

## Research Article

# Impact of Ergonomics on Prevalence of Musculoskeletal Disorders in Dental College of King Saud University

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## Introduction

Work related Musculo-Skeletal Disorders are very common among dental practitioners. Dentistry involves physically demanding procedures which require high level of precision over a duration of time. Postural defects would magnify the strain on the body and so considered one of the main causes of WMSD<sup>[1-3]</sup>. While the American Dental Association contended that ergonomic risks are fairly low in dental practice due to ergonomic equipment<sup>[4]</sup>.

WMSDs defined as injuries to the human support system, which consists of the bones, muscles, ligaments and tendons, as well as the vascular and nerve supply. Commonly affected body regions include the neck, shoulder and lower back, but they can affect any area of the body, including elbows, wrists, hips, knees and ankles<sup>[5,6]</sup>. Where around 68% of dentists reported having musculoskeletal pain in the past 12 months, mainly back pain (49%), neck pain (33%), shoulder pain (25%)

## Abstract

**Objectives:** Work-related musculoskeletal disorders are one of the main occupational health hazards affecting dental practitioners. This study was conducted to assess the prevalence of Work-related Musculoskeletal Disorder (WMSD) amongst dental students. Possible correlations with the working environment and ergonomics taught among dental students in Collage of Dentistry of King Saud University in Riyadh (KSA) in their clinical and non-clinical years.

**Subjects & Methods:** Randomly chosen dental students in King Saud University participated in this cross-sectional study. A validated self-administered questionnaire was used to establish the point prevalence of WMSD in the dental students based on various body regions. The questionnaire also collected data regarding the working environment, clinical practice and the taught ergonomics of the students during their training years.

**Results:** Out of two hundred forty two (242) of dental students who participated in the study, 200 were in their clinical years while 42 were students in their non-clinical years. (68.2%) of the clinical year students reported symptoms of WMSDs in one or more body regions. Female students reported a significantly higher numbers of symptoms compared to male students. The neck (83.1%) and lower back (84.7%) were reported to have the highest prevalence of WMSD. Discomfort in the neck region was found to be associated with self-reported frequency of bending of the neck. A majority of students (94.2%) reported minimum participation in workshops related to ergonomics in dentistry and (86.8%) were unfamiliar with treatment and remedies available in the case of WMSDs.

**Conclusion:** There was more WMSDs seen in dental students who had started their clinical years. Neck and lower back are more injury prone areas and are at increased risk of developing WMSDs. Theory and practice of ergonomics should be incorporated into the dental undergraduate curriculum.

and hand/wrist pain<sup>[7]</sup>. According to the World Health Organization (WHO) and the National Institute for Occupational Safety and Health (NIOSH), the Etiology of WMSDs is multifactorial including not only workplace conditions and workplace exposures but also organizational, psychosocial and sociocultural variables, amongst others<sup>[1,8,9]</sup>. Furthermore, MSD is prevalent world over and is one of the commonest causes of long-term pain and disability affecting hundreds of millions of people<sup>[10]</sup> linked to the aforementioned it is important to highlight this WMSDs issue in dentistry might possibly lead to reduce productivity, working inability and even cession of dental practice<sup>[5,8,11]</sup>. Since there are very limited possibilities for changing the work situations within the same profession for the different categories in dentistry<sup>[5,8,12,13]</sup>. Therefore the awareness of occupational health problems should be highlighted at all clinical and research symposia<sup>[7]</sup>.

On the other hand, some studies have shown that musculoskeletal pain was negatively correlated with years of expe-

rience. It has been hypothesized that more experienced dentists learn to adjust their work posture to avoid such problems, or that those dentists with severe WMSD have left the profession. Therefore, this suggests that even dental students can manifest early signs of WMSD during their years of training. These findings were supported by research that revealed that 93% of the clinical year dental students reported symptom of WMSDs in one or more body regions<sup>[1]</sup>. Female shows more symptom of WMSDs than male due to facing to some extent different musculoskeletal demands<sup>[14]</sup>.

