

## RELATION AND INFLUENCE OF NECK AND WRIST PAIN ON GRIP AND PINCH STRENGTH AMONG DENTISTS

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### Abstract

**Background:** The dental professionals are exposed to Work-related Musculoskeletal Disorders such as the hand, wrist, shoulder, and neck pain that may affect their hand function and work performance.

**Objective:** The aim of this study was to investigate the influence and relationship between neck and wrist pain with grip and pinch strength among dentists in Jeddah city in Saudi Arabia.

**Methods:** A cross-sectional study was conducted in Jeddah on 100 male and female dentists, their age ranged from 25 to 50 years. Dentists were assessed for neck pain by Neck Disability Index (NDI) and wrist pain was evaluated by the Boston Carpal Tunnel Questionnaire (BCTQ). In addition to that, a handheld dynamometer and pinch meter were used to measure grip strength and pinch strength on the dominant hand.

**Results:** The results showed a significant weak negative relationship between the neck pain and grip strength ( $r = -0.3$ ), and non-significant relation between the neck pain and pinch strength. In addition to that, the results showed a significant weak negative relationship between the wrist pain and grip strength ( $r = -0.2$ ), and non-significant relation between wrist pain and pinch strength. The results of the simple linear regression analysis showed that grip strength was significantly influenced by neck pain measured by NDI ( $\beta = -.27$ ) then by wrist pain measured by BCTQ symptoms ( $\beta = -.22$ ) and BCTQ function ( $\beta = -.189$ ).

**Conclusion:** Neck and wrist pain has a negative impact on grip strength among dentists in Jeddah city in Saudi Arabia which might affect their work performance.

**Keywords:** Dentists. Work-Related Musculoskeletal Disorders. Neck Pain. Wrist Pain. Grip Strength. Pinch Strength.

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### Introduction

Work-related musculoskeletal disorders (WRMSDs) are a significant concern of the occupational health among healthcare professionals. The symptoms of the WRMSDs affect the general health of the healthcare workers and can subsequently impact the patient safety and the quality of care and it is therefore important to raise awareness among stakeholders (1).

The rate of WRMSDs among dentists is significantly higher as compared with non-dentist (mostly neck pain with a prevalence of 73%), this high prevalence is due to several reasons, such as working for prolonged hours, and working in restricted ergonomics and making repetitive movements all the time. Musculoskeletal (MSK) disorders such as neck pain, back pain, and wrist pain have an impact on the function, quality of life, psychological status, as well as the quality of work performance which may be reduced due to pain, stress, and poor sleep (2-4).

The dental professionals are one of many healthcare providers that depend mostly on the upper regions of the body to perform their work. There are some reasons that make the dentists more susceptible to WRMSDs in the upper extremity (hand, wrist, shoulder, and neck) such as maintaining uncomfortable static positions for their head, neck, and shoulder during work, as they are required to pay close attention to the patient's mouth, this incorrect posture may contribute to chronic muscular fatigue and discomfort (5).

Causes of wrist pain among dentists include the repetitive wrist movement in flexion, extension, supination, and pronation, besides loading the joint beyond its ability; this may lead to some complications such as Carpal Tunnel Syndrome (CTS) and decreased Hand Grip Strength (HGS) (6).

Dentists use different fine motor and gross motor movements that are important skills to make them able to work with different dental instruments. They require different types of fine grasp such as in-hand manipulation, tip-to-tip pinch, key pinch (lateral pinch), palmar pinch and other types. As well as, inability to select an appropriate size of instrument was the main risk factor of shoulder and wrist/hand pain (7).

Grip strength represents the amount of contraction of intrinsic and extrinsic muscles of the hand required when objects are held by thumb, fingers, and palm (8). Manual workers have higher HGS than non-manual workers (6). Additionally, the pinch strength is represented when the objects are manipulated by any finger in coordination with the thumb (8).

There are a total of 27181 Saudi dental surgeons licensed in the Saudi Commission for Health Specialty (SCFHS) as of 2020 (9). WRMSDs have been widely associated with dentistry occupation. Additionally, the dental clinics are receiving a high load of continuous work hours which increases the chance to get WRMSDs as neck and wrist pain that may affect the quality of performance. There are a limited number of studies that focus on the relation between musculoskeletal pain with hand grip and pinch grip strength among dentists. Therefore, the aim of this study was to investigate the influence and relationship of neck and wrist pain with hand grip and pinch strength among dentists in Jeddah city in Saudi Arabia.

