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Prevalence of carpal tunnel syndrome symptoms among dentists working in Riyadh

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BACKGROUND: Approximately 3-6% of the general population have carpal tunnel syndrome (CTS). CTS is more prevalent among people with occupations that involve repetitive and forceful maneuvers, such as dentists. It is important to identify risk factors for these symptoms and to understand the impact they may have on clinical practice.

OBJECTIVES: Measure the prevalence of CTS-symptoms and identify factors associated with CTS.

DESIGN: Cross-sectional.

SETTING: Dentists working in Riyadh.

SUBJECTS AND METHODS: In-person interviews from 15 July to 10 September 2017 of subjects obtained using random cluster sampling.

MAIN OUTCOME MEASURES: Prevalence of CTS-related symptoms among dentists.

SAMPLE SIZE: 223 dentists (134 males and 89 females).

RESULTS: The prevalence of CTS-related symptoms among dentists working in Riyadh was 30.5% (95% CI 0.25 to 0.36). Female dentists had a significantly greater risk of having CTS symptoms than male dentists (OR 2.13; 95% CI 1.09–4.17). Obese dentists were also more likely to complain of CTS symptoms than dentists within normal weight limits (OR 3.66; 95% CI 1.55–8.64). Left-hand dominance was strongly associated with CTS symptoms, with an estimated OR of 6.28 (95% CI 1.24–31.90). However, there was no relationship between CTS symptoms and age, marital status, history of smoking, exercise, dental specialty, occupation period, or having other educational degrees.

CONCLUSION: Thirty percent of dentists working in Riyadh had experienced severe or mild symptoms related to CTS. Several risk factors for CTS have been identified. Future research could explore the reasons behind these risk factors to identify and implement prevention measures.

LIMITATIONS: Cannot be generalized to the whole of Saudi Arabia, or the region. Larger controlled studies are needed to further identify the risk factors associated with CTS among dentists. In addition, since the Boston Carpal Tunnel Questionnaire was used, the self-reporting nature of the study might be affected by external bias.

CONFLICT OF INTEREST: None.

The carpal tunnel is a narrow passageway in the anterior part of the forearm that connects the wrist to the palm. It protects the median nerve and nine flexor tendons that bend the fingers. The deep carpal arch is a concave floor overlaid by the roof of the superficial flexor retinaculum. This tunnel is commonly susceptible to pathological compression, causing patients to suffer from compressive neuropathy that results in symptoms and signs collectively known as carpal tunnel syndrome (CTS). Compression of the median nerve most commonly causes numbness and tingling in the patient's hand(s). Patients with CTS may also present with aches, changes in temperature sensitivity, differences in skin color, or loss of hand power. There are no definitively known factors that cause CTS. However, various genetic, medical, social, vocational, avocational, and demographic risk factors are associated with abnormally high carpal tunnel pressures.[1]

The prevalence of CTS in the general population ranges between 3% and 6%.[2,3] The prevalence of CTS varies among clinical subpopulations from as high as 62% in pregnant women,[4-7] while among diabetic patients, the prevalence is almost 20%.[8,9] CTS is more prevalent among certain occupations.[10] The prevalence of CTS is significantly higher in the working population than the non-working population (those without a job).[10] A high prevalence of CTS was found in people holding jobs involving repetitive and forceful maneuvers. Many construction workers begin developing CTS before or during their apprenticeship, although few are aware of or are diagnosed with CTS.[11] Among dentists, CTS tends to be more common in the dominant hand than it is in the general population.[12] In a large study of American dental hygienists, the prevalence of classic CTS symptoms was almost 56%.[13] Another study from Australia found the prevalence of CTS among dentists to be 11%.[14] Almost 17% of dentists in Iran have CTS.[15]

The number of dentists is increasing in Saudi Arabia. According to the Saudi Ministry of Health's yearly statistics booklet, there were 5122 dentists working in Riyadh, the capital, in 2016. Unfortunately, there is a paucity of data on CTS prevalence among dentists in developing countries, including Saudi Arabia. However, one study carried out in Riyadh reported that 14% of dentists experienced previous hand pain.[16] Another study of Saudi medical laboratory staff showed the prevalence of CTS to be 25.3%.[17] The aim of this study was to measure the prevalence of CTS among dentists working in Riyadh and to identify the factors associated with this syndrome.

