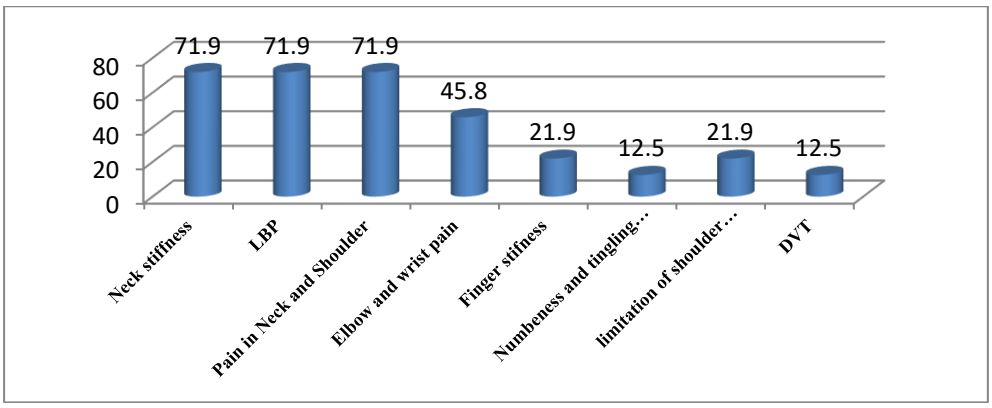

Figure (2): Bar chart of prevalence of self-reported WMSD among dentists.

LBP: Lower back pain
DVT: Deep venous thrombosis

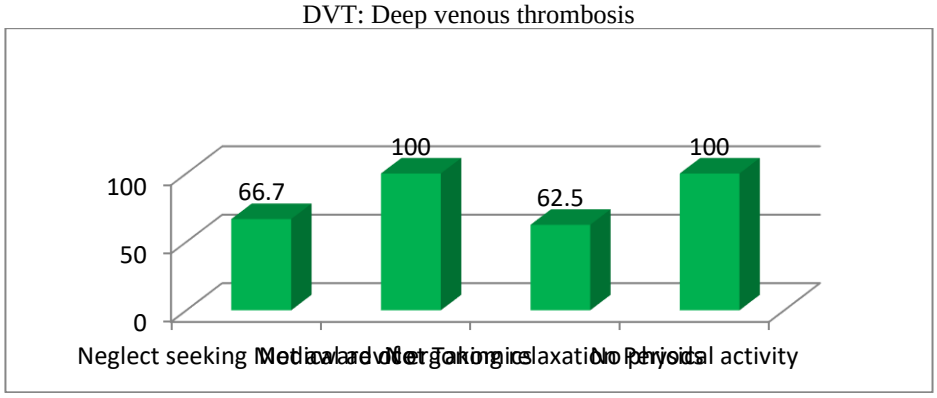

Figure (3): Bar chart of lack of protective practice among ZUC dentists

DISCUSSION

Our study has disclosed the prevalence of MSD as 71.9 % among Zagazig University Clinics (ZUCs) dentists. This was in line with Meenakshi et al., who reported a similar prevalence of 77.5% among general practitioners of the Mysore district in India [2]. In contrast to the Saudi Arabia study, Abduljabbar reported a lower prevalence (59.2%) [8]. A higher prevalence was reported from Australia (87.2%) [9], Lithuania (86.5%) [10], and Turkey (94%) [11].

Moreover, the highest prevalence of WMSDs was 71.9 %, complaining of lower back pain. This was in a match with Polat et al. and Puriene et al.. They have reported that the most common musculoskeletal complaint was low back pain that was recognized due to the forward sitting of the dentist to approach the proper working position [11] and [12].

Also, the prevalence of neck and shoulder pain of WMSDs among ZUCs dentists was 71.9 %, then 45.8% of elbows and wrists pain, 21.9% of finger stiffness, 12,5 % of numbness and tingling in the cervical region, 21.9 % of limitation of the shoulder movements and finally 12.5 % DVT. This was in a match with Meenakshi et al., who found that the neck and shoulders were among the most regularly affected body parts, at 40.8%, followed by low back pain at 14.2%, then elbow and wrist at 14.2%, and last, stiffness in fingers as 21.7%[2].

In addition, all ZUCs dentists were unaware of ergonomics, neither the definition nor the application, and had not practised physical exercises. This was in line with Meenakshi et al., who reported a low rate of ergonomics knowledge (31.7 %) among dentists in India [2]. Moreover, this was contrary to Anu et al., who reported that 61.0 % of dentists were aware of ergonomics during dental practice [14].On the other hand, ZUCs dentists who did not practice the relaxation periods frequently during working hours were 62.5 %.

This was consistent with Meenakshi et al., who reported that 73.3% of dentists were not practising rest periods during their work (2). The results were much higher than the studies done by Szymańska, which discovered that more than 30% of dentists practice their procedures with no rest periods [13].

Furthermore, ZUCs dentists in the age group (31-55 years old) were working (> 6) hours daily. At the same time, most dentists who had (< 30 years old) were working fewer hours. This was in line with Meenakshi et al., who found that older age groups (31-50 years old) increased the working hours between 4-6 hours and more than 6 hours significantly [2].

Regarding working hours and WMSDs, this study showed that 52.2 % of dentists with WMSDs had practised more than 6 hours daily. This was matched with Meenakshi et al., who reported a significant association between working hours and WMSDs [2].