### Method and Materials

#### Design of the study:

This is an observational cross-sectional study. The study was carried out from January 2022 to April 2022, to investigate the influence and relationship between neck and wrist pain with grip and pinch strength among dentists in Jeddah city in Saudi Arabia.

#### Subjects:

100 dentists (51 males and 49 females) from different dentistry clinics (governmental and private) in Jeddah city, with an age range between 25 and 50 years and with at least one year of experience were participated in this study. A written signed informed consent was obtained from all the subjects before participation. Participants with any chronic diseases, trauma or surgery to the neck or wrist were excluded from the study.

#### Procedures:

This study was approved by the Faculty of Medical Rehabilitation Sciences Research Ethical Committee. A detailed explanation about the study goals and procedures had been given to each dentist participated. The basic demographic data were collected. Neck Disability Index (NDI) was used to measure neck pain, Boston Carpal Tunnel questionnaire (BCTQ) was used to measure the severity of the wrist pain symptoms, as well as the functional status. Hand Grip Strength and Pinch Strength were measured by Hydraulic Hand Dynamometer and Jamar hydraulic pinch gauge respectively.

#### Neck Disability Index:

It is a valid and reliable questionnaire that measures patient's self-reported

neck pain related disability based on 10 items (10). The Questions included activities of daily living, such as: pain intensity, personal care, lifting, reading, headache, concentration, work, driving, sleeping and recreation. Each question is measured on a scale from 0 (no disability) to 5 the greater score indicates greater disability due to neck pain (11).

**Boston Carpal Tunnel questionnaire:**

A valid and reliable Arabic version was used to measure the severity of the wrist pain symptoms, as well as the functional status. The BCTQ consists of two scales, the Symptoms Severity Scale (SSS) which consists of 11 questions, and the Functional Status Scale (FSS) which consist of 8 questions. The SSS questions are scored from 1 (mildest) to 5 (severe). The FSS is scored from 1 (no difficulty with the activity) to 5 (cannot perform the activity at all). The total score was measured by taking the mean of all the items (12,13).

**Hand Grip Strength:**

The Jamar Hydraulic Hand Dynamometer is a reliable device used to measure grip strength (14). The dynamometer handle was adjusted at its second position. The subjects were instructed to sit with elbow flexed 90 degrees, wrist in a neutral position, and the elbow close to the trunk without resting the arm and wrist on the chair. Afterwards, the subject was verbally encouraged to exert maximum effort while pressing the handle. Measurement was conducted on the dominant hand and only one attempt was scored (15).

**Pinch Strength**

Key Pinch (Lateral Pinch) strength was measured by Jamar hydraulic pinch gauge. The participants were asked to sit comfortably upright in a chair without back support with their feet resting on the floor; elbow of the dominant hand was flexed at 90°, forearm and wrist in neutral position. The participants were instructed to place the pinch gauge between the lateral side of index finger and the pad of the thumb in a position of partial thumb adduction, metacarpophalangeal flexion and slight inter-phalangeal flexion in index finger more than other fingers. Demonstration of the activity was provided to the participant by the investigator. All participants were instructed to exert the maximum force by the dominant hand in a single trial. Each key-pinch strength was measured in kilogram (0.45 kg = 1lb.) (15).

**Statistical analysis:**

The statistical package for social sciences version 20 (SPSS Inc, Chicago, IL, USA) was used for data analysis. Qualitative data represented as number and percentage, quantitative represented by mean ± SD. The Pearson Linear correlation coefficient was used to test the existence of the linear relationship between two quantitative variables. Simple linear regression analysis was performed to determine the most influencing factors. A p-value of 0.05 or lower was considered statistically significant.

**Results**

**1- Demographic Data**

The demographic data (Table 1) showed that a total of 100 dentists were included in this study with mean age (33.5±5.9) years, height (167.9±9.8) cm and weight (71.5±16) Kg. Most of the participants were males (51%). The majority of the study sample had a right dominant hand (94%).

The NDI score ranged from 0 to 44 with mean of 14±10.4. The mean BCTQ - Symptoms score was 26.7± 8.2 with range of 20-60. The BCTQ - Functional score ranged from 0 - 42.5 with mean of 22.5±6.1. The mean Grip strength score was 34.1± 11.1 with range of 14- 58. The Pinch strength score ranged from 2.5-13.5 with mean of 6.5±2.5.

