Original Article

Nordic Assessment of Occupational Disorders among Dental Students and Dentists in Saudi Arabia

Khalid T. Aboalshamat

Dental Public Health Division, Preventative Dentistry Department, College of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia

Head of Medicine and Medical Science Research Center, Deanship of Scientific Research, Umm Al-Qura University, Makkah, Saudi Arabia

ABSTRACT

Objectives: Ergonomics and the avoidance of occupational or work-related musculoskeletal disorders (WRMSDs) are crucial for a future dentist's career, as studies have linked WRMSDs to some serious complications, including early retirement. This study aimed to investigate the level of knowledge and awareness about ergonomics and the prevalence of WRMSDs among dental students and dentists in Makkah province, Saudi Arabia. **Materials and Methods:** A cross-sectional study was conducted of 322 dental students and dentists from two universities in Makkah province, Saudi Arabia, using a self-report questionnaire to measure ergonomic awareness and the Nordic Musculoskeletal Questionnaire to measure WRMSDs. **Results:** Among the respondents, only 4.82% could correctly explain ergonomics, 14.16% had attended a course or workshop on ergonomics, 55.12% were familiar with preventive techniques for WRMSDs, and 37.95% were familiar with remedies/treatment for WRMSDs. Females were significantly more aware of WRMSDs than males. There was 81.33% who had trouble (pain, aches, or discomfort) in one or more parts of their body during the previous 12 months. The most common sites for WRMSDs were the upper back (48.19%), wrists/hands (44.27%), lower back (43.98%), neck (36.45%), and shoulder (33.43%). In most body parts, WRMSDs were more common among males and participants from a governmental university than among females or those from a private university. **Conclusion:** Both dental students and dentists in Saudi Arabia lacked awareness of ergonomics and experienced high levels of WRMSDs. More educational efforts and attempts are needed to boost dental professionals' knowledge about musculoskeletal disorders related to dental profession and built the skills to cope with them.

Keywords: *Dental students, ergonomic, occupational health, Saudi Arabia, work-related musculoskeletal disorders*

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Introduction

The US Centers for Disease Control and Prevention (CDC) has defined a musculoskeletal disorder (MSD) as any disease or injury that occurs in muscle, joints, tendon, cartilage, spinal discs, or nerves, and they have been found to be the second most common cause of disability, according to the Global Burden of Disease Study.[1] A subset of these, work-related musculoskeletal disorders (WRMSDs), are defined as MSDs that are caused by the patient's occupation and that are accompanied by pain that appears slowly and

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Address for correspondence: Dr. Khalid Aboalshamat
Assistant professor,
Dental Public Health Division, Preventative Dentistry Department, College of Dentistry, Umm Al-Qura University, Makkah, Saudi Arabia, Head of Medicine and Medical Science Research Center, Deanship of Scientific Research, Umm Al-Qura University, Makkah, Saudi Arabia.
E-mail: ktaboalshamat@uqu.edu.sa

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turns into a persistent problem.[2-4] A widespread field of study, ergonomics, concerns fitting the workplace to the worker's needs with the goal of increasing safety, comfort, and productivity.[2,5] In other words, ergonomics aim to reduce the incidence of WRMSDs.

Dentistry is a physically demanding occupation that requires awkward neck and back positions, high risk of muscle strains, repeated muscle movement in the hands and wrists, isometric muscle contractions, and working with vibrating devices for long periods.[6-8] These movements and actions lead to WRMSDs, pain, and discomfort.[9] In fact, WRMSDs are well documented among dentists worldwide,[7,10-17] including in Saudi Arabia.[18,19] Although these studies show the prevalence of WRMSDs among dentists, they also show that the prevalence is different from country to country. A systematic review on global level determined that the prevalence of WRMSDs among dentists ranged from 64% to 93%.[20] Back pain was the most prominent, with a prevalence of 36.3%–60.1%, followed by neck pain, with 19.8%–85%.[20] However, the systematic review identified a gap in our knowledge due to a limited number of studies conducted among dental students.