In addition, all older ZUCs dentists, those in the age group (> 30 years old), had WMSDs, although the younger age showed a significantly higher prevalence of WMSDs (59.4 %). This is because the number of the active older group was much less than the younger group and all complained of WMSDs (whole age group N=28). This was matched with Meenakshi et al., who reported that the incidence of WMSDs increased linearly and significantly [2]. Also, this was not followed by Al Wazzan et al., who found that the existence of MSDs depends on the number of working hours, though there is no difference between younger and older dentists reporting the same symptoms [15].In addition, our study showed that male dentists had a higher WMSDs prevalence than females, with a statistically significant difference. This may be because males have more working hours in Zagazig University and private clinics. This was not a match with Meenakshi et al., who found no difference in the prevalence of MSD between males and female general dental practitioners [2]. Moreover, Lindfors et al. reported a higher incidence of MSD among females [16].

Among ZUCs, the majority of dentists with less experience (<6 years) were practising sitting only, followed by standing (76.1%, 57.4 %, respectively). In addition, dentists with six years of experience were practising alternative sitting and standing styles instead of sitting posture or standing alone (100.0 % vs 42.5%, 23.8%, respectively). This was matched with a study by Meenakshi et al., who reported that dentists with fewer working years had a significantly higher prevalence of sitting positions, followed by standing (73.1%). At the same time, those with more than five years of experience were practising alternate sitting and standing dentistry instead of sitting positions, at only 44.7% [2].

Furthermore, the prevalence of ZUCs dentists with WMSDs was significantly associated with the unfair practice of sitting and standing (100.0 and 100.0 %, respectively). In comparison, the absence of WMSDs was significantly higher among dentists who practice alternative sitting standing (96.4 %). This was explained by Ratzon et al., who found that dentists operating in sitting posture only had more severe low back pain than those who practice interchanged postures between sitting and standing positions, as this practice alternates the stress on different muscles on changing the position [17].The logistic regression analysis indicates that the probability of WMSDs among male dentists increased more markedly than in females, yet not statistically significant. Also, the probability of WMSDs among ZUCs dentists who have worked for six years or more increased markedly than those with fewer years of experience, although not statistically significant. This may be explained by the small sample of dentists in the ZUCs.

This was inconsistent with Ahmed and Oraby, who reported opposite results with dentists who had worked more than ten years and those aged >40. They reported that these were the most WMSDs among the studied dentists [18].

Limitations of the study:

Lack of cooperation was noticed from younger age groups, which was overcome by the older doctors and the clinics' managers. In addition, the small sample size was an obstacle, but this can be overlooked as this was the first step paper in multiple steps followed by ergonomics interventional and comparative studies among dentists and other

healthcare workers in El-Sharkia governorate and other governorates in Egypt.

CONCLUSIONS

None of the dental practitioners in this study knew about dental ergonomics or practiced protective actions. Subsequently, we recommend the introduction of dental ergonomics in dental care practice and the dental students' curricula. In addition, more occupational health programs at the dental health clinics on embracing ergonomics in the dental health stations should be escalated. Moreover, alternative postures can minimize WMSDs prevalence significantly.

Conflicts of interest: The authors declare that they have no conflicts of interest.

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SUPPLIMENTARY FILES

Table (1S): reliability measure for internal consistency of the questionnaire

Cronbach's alpha	Cronbach's alpha is based on standardized items	No. of items
0.81	**0.93**	**22**

Table (2S): Interclass correlation coefficient of the reliability measures.

Type of measures	Interclass correlation	95 % CI		F-test with true value)			
		Lower Bound	Upper Bound	Value	df1	df2	Sig.
Single	**0.18[a]**	**0.14**	**0.25**	**5.2**	**95**	**1615**	**0.000**
Average measures	**0.80[c]**	**0.74**	**0.86**	**5.2**	**95**	**1615**	**0.000**

In the two-way mixed-effects model, people effects are random, and measures effects are fixed.

a. The estimator is the same, whether the interaction effect is present.
b. Type C interclass correlation coefficients using a consistency definition-the between-measure variance are excluded from the denominator variance.
c. This estimate is computed assuming the interaction effect is absent because it is not estimable otherwise.

Table (3S): Explanatory Factor analysis for the three sections of the questionnaire.

Component Matrix	
	Component
	1
WEinYears	.986
age group	.979
WEYearsrange	.979
Age	.974
range	.909
Hours	.909
Gender	-.615
Extraction Method: Principal Component Analysis.	
a. 1 component extracted.	

Table (4S): Explanatory Factor analysis in section two of the questionnaire.

Component Matrix		
	Component	
	1	2
Limbs	.864	.263
elbowwristpain	.847	-.312
finger stiffness	.706	-.489
neck stiffness	.465	.823
Extraction Method: Principal Component Analysis.		
a. 2 components extracted.		

Rotated Component Matrix		
	Component	
	1	2
elbowwristpain	.883	.187
finger stiffness	.858	

Rotated Component Matrix		
neck stiffness		.944
Limbs	.591	.682
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.		
a. Rotation converged in 3 iterations.		

Component Matrix	
	Component
	1
backpain	.725
DVT	.725
Extraction Method: Principal Component Analysis.	
a. 1 component extracted.	

Table (5S): Explanatory Factor analysis on section three questionnaire items.

Component Matrix	
	Component
	1
standing	.942
sitting	.933
Both	.905
positions	.722
DVT	.415
Extraction Method: Principal Component Analysis.	
a. 1 component extracted.	

Table (6S): Explanatory Factor analysis section four questionnaire items.

Component Matrix	
	Component
	1
relaxation	.798
Mediassist	.798
No physical exercise	.798
Extraction Method: Principal Component Analysis.	
a. 1 component extracted.	