**Table 1.** Basic demographic characteristics of the subjects.

Variables		Frequency	Percent
Gender	Female	49	49%
	Male	51	51%
	Total	100	100
Dominant Hand	Left	6	6
	Right	94	94
	Total	100	100
		<b>Mean ± SD</b>	<b>Range</b>
Age		33.5±5.9	25-50
Height		167.9±9.8	152-188
Weight		71.5±16	44-119

SD; standard deviation

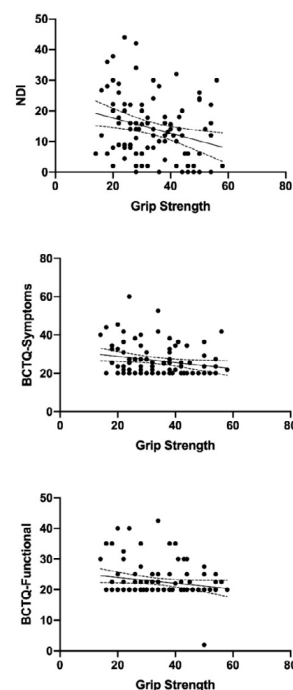
**2- Relations:**

**i- Relation of grip strength with neck and wrist pain:**

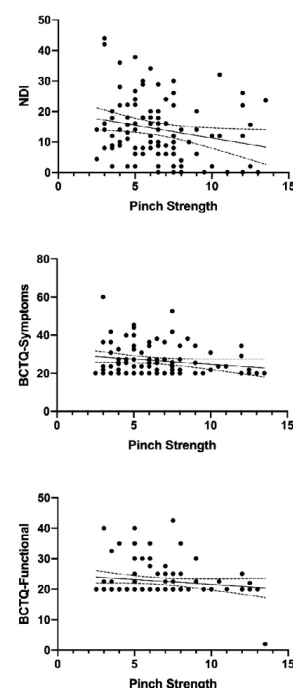
The results showed that, there was a significant (p-value < 0.05) weak negative correlation between neck pain and grip strength (r= -0.32), a significant (p-value < 0.05) weak negative correlation between BCTQ - Symptoms and grip strength (r= -0.243), and a significant (p-value < 0.05) weak negative correlation between BCTQ - Function and grip strength (r= -0.201) as shown in figure 1.

**ii- Relation of pinch strength with neck and wrist pain**

The results showed a non-significant (p-value > 0.05) correlations between both neck and wrist pain with pinch strength as shown in figure 2



**Figure 1.** Relation of grip strength with neck and wrist pain.



**Figure 2.** Relation of pinch strength with neck and wrist pain.

**3. Regression analysis**

**i- Association of grip strength to neck and wrist pain**

Simple linear regression analysis was performed to determine the influence of neck and wrist pain as the independent variables on grip strength as the dependent variable (table 3). The significant influencing factors were neck pain measured by NDI ( $\beta = -.27$ ;  $p$ -value = .006), BCTQ symptoms ( $\beta = -.22$ ;  $p$ -value = .029) and BCTQ function ( $\beta = -.189$ ;  $p$ -value = 0.05).

**ii- Association of pinch strength to neck and wrist pain**

The results of simple linear regression analysis revealed non-significant influence of both neck and wrist pain on pinch strength as  $p$ -value > 0.05 (table 3, 4).

**Discussion**

This study was conducted to investigate the influence and relationship between neck and wrist pain with grip and pinch strength among dentists in Saudi Arabia. The results showed that there was a significant weak negative relationship between the neck pain and grip strength, and non-significant relationship between the neck pain and pinch strength. In addition to that, the results showed a significant weak negative relationship between the wrist pain and grip strength, and non-significant relationship between wrist pain and pinch strength.

The results was supported by Jyoti Kiran et al, who measured the relation between the neck pain and grip strength using the visual analog scale (VAS) and dynamometer, and their results showed a significant indirect correlation between neck pain and grip strength (16).

On the other hand, Eman S, studied the relationship between neck pain intensity and hand grip strength on 25 male and female dentists and found a significant direct relationship between neck pain and grip strength. This disagreement with the present study results may be due to the small sample size and difference in assessment tools (17).

Nejad NH et al., assessed the relationship of grip and pinch strength with WRMSDs among female carpet weavers in Iran. According to their results, the high prevalence of MSK disorders has led to a significant reduction in the grip and pinch strength of carpet weavers. This decrease was also significant compared with the normal values of grip and pinch strength. Therefore, they recommend ergonomic interventions to be undertaken during designing the workstation of carpet weavers (8).

The results of the current study showed that neck pain has a significant influence on HGS which come in agreement with the results of the study conducted by Wollesen et al., to assess the HGS among industrial workers with and without neck pain and showed a significant difference between both groups where the neck pain group had a weaker HGS (6).