Dentist are among the increasingly group been referred for physical therapy and seeking ergonomic advice in the recent past. There is a scope for further decreasing the prevalence and severity of these disorders by performing regular specific exercises<sup>[14]</sup>. A preventive measure, there are study's recommended that the dental students should be taught relaxation techniques early in their clinical training, and they should be taught correct working positions at chair side. When we try to define the terminology of Ergonomics and apply it here it means the application of a body of knowledge addressing the interactions between the dentist and the total working environment, such as atmosphere, heat, light and sound, as well as all tools and equipment of the workplace<sup>[15,16]</sup>. It takes account of the worker's capabilities and limitations to ensure that tasks, equipment, information and the environment suit each worker<sup>[16]</sup>.

Several studies have reviewed the mechanisms that lead to the emergence of pain in dentists while practicing dentistry, such as: a) elevated work area with permanent static positions of more than 30 degrees, which would produce a reduction of blood flow in the supra spine tendon and would also originate high muscle tension on the trapezoids. b) Lack of support of the forearms during repetitive holding of instruments, which would compromise different body segments such as spine, shoulder, and wrists. The precision required forces the dentist to maintain forced wrist postures, which might produce tendinitis or carpal tunnel syndrome. c) The handling of vibrating instruments is associated with specific lesions such as nerve trapping, early arthrosis and even, with Reynaud's syndrome. d) Forced cervical static postures. In order to obtain a good vision of the mouth, dentists frequently adopt cervical torsions and flexions that end up in pain. e) Poor posture when seating. The flexion of the lumbar spine, when seating forward, produces marked pressure increments between the interdiscal spaces. f) Lighting at the work place: the lack or excess of light can generate myopia and irreversible retinal lesions, among others. g) Temperature, ventilation and humidity at the work place. If the temperature is high and the air is saturated with humidity, there is exhaustion, increased body temperature and, respiratory and circulatory disorders. h) Noise at the work place. Intermittent and continuous noise produced by high and low speed instruments is the biggest responsible for auditive alterations<sup>[16-19]</sup>.

The main objective of this study is to assess the prevalence of (WMSDs) among dental students in Collage of Dentistry in King Saud University in Riyadh (KSA) in their clinical and non-clinical years. The secondary objective of the study is to correlate the prevalence of WMSDs of clinical-year students with the work characteristics during their training years and highlighting on the issue that may describe WMSDs to use it for increasing the level of awareness of WMSDs in dentistry.

## Subjects and Methods

### Study Design

This study use a descriptive retrospective analytical cross-sectional design. Data entry and statistical analysis was performed using SPSS version 15.

### Study Population

Request for ethical Approval for this study was made by applying to College of Dentistry Research Center. The target population in this study was students of collage of dentistry in King Saud University among the last five years and assigned by leaders of each year class.

Thirty male and fifteen female dental students from each year were randomly invited to participate in the survey. Students with previously diagnosed WMSDs will be excluded from the study. First and second year dental student were recruited into the study to act as a control group. The questionnaire administered in this study was an English modified version of the questionnaire developed by Khan, et al. 2013. The questionnaire was given to five dental student of each year for informal feedback and pilot tested. The questionnaire was modified based on the panel comments and feedback. The questionnaire comprised of four main sections: the first section addressed the demographics, the second section assessed the working environment and practicing characteristics, the third section addressed the taught ergonomics, while the fourth section assessed the prevalence of WMSD based on body regions.

The questionnaire was piloted with group of 15 students. The pilot study results were as follows; nine students reported lower back discomfort, seven students reported neck discomfort, and six students reported hand and fingers discomfort. Three and four students reported lower shoulder and forearms discomfort respectively, while one student reported elbow discomfort.

## Result

A total of 250 dental students participated in this study yielding a response rate 95.8%. 200 clinical year students participated in the study, while there were 42 nonclinical year students. The demographics of students enrolled in this study showed the characteristics are shown in (Table 1). Ten students were excluded due to medical problems. All the missing data were checked. None of the questions had more than 5% missing values. The majority of questions had five or fewer missing values. An accuracy check of 20 randomly selected questionnaires yielded no errors after data checking and cleaning procedures.