There have been a few studies in Saudi Arabia investigating knowledge of WRMSDs among dental students; most of them were conducted in Riyadh city,[21-24] except for one study in Jizan.[25] One of these studies showed a significant difference between the results for dental students and those for dentists,[6] and the results showed that 30%–53% of dental students were aware of ergonomics.[6,22] However, the majority had not attended any lectures, implemented ergonomics, or knew of preventive measure for MSDs.[6,22] Other studies have shown that the prevalence of WRMSDs among Saudi dental students ranged from 43% to 95.8%.[21,23,24,26] In addition, there were significant differences in the prevalence of WRMSDs related to academic year and gender,[21-24] where students in clinical years reported more WRMSDs.[21,23] Also, females had higher rates of WRMSDs[21,22,24] despite being more knowledgeable about ergonomics than males.[22] These studies did not have agreement in terms of the most common site of WRMSD pain and discomfort, alternating between lower back, shoulder, and neck.[21,24] Notably, most of these studies were done within the last 5 years, indicating a great shift in academic researcher attention toward this issue in Saudi Arabia. However, as mentioned, most of these concentrated on only Riyadh, the capital city of Saudi Arabia. More studies in other Saudi universities and provinces are needed to have more generalizable findings. This includes Makkah province that includes five dental colleges and has the second highest number of dentists in Saudi Arabia after Riyadh providence. In fact, Makkah province receives millions of pilgrims for performing Islamic Omrah and Haj rituals, which might accentuate the problem due to the high demand of dental care during these events' times. Also, it is not clear if there is difference between governmental and private dental colleges in this regard.

Ergonomics as a way to avoid WRMSDs is crucial for a future dentist's career given that studies have linked WRMSDs to some serious complications, including early retirement,[20,27] poor quality of life,[20] and negative work experiences.[28] In fact, MSDs accounted for 40% of expenditures on treatment of work-related injuries.[29] Thus, it is important to investigate dental students, as it would be easier to intervene in the early stages of their careers to prevent more damage. Because there is also a lack of studies investigating the levels of knowledge about ergonomics and WRMSDs among dental students, this study aimed to investigate the levels of awareness about ergonomics and the prevalence of WRMSDs among dental students in Makkah province, Saudi Arabia.

Materials and Methods

A cross-sectional study was conducted to assess knowledge and awareness about ergonomics in two major colleges of dentistry in Makkah province: Umm Al-Qura University (a government institution) and Alfarabi Dental College (private). Using convenience sampling, participants were invited from October to November 2019 to participate in the study during their free time, including answering the study's self-report questionnaire. The inclusion criteria of the study included dental students studying in the third through the sixth year; interns and working dentists were also included. Participants who did not sign the study consent in addition to students from the first and second years were excluded from the study. Data were obtained via the self-report hard-copy questionnaire given in the English language, which took approximately 7 min to complete. Participants were required to sign the study's informed consent form before answering the questionnaire. The research team members were trained to use the questionnaire to answer the participant's questions for any ambiguity. The questionnaires were given face to face. All data were handled without revealing participants' personal information.

The questionnaire comprised four sections. Section one contained seven demographic questions regarding age, gender, academic year, years of experience, height, weight, and working hours per week. Body mass index (BMI) was calculated as BMI equals participant's weight

(kilograms) divided by height squared (meter). BMI was classified into severely underweight (BMI < 16.5), underweight (BMI = 16.5–18.4), normal (BMI = 18.5–24.9), overweight (BMI = 25.0–29.9), and obese (BMI = 30 and above). Section two assessed the level of awareness of ergonomics with five questions taken from a previously validated and tested questionnaire.[22] Section three was the general Nordic questionnaire about MSD in the neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet.[30] Finally, the fourth section was the special Nordic questionnaire asking specifically about pain in the neck, shoulders, and lower back, which are the most common sites for MSD.[30] The Nordic questionnaire is a cross-cultural well-validated questionnaire[31-34] used to assess WRMSDs[30] with good reliability and is composed of 52 questions.