SUBJECTS AND METHODS

This cross-sectional study was carried out in Riyadh, the largest city and the capital of Saudi Arabia. The study targeted male and female dentists working in Riyadh who had worked for at least 1 year. Dentists with a history of orthopedic trauma or congenital deformities were excluded from the study. In addition, no dental interns were included. A previous study showed that the prevalence of hand pain among dentists working in Saudi Arabia was 14%.[16] For a population of 5122 dentists, with a 5% margin of error and a 95% confidence level, a minimum sample size of 179 dentists was needed. Random cluster sampling was used to select participants from the 575 dental clinics in the city, mostly private clinics, located across the 15 administrative areas of Riyadh. Five private clinics from each area (75 dental clinics in total) were randomly selected using the SPSS program. All five government-run hospitals and medical cities with dental clinics were also included in the study. The paper questionnaire surveys were distributed by the research team members through in-personal interviews with the dentists available at the time of data collection. The Institutional Review Board, King Abdullah International Medical Research Centre, Ministry of National Guard Health Affairs, Riyadh, Saudi Arabia approved this study. All participants were informed of their right to abstain from participation in the study or to withdraw their consent to participate at any time without reprisal.

The Boston Carpal Tunnel Questionnaire (BCTQ), originally developed by Levine et al,[18] was used to survey dentists on the symptoms of CTS and the effects on function. Previous studies have found this test to be valid, with excellent test–retest reliability, and intraclass correlation coefficients ranging between 0.8 and 0.9.[19-21] The BCTQ is as useful in predicting CTS as electro-diagnostic testing.[22] The questionnaire used in this study included three parts: demographic and health data, the functional status scale (FSS), and the symptom severity scale (SSS). Demographic and health data were age, gender, marital status, height, weight, smoking status, exercise, dominant hand, specialty, years of occupation, contact time with patients per day, pre-existing diseases or conditions, degrees other than dentistry, and previous diagnosis with CTS. The FSS rated the degree of difficulty for eight functional tasks (writing, buttoning of clothes, holding a book while reading, gripping of a telephone handle, opening of jars, household chores, carrying of grocery basket, and bathing and dressing). The SSS comprised 11 questions about CTS symptoms over the course of an ordinary day (severity of hand pain in the night, pain in the hand during day-

Table 1. Demographic and health characteristics of respondents (N=232).

Variable	Category	n (%)
Gender	Male	134 (60)
	Female	89 (40)
Age (years)	Up to 30	55 (25)
	31–35	62 (28)
	36–40	42 (19)
	41+	64 (29)
Body mass index group	Normal	70 (32)
	Overweight	84 (38)
	Obese	67 (30)
Marital status	Single	55 (25)
	Married	168 (75)
Smoking	No	174 (78)
	Yes	49 (22)
Exercise	No	136 (61)
	Yes	87 (39)
Dominant hand	Right-handed	215 (96)
	Left-handed	8 (4)
Current practice in dental specialty clinic	Restorative dentistry	14 (6)
	Endodontic dentistry	10 (5)
	Pediatric dentistry	7 (3)
	Prosthodontics	14 (6)
	Orthodontics	16 (7)
	Maxillofacial surgery	32 (14)
	General practitioner	122 (55)
	Others	8 (4)
Occupation (years)	Up to 5	49 (22)
	6–10	58 (26)
	11–15	40 (18)
	16–20	30 (14)
	21+	46 (21)
Contact time with the patients (hours/day)	Up to 8	187 (84)
	More than 8	36 (16)
Other degrees	No	177 (79)
	Medical Education	25 (11)
	Degree in Dentistry	13 (6)
	Other	8 (4)

time, duration of the pain, hand numbness, weakness in the hand, numbness in the night, difficulty grasping small objects) . A rating scale of 1–5 was used, where 1 indicated no functional difficulty or no symptoms, and 5 indicated an inability to perform the functional task or maximum symptoms. The total score on the two subscales was calculated by dividing the absolute score by the number of items: 11–55/11 for SSS and 8–40/8 for FSS.[19–21]

Microsoft Excel was used for data entry and data management, and SPSS Statistics for Windows (version 22.0. Armonk, NY: IBM Corp) was used for data analysis. Demographics were presented as frequencies and percentages. Prevalence was calculated with a 95% confidence interval (CI). Body mass index (BMI) was classified as normal weight (BMI of 24.9 and less), overweight (25.0–29.9), and obese (30.0 and above). The chi-square test was used to select potential predictors for a forward stepwise multivariate logistic regression model with diagnosis of CTS (Yes/No). All tests were considered statistically significant if the *P* value was less than .05.