**Table 1:** Demographic characteristics of dental students

Demographic		N	Rate%
Gender	Male	141	58.3
	Female	101	41.7
Diagnosed with any of WMSDs	YES	10(4.1)	NO
			232(95.9)

### Working Environment and Its Characteristics

Work environment and its characteristics were represented by four domains; sitting position, instrument handling, use or non use of dental loupes and duration of working hours. Sitting position was evaluated under three criteria-the use of comfortable stool, its height adjustment and back support during the treatment. Instrument handling was evaluated under four criteria- reaching for instrument without strenuous movement, use of forceful movement to perform clinical work, performing clinical work with arms above shoulder height and bending and twisting of the neck. The use of dental loupes was addressed in one item. One items in the questionnaire assessed the number of working hours in the clinic. Chi-square and logistic regression analysis were conducted in order to gain a better understanding of the relationships between reported symptoms in various regions of the body and the four common working characteristics in the clinic.

### Sitting Position

In relation to sitting position of the students as part of their working environment, three variables were assessed: sitting position was evaluated under three criteria- comfort provided by the operator stool and adjustment of its height and back support. One hundred twenty (49.6%) students indicated that the stool they used was comfortable. Adjustment of the height of the stool is very common practice among the students as 146 (60.3%) students reported that they often adjusted the chair prior to their work. One hundred and fifteen (47.5%) reported that they sat with their back supported while 69 (28.5%) reported “seldom” and 19 (19%) reported “never” to the question about adjusting the back support. Statistics clearly show that there is strong correlation between presence of lower back pain, sitting position and back support ( $p < 0.05$ ). At the same time there is no significant association between lower back pain and height of the operating stool. This would mean that those students who used comfortable stool with well supported back rests are led likely to develop lower back pain.

### Instrument Handling

Regarding the handling of instruments, four working characteristics were assessed: whether four handed dentistry is facilitated at the school, whether instruments were within hand reach so avoiding the need for strenuous movements, work being done with arms above shoulder height and finally, using forceful movements to perform clinical work.

One hundred and fifty (61.9%) students had fourhanded dentistry facilities at their respective dental schools. Statistical analysis showed that students who practiced fourhanded dentistry at their dental school were less likely to report symptoms in both elbow ( $p < 0.05$ ) and forearm ( $p < 0.05$ ). There was no association with symptoms in other body regions. The ability to reach the instrument without making strenuous movement was reported by 211 (87%) students. Statistical analysis revealed no association between approaching the instruments easily and WMSD symptoms in the lower shoulder, forearm and elbow. Work done in clinics with arms above shoulder height and forceful movement of arms while working were found to be statistically associated with WMSD symptoms in the lower shoulder and forearm while no statistically significant association was detected between these two variables and WMSDs symptoms in

the elbow (Table2).

**Table 2:** Working characteristics of clinical year students and its association with WMSD symptoms in lower shoulder, forearm and elbow

	Very Often N (%)	Often N (%)	Seldom N (%)	Never N (%)	* Lower shoulder	* Forearm	* Elbow
Work done in clinics with arms above shoulder height	12(5)	115 (47.5)	69 (28.5)	46 (19)	0.002**	0.002**	0.057
Forceful movements with arms	9(3.7)	122 (50.4)	82 (33.9)	29 (12)	0.002**	0.001**	0.054

\* Association between WMSD symptoms in these regions and the working characteristics.

\*\*Significant at p-value < 0.05

With regard to reaching the instrument without strenuous movement, one hundred and forty eight (61.2%) and 46 (19%) students reported that they “very often” and “often” bent or twisted their neck when treating patients. Discomfort at the neck and upper back region was reported by 201 students (83%). Statistical analysis revealed a significant association ( $p < 0.05$ ) between neck and upper back discomfort and bending or twisting neck movements during clinical work.

### Dental Loupes

Out of 242 clinical students, 158 (65.3%) did not use dental loupes. No statistical significance was found between use of dental loupes and prevalence of discomfort in the neck and upper back.

The fourth part of the questionnaire addressed the taught ergonomics and prevention of WMSD. Ninety four percent of the students had never attended any hands-on training and /or workshop on preventing WMSDs at their dental school and only 17.8% reported exercising following clinical work, which is the key factor for preventing the initiation of musculoskeletal disorder. (78.9) percent of the students showed willingness to be evaluated for WMSDs (Table3).