The Statistical Package for the Social Sciences (SPSS) software program, version 21.0 (IBM, Armonk, New York) was used to conduct the data analysis. Tables of descriptive statistics were generated to show means, standard deviation (SD), percentages, and frequencies. Differences in MSD in relation to demographic variables were tested by chi-square and Fisher's exact tests. A *P*-value of 0.05 was the level of statistical significance. Data were saved in a secured computer, and the principal investigator entered the data. This study was approved by the Institute Review Board at the Faculty of Dentistry (130-19), Umm Al-Qura University, Saudi Arabia.

Results

A total of 322 participants completed the questionnaire, for a response rate of 60.64%. The mean (M) age of participants was 23.5 with an SD of 2.83. Participant's contact hours with patients on a weekly basis were M = 12.42 and SD = 8.96. Respondents' BMI was M = 23.26 and SD = 4.68. There were 274 (82.53%) student respondents and 58 (17.47%) interns/graduated dentists in this study. The demographic data are shown in Table 1.

Although 37 (11.14%) of the participants reported knowing the meaning of dental ergonomics, only 16 (4.82%) could correctly define ergonomics. Nevertheless, 47 (14.16%) reported they had attended a course, workshop, or online lecture about dental ergonomics. There were 200 (60.24%) respondents who knew about WRMSDs, and 183 (55.12%) respondents were familiar with preventive techniques to decrease the risk of WRMSDs; 126 (37.95%) were familiar with remedies and treatment options for WRMSDs.

The chi-square test determined that females were significantly more aware of WRMSDs (67.5% vs. 48.8%, $\chi^2[1] = 11.45$, $P = 0.001$), preventive techniques (62.6% vs. 43.4%, $\chi^2[1] = 11.68$, $P = 0.001$), and remedies and treatments for WRMSDs (42.9% vs. 30.2%, $\chi^2[1] = 5.33$, $P = 0.021$) than were males. However, there was no statistically significant difference between males and females regarding awareness or for having attended courses on ergonomics. Also, there were no significant differences between students and interns/dentists regarding awareness of ergonomics, WRMSDs, attendance at ergonomics workshops, preventive techniques, or remedies/treatments for WRMSDs.

Regarding the prevalence of WRMSDs in different parts of the body, there were 270 (81.33%) participants who reported trouble (pain, ache, or discomfort) in one or more body parts in the prior 12 months, whereas there were only 62 (18.67%) who had no such trouble during

Table 1: Demographic variables

Variables		*n*	%
Gender	Male	129	38.86
	Female	203	61.14
Academic year	Third year	33	9.94
	Fourth year	42	12.65
	Fifth year	73	21.99
	Sixth year	126	37.95
	Intern	40	12.05
	Graduated dentist	18	5.42
College	Governmental	154	46.39
	Private	178	53.61
BMI classification	Severely underweight (BMI < 16.5)	9	2.71
	Underweight (BMI = 16.5–18.4)	32	9.64
	Normal (BMI = 18.5–24.9)	208	62.65
	Overweight (BMI = 25.0–29.9)	50	15.06
	Obese (BMI = 30 and above)	33	9.94

BMI = body mass index

the previous 12 months. The mean of affected body part was 3 (SD = 2.33). Table 2 shows the prevalence among respondents of troubles in the lower back, neck, shoulder, elbow, wrist, upper back, hip/thigh, knee, and ankle/foot, according to the Nordic questionnaire, to show troubles in the previous 12 months and the previous 7 days. It also shows the prevalence of troubles that resulted in reduced activity at work, at home, and when relaxing. Table 3 provides more details for lower back, neck, and shoulder WRMSDs.