Pascucci Sande et al., studied the effect of musculoskeletal disorders on prehension strength among workers performing repetitive movement of the upper extremity, and found an indirect relation between the disease severity and the pinch strength (18).

Osborn JB et al., investigated the prevalence of the CTS among dental hygienists and its effect on clinical practice. The result revealed that the CTS had an impact on clinical practice by reducing the number of working days and hand strength, in addition to forcing them to earlier retirement (19).

Al-zayani et al, conducted a study among dental staff in Armed Force Hospital in Dhahran, Saudi Arabia, to investigate the prevalence and associated risk factors, related to WRMSDs. They used a self-administered validated and structured standardized Nordic Musculoskeletal Questionnaire and a sample of 130 participants. The results revealed that the prevalence of WRMSDs and symptoms is very high among dentists. The most frequently affected anatomical sites were the low back, neck and shoulders. They recommended that dentists must follow the basic health and safety principles and be aware of correct working postures. In addition, regular rest intermissions between the patients and regular medical examination can be a very proactive strategy.(20).

A German study was done to investigate the prevalence of musculoskeletal (MSK) disorders of the upper extremity using a written survey and Nordic Musculoskeletal Questionnaire (NMQ) among 229 dentists. The results showed that the most affected area were the neck (65.1%) and the shoulder (58.1%). As well, daily activities were limited about 15.9% due to neck pain and 15.4% due to shoulder pain. Moreover, 23.7 % sought medical help for neck discomfort, and 21.1 % for shoulder pain (21).

Al-mohrej OA et al., investigated the prevalence of MSK pain among dentists in Riyadh, Saudi Arabia. They used a questionnaire consisted of 98 questions to identify neck, upper extremity, and low back pain. The results showed that 68.7% of dentists experienced low back pain. The prevalence of neck and shoulder pain was 34.4%, while hand and wrist pain was 22.1% (22).

**Table 2.** Outcome measures of the subjects.

Variables	Mean ± SD	Range
NDI	14±10.4	0-44
BCTQ - Symptoms	26.7±8.2	20-60
BCTQ - Functional	22.5±6.1	0 - 42.5
Grip strength	34.1± 11.1	14- 58
Pinch strength	6.5±2.5	2.5 - 13.5

SD; standard deviation, NDI; neck disability index, BCTQ; Boston carpal tunnel syndrome questionnaire.

**Table 3.** Simple linear regression results for grip strength with neck pain and wrist pain.

Independent Variables	Unstandardized Coefficient		Standardized Coefficient	t	95% CI		p-value
	B	SE	Beta		Lower bound	Upper bound	
Constant	38.072	1.828					
NDI	-.294	.105	-.271	-2.805	-.501	-.086	.006
Constant	41.934	3.760					
BCTQ symptoms	-.301	.135	-.220	-2.220	-.569	-.032	.029
Constant	42.425	4.580					
BCTQ function	-.376	.196	-.189	-1.916	-.765	.013	.054

Abbreviations: SE, standard error; 95% CI, 95% confidence interval; NDI, neck disability index, BCTQ, Boston carpal tunnel questionnaire

**Table 4.** Simple linear regression results for pinch strength with neck pain and wrist pain.

Independent Variables	Unstandardized Coefficient		Standardized Coefficient	t	95% CI		p-value
	B	SE	Beta		Lower bound	Upper bound	
Constant	8.158	1.248					
NDI	-.068	.071	-.096	-.956	-.210	.073	.341
Constant	4.512	2.521					
BCTQ symptoms	.104	.091	.115	1.143	-.076	.284	.256
Constant	7.644	3.077					
BCTQ function	-.020	.132	-.015	-.152	-.282	.241	.879

Abbreviations: SE, standard error; 95% CI, 95% confidence interval; NDI, neck disability index, BCTQ, Boston carpal tunnel questionnaire

In the present study the grip strength was more affected by neck and wrist pain than pinch strength. The explanation for that may be that the grip muscles are more loaded as they are activated while using all types of dental equipment, even those requiring pinching. Furthermore, the function that requires activation of pinch muscles needs more precision and coordination than strength. On the other hand the conduction of the study into Jeddah city only is considered a limitation of the study as this will limit the generalization to all Saudi Arabia.

### Conclusion

Neck and wrist pain has a negative correlation with grip strength among dentists in Jeddah city in Saudi Arabia which may affect their work performance. Therefore dentists must follow the basic health and safety principles and be aware of correct working postures to avoid WRMSDs. In addition, regular rest intermissions between the patients, regular medical examination and ergonomic interventions can be a very proactive strategy.

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