**Table3:** Knowledge of working environment and its characteristics

	Frequency	Approval degree	
	Rate %	Yes	No
Would you like to be evaluated for MSD symptoms at your dental school?	F	191	51
	%	78.9	21.1
Are you familiar with preventive technique to decrease the possible risk of having WMSDs?	F	56	186
	%	23.1	76.9
After finishing clinical practice, do you perform stretching exercise?	F	43	199
	%	17.8	82.2
Are you familiar with remedies/ treatment options once you are subjected to WMSDs problem?	F	32	210
	%	132	161
Is ergonomics a taught subject at your dental school?	F	26	216
	%	10.7	98.3
Have you ever attended a workshop on preventing WMSDs at your dental school?	F	14	228
	%	5.8	94.2

## Discussion

WMSDs are defined as injuries to the human support system, which consists of the bones, muscles, ligaments and tendons, as well as the vascular and nerve supply. Commonly affected body regions include the neck, shoulder and lower back, but they can affect any area of the body, including elbows, wrists, hips, knees and ankles<sup>[5,6]</sup>. Work related Musculo-Skeletal Disorders are very common among dental practitioners. Dentistry involves physically demanding procedures which require high level of precision over a duration of time. Postural defects would magnify the strain on the body and so considered one of the main causes of WMSD<sup>[1-3]</sup>. Where around 68% of dentists reported having musculoskeletal pain in the past 12 months, mainly back pain (49%), neck pain (33%), shoulder pain (25%) and hand/wrist pain<sup>[7]</sup>. Since there are very limited possibilities for changing the work situations within the same profession for the different categories in dentistry. Therefore the awareness of occupational health problems should be highlighted at all clinical and research symposia<sup>[7]</sup>. Some studies have shown that dental students can manifest early signs of WMSD during their years of training. These findings were supported by research that revealed that 93% of the clinical year dental students reported symptom of WMSDs in one or more body regions<sup>[1]</sup>.

Therefore, The main objective of this study was to assess the prevalence of (WMSDs) among dental students in College of Dentistry in King Saud University in Riyadh (KSA) and to correlate the prevalence of WMSDs of clinical-year students with the work characteristics during their training years and highlighting on this issue which may describe WMSDs to use it for increasing the level of awareness of WMSDs.

Out of two hundred forty two of dental students who participated in the present study, 200 were in their clinical years whilst 42 were students in their non- clinical years. (68.2) of the clinical year students reported symptoms of WMSD in one or more body regions. Female students reported a significantly higher numbers of symptoms compared to male students. This could be due to less knowledge about the chair side doctor positions or due to lack of proper guidance because of female staff shortage. The neck (83.1%) and lower back (84.7%) were reported to have the highest prevalence of WMSDs. Discomfort in the neck region was found to be associated with self-reported frequency of bending of the neck. A majority of students (94.2%) reported minimum participation in workshops related to ergonomics in dentistry and (86.8%) were unfamiliar with treatment and remedies available in the case of WMSDs and (76.9) were unfamiliar with the preventive techniques to decrease the possible risk of having MSDs. This result explain that the prevalence of WMSDs among the dental student were high and that was caused low level of awareness of WMSDs in dentistry.

The main limitation of the study is that the cross sectional design used was not able to establish a temporal relationship between prevalence of discomfort (WMSD) and work characteristics. So, the present study recommended for further studies to clarify the prevalence of discomfort WMSDs.

## Conclusion and Recommendations

Overall, the study demonstrates that WMSD may represent a significant burden for dental students in the dental col-

lage of King Saud University. Dental student report with musculoskeletal symptoms, sometimes as early as their first year in dental school. This underlines the importance of ergonomics and the need to induct it into the dental so as to reduce the risk of WMSD in young dental professional and as preventive measure in the future. To reduce discomfort in the neck and upper back it is highly recommended that working distance should be maintained for optimal posture, with shoulders relaxed and elbows closed to the sides. The operator should maintain 20 degree or less flexion of neck to avoid hunch over the patient. Dental loupes with magnification of 2x are sufficient to visualize the working field details. Before starting any clinical work, the operator must adjust the arm rest which will improve elbow support and decrease neck and shoulder fatigue. Discomfort in the lower back can be prevented by using a saddle type operator stool with lumbar support. This is to maintain the natural lower back curvature which also allows to the operator to stay closer to the patient. The lumbar support should always stay in contact with the operator's back. It is recommended to conduct more research through observational studies, physical examination and assessment. It is equally important to develop intervention programs to address the students' knowledge and practice of ergonomics.

**Conflict of Interest:** The authors have no conflict of interest to declare.

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