The results of the chi-square and Fisher's exact tests with regard to the prevalence of WRMSDs in the last 12 months and their relationship to gender, workplace, and academic status are shown in Tables 4 and 5. Also, the prevalence of WRMSDs during the last 12 months was tested against

Table 2: Nordic assessment of prevalence of work-related musculoskeletal disorders in the lower back, neck, shoulder, elbow, wrists/hands, upper back, hips/thighs, knees, and ankles/feet

	Troubles in the previous 12 months	Reduction in home activities, work activities, or relaxation time in the previous 12 months	Troubles in the previous 7 days
	N (%)	*N* (%)	*N* (%)
Elbow	93 (28.01) Right 41 (12.3) Left 24 (7.23) Both 28 (8.43)	44 (13.25)	34 (10.24)
Wrist/hands	147 (44.27) Right 68 (20.48) Left 28 (8.43) Both 51 (15.36)	75 (22.59)	65 (19.58)
Upper back	160 (48.19)	116 (34.94)	83 (25)
Hips/thighs	82 (24.7)	57 (17.17)	42 (12.65)
Knee	66 (19.88)	63 (18.98)	34 (10.24)
Ankles/feet	68 (20.48)	50 (15.06)	34 (10.24)
Lower back	146 (43.98)	45 (13.55)	108 (32.53)
Neck	121 (36.45)	33 (9.94)	85 (25.6)
Shoulders	111 (33.43) Right 50 (15.06) Left 7 (2.11) Both 53 (15.96)	38 (11.5)	80 (24.1)

*Trouble means pain, aches, or discomfort

Table 3: Nordic detailed assessment of prevalence of work-related musculoskeletal disorders for lower back, neck, and shoulders

		Lower back *N* (%)	Neck *N* (%)	Shoulder *N* (%)
Pain, aches, or discomfort within the last 12 months	Yes	146 (43.98)	121 (36.45)	110 (33.13) Right 50 (15.06) Left 7 (2.11) Both 53 (15.96)
Number of days with pain, aches, or discomfort within the last 12 months	Median (Min–Max)	0 (0–93)	0 (1–2)	0 (0–300)
Reduction in activities due to pain, aches, or discomfort within the last 12 months	Yes	68 (20.48)	51 (15.36)	46 (13.86)
At-work activities	Yes	53 (15.96)	44 (13.25)	42 (12.65)
Relaxation activities	Yes	32 (9.64)	23 (6.93)	23 (6.93)
Total number of days with reduced activity	Median (Min–Max)	0 (0–32)	0 (0–365)	0 (0–80)
See a doctor, physiotherapist, or chiropractor because of trouble	Yes	25 (7.53)	18 (5.42)	47 (14.16)
Had an accident	Yes	12 (3.61)	13 (3.92)	14 (4.22)
Pain, aches, or discomfort within the last 7 days	Yes	45 (13.55)	33 (9.94)	38 (11.45)

Min = minimum, max = maximum

the number of ergonomic courses/lectures attended and familiarity with preventive measures and remedies/treatment for WRMSDs, and the results are given in Table 5.

Discussion

Our results indicate that very few participants were aware of ergonomics, but more than half, mostly female, were aware of WRMSDs and preventive techniques to avoid WRMSDs. Approximately four-fifths of the participants had WRMSDs in at least one body part, and the three most common body parts had caused trouble during the previous 12 months. Among the respondents, 43.89%–48.19% had WRMSDs in the upper back, wrists/hands, or lower back, and between 19.98% and 34.94% had a reduction in their work or home activities or in their relaxation time due to troubles in the upper back, wrists/hands, or knees during the previous 12 months. Males had a greater prevalence of WRMSDs in the wrists/hands, upper back, hips/thighs, knees, ankles/feet, and lower back. Participants studying or working in a governmental university had higher rates of WRMSDs than those in a private university. Dental students had a more prevalence of WRMSDs in the elbow and wrist/hand, but interns/graduated dentists had greater prevalence of upper back WRMSDs. Attending courses/lectures on ergonomics and being familiar with preventive measures or remedies/treatments for WRMSDs were associated with a lower prevalence of WRMSDs in the wrists/hands, hips/thighs, elbows, and knees.