RESULTS

From 15 July to 10 September 2017, 252 questionnaires were distributed and 223 were completed (response rate 90%). Most participants were male dentists (60%, 134 participants). There was a wide distribution of ages among participants (**Table 1**). A normal BMI was observed in about one-third of participants (32%). Only 25% were single, while the rest were married. More than three quarters of the sample were non-smokers (78%). Nearly all participants were right-handed (96%). Most dentists worked in different specialty clinics. About 21% of participants had been working as dentists for more the 20 years. Most dentists (84%) reported having less than 8 hours of contact time with patients per day. A minority of participants had another degree apart from dentistry (6%). Only 9% of participants reported a pre-existing disease or condition other than CTS. Thirty percent of participants reported having CTS symptoms (95% CI, 0.25-0.36), while 8% said they had previously been diagnosed with CTS.

Gender appeared to be important predictor of CTS symptoms, as female dentists were more likely to have CTS symptoms (*P*= .042) (**Table 2**). CTS symptoms were more prevalent in those over 41 years of age (33%), but the difference was not statistically significant. BMI was significant (*P*=.018), with 43% of obese dentists having CTSsymptoms. Dentists with mild and severe CTS symptoms were more often overweight and obese than others (**Figure 1**). Sixty-three percent of left-handed

dentists had CTS symptoms (*P*=.045). Married participants did not suffer with CTS symptoms as much as single participants. Neither smoking nor exercise were significant predictors contributing to CTS symptoms. Among dentists who were practicing in different dental specialty clinics, pediatric dentists were the most likely to have CTS symptoms (43%), and endodontic dentists were the least likely (10%). Among dentists who had spent 5 years or fewer (49 dentists) in the career, 80% (n=39) had no CTS symptoms, while among those who had spent more than 20 years in the practice, 59% (n=19) reported no CTS symptoms. However, the number of years of occupation was not statically significant (*P*=.093). Amount of daily contact time with patients appeared to be significant predictor of CTS symptoms (*P*=.047). Dentists with more than 8 hours contact with patients per day reported CTS symptoms more often (44%, 16 participants) than those with fewer than 8 hours (28%, 52 participants). Having another degree apart from dentistry was not associated with more frequent CTS symptoms. Participants with previous medical diseases or conditions reported CTS symptoms more often (60%) than those not having any diseases or conditions (28%) (*P*=.003).

There was no relationship between dentists having CTS symptoms and age group, marital status, smoking status, exercise level, dental specialty, time in occupation, or having other degrees. Gender, BMI, hand dominance, and daily contact time with patients were predictive of CTS symptoms (**Table 3**). A significantly greater proportion of female than male dentists reported CTS symptoms (OR 2.13; 95% CI 1.09–4.17). Obese dentists were more likely to complain of CTS symptoms than those of normal weight (OR 3.66; 95% CI 1.55–8.64). Interestingly, left-handedness was strongly associated with CTS symptoms (OR 6.28; 95% CI 1.24–31.90). In addition, dentists who spent more than 8 hours of contact time with patients per day were more likely to report symptoms of CTS than those who spent fewer than 8 hours per day with patients (OR 2.83; 95% CI 1.28–6.29).

Table 1 (cont.). Demographic and health characteristics of respondents (N=232).

Variable	Category	n (%)
Medical diseases or conditions	No	203 (91)
	Yes	20 (9)
Previously diagnosed with CTS	No	206 (92)
	Yes	17 (8)
CTS symptoms	No CTS symptoms	155 (70)
	Mild symptoms	45 (20)
	Severe symptoms	23 (10)

DISCUSSION

Besides dentistry, CTS symptoms are more common among people in certain other professions (forestry workers, quarry drillers, stone carvers, assembly workers, food processors and retailers, textile workers, dental hygienists, etc.).[23–25] CTS symptoms are more prevalent in dentists than in the worldwide general population.[13,15,26-28] Thus, it is important to identify the various risk factors leading to these symptoms in dentists, and to understand the impact they have on clinical practice, so that appropriate interventional measures can be designed and implemented for better outcomes for both dentists and their patients.