Despite 11.14% of respondents reporting that they knew ergonomics, only 16 (4.82%) participants could explain it. This level of awareness was lower than studies conducted in Brazil (35%),[5] Egypt (35%),[35] India (19%),[36] and Riyadh, Saudi Arabia (30%–53%).[6,22] Nevertheless, 14.16% of participants in our study reported they had attended an in-person or virtual course or lecture related to ergonomics, which is a higher number than the study conducted in Riyadh (7%).[22] The reason for this might be due to differences in the educational institution, but in general, it indicated that ergonomics is not an integral

Table 4: The relationship of the prevalence of work-related musculoskeletal disorders in the last 12 months to gender and workplace

Body part	Gender		Workplace		Academic status	
	Male	Female	Governmental	Private	Dental students	Interns/ graduated dentists
	N (%)	*N* (%)	*N* (%)	*N* (%)		
Elbow	10 (7.75)	**83 (40.89)***	**84 (54.54)**	9 (5.06)*	**87 (31.75)**	6 (10.34)*
Wrists/hands	**74 (57.36)**	73 (35.96)*	**132 (85.71)**	15 (8.43)*	**133 (48.54)**	14 (24.13)*
Upper back	**96 (74.42)**	64 (31.53)*	**98 (63.64)**	62 (34.83)*	120 (43.8)	**40 (68.97)***
Hips/thighs	**42 (32.56)**	40 (19.7)*	**59 (38.31)**	23 (12.92)*	69 (25.18)	13 (22.41)
Knees	**38 (29.46)**	28 (13.79)*	**47 (30.52)**	19 (10.67)*	51 (18.61)	15 (25.86)
Ankles/feet	**35 (27.13)**	33 (16.26)*	**50 (32.47)**	18 (10.11)*	56 (20.44)	12 (20.69)
Lower back	**66 (51.16)**	80 (39.41)*	**83 (53.9)**	63 (35.39)*	125 (45.62)	21 (36.21)
Neck	55 (42.64)	66 (32.51)	**75 (48.7)**	46 (25.84)*	105 (38.32)	16 (27.59)
Shoulders	51 (39.53)	59 (29.06)	**69 (44.8)**	41 (23.04)*	92 (33.57)	18 (31.03)

* $P < 0.05$

Table 5: The relationship between the prevalence of work-related musculoskeletal disorders (WRMSDs) in the last 12 months and ergonomic courses attended or familiarity with preventive measures and remedies/treatment for WRMSDs

	Attended ergonomic course		Familiar with preventive measures for WRMSDs		Familiar with remedies/ treatments for WRMSDs	
	Yes, *N* (%)	No, N (%)	Yes, *N* (%)	No, *N* (%)	Yes, *N* (%)	No, *N* (%)
Elbow	3 (6.38)	**90 (31.58)***	50 (27.32)	43 (28.86)	32 (25.4)	61 (29.61)
Wrists/hands	12 (25.53)	**135 (47.37)***	71 (38.8)	**76 (51.01)***	43 (34.13)	**104 (50.49)***
Upper back	18 (38.3)	142 (49.82)	83 (45.36)	77 (51.68)	59 (46.83)	101 (49.03)
Hips/thighs	6 (12.77)	**76 (26.67)***	36 (19.67)	**46 (30.87)***	21 (16.67)	**61 (29.61)***
Knees	7 (14.89)	59 (20.7)	31 (16.94)	35 (23.49)	17 (13.49)	**49 (23.79)***
Ankles/feet	5 (10.64)	63 (22.11)	32 (17.49)	36 (24.16)	21 (16.67)	47 (22.82)
Lower back	20 (42.55)	126 (44.21)	74 (40.44)	72 (48.32)	59 (46.83)	87 (42.23)
Neck	19 (40.43)	102 (35.79)	65 (35.52)	56 (37.58)	48 (38.1)	73 (35.44)
Shoulders	15 (31.91)	96 (33.68)	55 (30.05)	56 (37.58)	43 (34.13)	68 (33.01)

WRMSDs = work-related musculoskeletal disorders

* $P < 0.05$

part of dental professionals' curriculum or continuing education, and many are unaware of it, especially in Saudi Arabia. In fact, many studies showed that dental students and dentists did not know how to position themselves correctly when working.[25,37,38]