In the present study, 30.5% of Riyadh-based dentists surveyed reported having mild or severe CTS symptoms. In a similar study conducted in Iran, the prevalence of clinical CTS symptoms was 16.7%.[15] Other studies conducted in Pakistan and Malaysia revealed a 10.3% and 21.2% prevalence of CTS symptoms, respectively.[27,29] Another study conducted in Lahore, Pakistan, showed a 15.5% prevalence of CTS symptoms.[28] Studies from the USA have revealed inconsistent results, with one study of Michigan dentists showing a very high prevalence of CTS (32%),[12] while another in the same state revealed that only 3% of participating dentists had CTS.[30] Pediatric dentists reported CTS symptoms (43%) more often than other specialties, while only 10% of endodontic dentists experienced symptoms. This is inconsistent with the findings of a study conducted in Pakistan, which showed the highest prevalence of CTS symptoms among endodontic dentists, and the least among general practitioners. It is well-known that endodontic practice involves repetitive movements of the wrist, and hence there may be a higher chance of developing CTS, but the results of our study do not support this conclusion.

The present study showed that dentists who had been working for the most number of years were the most affected by CTS symptoms but differences from younger dentists were not statistically significant. This is supported by Lalumandier et al, who found that dental hygienists who had been practicing clinical dentistry for more than ten years were more likely to develop CTS.[13] This is also consistent with a study conducted in Karachi, Pakistan, which revealed that dentists in

Table 2. Demographics of dentists with and without carpal tunnel syndrome (CTS) symptoms (N=223).

Variable	Category	CTS symptoms		*P* value
		No (155)	Yes (68)	
		N (%)	N (%)	
Gender	Male	100 (75)	34 (25)	**.042**
	Female	55 (62)	34 (38)	
Age (years)	Up to 30	38 (69)	17 (31)	.93
	31–35	45 (73)	17 (27)	
	36–40	29 (69)	13 (31)	
	41+	43 (67)	21 (33)	
Body mass index group	Normal	55 (79)	15 (21)	**.018**
	Overweight	60 (71)	24 (29)	
	Obese	38 (57)	29 (43)	
Marital status	Single	35 (64)	20 (36)	.276
	Married	120 (71)	48 (29)	
Smoking	No	121 (70)	53 (31)	.984
	Yes	34 (69)	15 (31)	
Exercise	No	91 (67)	45 (33)	.293
	Yes	64 (74)	23 (26)	
Dominant hand	Right-handed	152 (71)	63 (29)	**.045**
	Left-handed	3 (37)	5 (63)	
Current practice in dental specialty clinic	Restorative dentistry	11 (79)	3 (21)	.264
	Endodontic dentistry	9 (90)	1 (10)	
	Pediatric dentistry	4 (57)	3 (43)	
	Prosthodontics	11 (79)	3 (21)	
	Orthodontics	13 (81)	3 (19)	
	Maxillofacial surgery	25 (78)	7 (22)	
	General practitioner	76 (62)	46 (38)	
	Others	6 (75)	2 (25)	
Duration of occupation (years)	Up to 5	39 (80)	10 (20)	.093
	6–10	37 (64)	21 (36)	
	11–15	32 (80)	8 (20)	
	16–20	20 (67)	10 (33)	
	21+	27 (59)	19 (41)	

Table 2 (cont). Demographics of dentists with and without carpal tunnel syndrome (CTS) symptoms (N=223).

Variable	Category	CTS symptoms		*P* value
		No (155)	Yes (68)	
		N (%)	N (%)	
Contact time with the patients (hours/day)	Up to 8	135 (72)	52 (28)	**.047**
	More than 8	20 (56)	16 (44)	
Other degrees	No	126 (71)	51 (29)	.582
	Medical Education	17 (68)	8 (32)	
	Degree in Dentistry	7 (54)	6 (46)	
	Other	5 (63)	3 (38)	
Medical diseases or conditions	No	147 (72)	56 (28)	**.003**
	Yes	8 (40)	12 (60)	
Previously diagnosed with CTS	No	152 (74)	54 (26)	**.001**
	Yes	3 (18)	14 (82)	

CTS symptom classification based on response to Boston Carpal Tunnel Questionnaire.