Our results align with the previous study in Riyadh, Saudi Arabia,[22] where approximately half of dental students and dentists were aware of WRMSDs, but only one-third were aware of how to prevent and deal with them. Also, both studies found that females were more aware of those points than were males. In fact, one study indicated that this could be because females are more prone to WRMSDs and they are thus more keen to learn about ergonomics than males.[39]

In regard to the prevalence of WRMSDs, our data indicated high levels of WRMSDs (81.33%) among dental students and dentists in Makkah province. This result aligned with what was reported by a previous systematic review (64% to 93%)[20] and the proportions were within the range of similar local studies in Saudi Arabia of 43%–95.8% in Riyadh,[18,21,23,24] Jeddah (70%),[26] and Hail (78%).[19] Furthermore, the most common sites of WRMSDs in our study were similar to previous studies, with the back (upper and lower), neck, shoulders, and hands/wrists.[20,21,23,24] Our results for back pain, 43.98%–48.19%, was similar to international studies (36.3%–60%)[20] and local studies in Saudi Arabia (30%–64%).[21,23,24] Similarly, neck pain's prevalence in our study was 36.45% and ranged from 19.8% to 85% in international studies,[20] whereas in local studies, it was 37%–62%.[21,23,24] Regarding shoulder and wrists/hands, our results were 33.43% and 44.27%, respectively, where local studies showed rates of 38%–46.1% for shoulders,[23,24] and 51% for wrists/hands.[21] This can give external validity to our results showing that WRMSD rates are high among dental students and dentists.

Males were found to have significantly higher rates of WRMSDs in most body part, including wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet. This contradicted most previous Saudi Arabian studies.[21,24,26] One possible explanation is that females were more aware of WRMSDs and the preventive techniques and remedies/treatment to deal with them. However, this justification cannot be verified. Therefore, a further qualitative study could investigate if females in western provinces behave differently with regard to WRMSDs than those in Riyadh city.

It was noticed that the prevalence of all WRMSDs in our results was significantly higher among participants from the governmental university. This again contradicted the previous study in Riyadh.[21] The reason for this might be because our study focused on comparing students from two different educational institutions, whereas the previous study[21] focused mostly on dental professionals working in the private sector.

When assessing the prevalence of WRMSDs and their relation to attendance of courses and familiarity with prevention techniques and treatments for WRMSDs, it was found that such knowledge was significantly associated with a lower rate of prevalence of WRMSDs in the wrists/hands and hips/thighs, in addition to elbows and knees. This is despite those sites not being the most common sites, as discussed earlier. It is suggested that such courses or information cover information regarding the less commonly afflicted areas. Bearing in mind that dental work requires a lot of shoulder use[28,40,41] and bending and twisting of the neck, inducing pain the cervical and lumbar regions,[42] it is apparent why the back, shoulder, and neck are more frequently affected by WRMSDs than others.

Many studies have indicated that the principles of ergonomics can help dental professionals reduce their rate of WRMSDs[24] by, among other things, adjusting the dental chair, using the arms and shoulders nearer to the body, and improving body posture to reduce fatigue.[43,44] In fact, previous studies found that many students reported being awkward in static postures.[25] Some other studies suggested using dental loupes[45] and taking short breaks.[6]

Despite this study being conducted in two major cities in Saudi Arabia, there are some limitations for this study, including use of a self-report questionnaire and convenient sampling, which can reduce the external validity of the study results. Future studies should use random sampling from different locations in Saudi Arabia.

Conclusion

Dental students and dentists in Saudi Arabia lack awareness of ergonomics and, therefore, experience high levels of WRMSDs, especially in the back, shoulders, and neck. More educational efforts are needed to improve the dental professional skills to deal with these problems to improve their health and work throughout their lifetime.

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Conflicts of interest

There are no conflicts of interest.

Author contribution

According to the guidelines of ICJME, I am the only one who was involved in the study conception, design, data analysis, data interpretation and manuscript writing.

Ethical policy and institutional review board statement

Not applicable.

Declaration of patient consent

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Data availability statement

Not applicable.

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