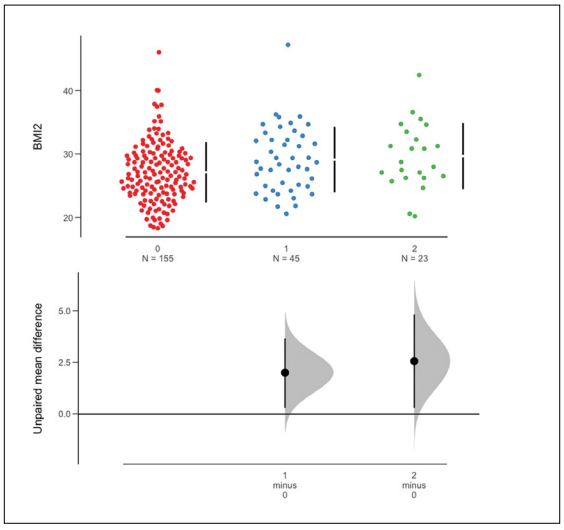

Figure 1. BMI in dentists with no CTS symptoms (red), mild symptoms (blue) and severe (green) symptoms.[36]

practice for 16–20 years were the most likely to have symptoms.[29] However, a study conducted in Kelantan, Malaysia, showed the contrary: dentists became less likely to report CTS symptoms with increasing years of experience and clinical practice.[27]

The present study reveals that female dentists have a more than two-fold risk of developing CTS symptoms than male dentists. However, this is inconsistent with another study, which concluded that "an equal risk between genders exists to have CTS when the occupational tasks (exposure) are truly similar." The authors also concluded that "the job and not the gender is the problem".[31] A similar conclusion was reached by Khosrawi et al, who showed no significant difference between female and male dentists in terms of having CTS.[15] However, there are studies with findings that are consistent with ours.[32] In general, women have smaller wrists and smaller carpal tunnel passageways. Other female-specific factors such as hormonal changes and pregnancy can also cause CTS in women.[4,7]

The current study also shows a significant association between obesity and CTS. Dentists with a BMI of 30 or greater were more likely to complain of CTS symptoms than dentists of normal weight. Indeed, obesity is a strong risk factor for CTS in the general population.[33] Numerous studies have obtained results consistent with this finding.[12,25,33]

CTS occurs more commonly in the dominant hand, but it can occur in both hands.[15,34] As in our study, previous studies have found the prevalence of symptoms consistent with CTS in the dominant hand to be higher than in the general population.[12] In this study, left-handed dentists were significantly more likely to suffer from CTS symptoms than right-handed dentists. This is consistent with similar studies of medical laboratory staff[17] and hairdressers,[35] although the reason(s) for this difference remains unknown.

The amount of time that dentists spend with their patients correlates to the presence of CTS symptoms. Participants with more than 8 hours of patient contact

Table 3. Forward stepwise multivariate logistic regression analysis of potential predictors of carpal tunnel syndrome (CTS) (N=223).

Variable	Category	Odds ratio	95% CI		*P* value
Gender	Female	2.13	1.09	4.17	**.027**
	Male*	1			
Body mass index group	Overweight	1.88	0.82	4.32	.136
	Obese	3.66	1.55	8.64	**.003**
	Normal*	1			
Dominant hand	Left-handed	6.28	1.24	31.90	**.027**
	Right-handed*	1			
Contact time with the patients (hours)	More than 8	2.83	1.28	6.29	**.01**
	Up to 8*	1			
Previously diagnosed with CTS	Yes	11.75	3.08	44.86	**.001**
	No*	1			

*Reference group. Model summary: -2 log likelihood=230.908, Cox & Snell R square=.173, Nagelkerke R square=.244, Omnibus test of model: chi-square=41.913, df=6, *P*<.001.

per day were more likely to have hand pain and CTS symptoms. Likewise, a previous study reported that dentists who worked longer hours during the year were more likely to report hand and finger pain symptoms.[12] A study of Iranian dentists also showed that those who worked more hours were more susceptible to CTS.[15]

To our knowledge this is the first study in the Middle East to look at the prevalence of CTS in dentists using a random cluster sampling method. One limitation of the study is that our results cannot be generalized to the whole of Saudi Arabia, or the region. Larger controlled studies are needed to further identify the risk factors associated with CTS among dentists. In addition, since the BCTQ was used, the self-reporting nature of the study means it might be affected by external bias.

In conclusion, dentists who work in Riyadh appear to suffer from CTS symptoms more than people in the general population. Female and/or obese dentists who are left-handed or who have more than eight hours of contact time with patients per day have an increased risk of CTS. Future work should explore the reasons behind these risk factors, and on implementing appropriate interventional measures and prevention methods to achieve better outcomes for both dentists and their patients. Future research should implement triangulation methods in longitudinal studies, a strategy that will surely advance our understanding of this complex occupational health issue.

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