

## Research Paper

## Neck Pain Severity and Work Ability Index: A Study of Tehran Dental Students



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**ABSTRACT**

**Objectives:** Considering the high prevalence of neck pain among dental professionals, as well as its adverse effects on the work activities and quality of life of dentists, this study investigates the prevalence of musculoskeletal disorders in dental students in addition to the relationship between the severity of neck pain and the ability to perform work.

**Methods:** In this cross-sectional study, a total of 108 senior dental students and residents participated. The data were collected through four questionnaires, including body map, neck pain and disability scale, neck disability index and work ability index. The data were analyzed through the SPSS software, version 25. Meanwhile, a  $P < 0.05$  was considered a significance level.

**Results:** In this study, 85 out of 180 individuals (87.7%) experienced at least one musculoskeletal disorder. The most reported pain was in the neck (45.4%), back (36.1%), and right shoulder (31.5%), respectively. There was a relatively positive and significant relationship between neck pain intensity and inability to perform daily work ( $R=0.717$ ,  $P \leq 0.01$ ). Also, there was a reverse and significant relationship between neck pain intensity and the ability to work ( $R=0.384$ ,  $P \leq 0.01$ ).

**Discussion:** Musculoskeletal disorders are high among dental students and residents in universities of Tehran City, Iran. Meanwhile, neck pain is the most common disorder. The existence of this disorder affects the daily ability to work, which can reduce productivity, increase sick leave, and ultimately premature retirement.

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## Highlights

- A total of 87.7% of dental students/residents in Tehran experienced at least one musculoskeletal disorder, with neck pain being the most common.
- Neck pain intensity had a significant and negative impact on the ability to work.
- The study highlights the need for preventive measures to reduce musculoskeletal disorders among dental professionals.

## Plain Language Summary

This study investigated the prevalence of musculoskeletal disorders in dental students and residents in universities of Tehran City, Iran, and explored the relationship between neck pain and workability. This study found that almost 90% of participants experienced at least one musculoskeletal disorder, with neck pain being the most common. Neck pain severity hurts the ability to perform daily work, highlighting the need for preventive measures to reduce musculoskeletal disorders and improve work conditions for dental professionals.

## Introduction

**W**ork-related musculoskeletal disorders (WMSDs) are a group of injuries to muscles, bones, cartilage, tendons, and nerves that are caused or aggravated by inappropriate activities and postures in the workplace [1-3]. Neck and upper limb musculoskeletal disorders are extremely common, with approximately 67% of individuals experiencing at least one episode of neck pain during their lifetime [4, 5]. Since these disorders can be prevented, comprehending their cause and prevalence is crucial for their management and prevention [6]. Several risk factors play a role in the occurrence of musculoskeletal disorders, including genetic predisposition, mental and emotional pressures, increasing age, and improper body posture during work, of which the essential factor is inappropriate body posture during work [7-9]. Musculoskeletal disorders represent a significant public health issue [10]. According to the American Occupational Health Research Office, the annual statistics of WMSDs have increased. In Iran, musculoskeletal disorders are the most common diseases and injuries caused by inappropriate postures in the workplace, accounting for 7% of all diseases in society and 14% of doctors' visits [11]. Among the workers of various professions, the highest prevalence of WMSDs has been attributed to jobs related to healthcare [12]. There are more work-related ergonomic harmful factors in dental professions than in other medical fields, including work-related stress, the lack of rest time, inappropriate body posture during work, imbalance of workload with individuals' physical ability, performing repetitive activities, and the unavail-

ability of tools and equipment which are consistent with the principles of ergonomics [13, 14]. Because of the small and limited area of dentists' work region (the patient's mouth), they are often forced to adopt improper and asymmetric postures as well as static postures. Accordingly, the head is bent forward.

Meanwhile, the hands are rotated and move away from the trunk. The continuation of this inappropriate posture leads to excessive pressure on some involved muscles and joints, especially in the neck, shoulders, back, and waist. Meanwhile, it leads to various symptoms, such as pain and discomfort. For this reason, identifying the area with the highest amount of disorder is always of interest to researchers [15]. The consequences of the prevalence of musculoskeletal disorders in the dental profession include a decrease in work efficiency, profitability, and productivity of the dentist, a limited number of patients, visiting in one day, fatigue, nervous pressure, increased treatment costs, increased lost work time, and early disability of dentists [16]. According to a meta-analysis of 30 studies, dental professionals are particularly vulnerable to WMSDs and upper extremity pain due to mainly usage of the upper body areas during work [17]. A study on dental professionals in Sari City, Iran, indicated that the highest prevalence of pain is in the neck (43.3%) and shoulder (40%) and the lowest prevalence is in the ankle (1.1%) [18]. Risk factors associated with musculoskeletal neck disorders include stressful life routines, maximum work effort, minimal social support and personal issues. Weakness of muscles, poor ergonomics related to work, and age-related changes in vertebrae are factors that cause neck and back pain [19]. Dentists are at

high risk of musculoskeletal disorders, and ergonomic pressure is high during the dental student period. The ability to work among dentists can be measured with the ability work index questionnaire. The work ability index (WAI) among the population of dental professionals and assistants in South China, most of whom were exposed to high and very high neck ergonomic risk, was in the range of 37-44 years, and ergonomic intervention in this population reduced WMSDs related to the neck, wrist and hand and increased WAI [20]. Reduction in the ability to do work is related to various factors, such as low quality of sleep, high job stress, and pain in several body parts [21]. Considering the high prevalence of neck pain among musculoskeletal disorders among dentists, as well as its adverse effects on the work activities and quality of life of dentists, and given that few studies have been conducted on the relationship between these disorders and the ability of dentists to perform their work, this study investigates the prevalence of musculoskeletal disorders in final year students of general dentists and assistants in dental specialties and examines the relationship between the severity of neck pain and the ability to perform their work.

## Materials and Methods

This descriptive and analytical cross-sectional study was conducted among senior dental students and residents working in clinics affiliated with universities in Tehran City, Iran, in 2022. The reason for choosing this community was that the researchers were interested in investigating the relationship between neck pain severity and work ability among dental students, who are at high risk for developing musculoskeletal disorders due to the nature of their work. Meanwhile, as the inclusion criteria of this study, this sample should not have neck pain from another factor from an unsuitable lifestyle, and entrance all samples by medical screening from general health (mental and physical). The exclusion criteria were senior dental students and residents who were not present in the clinical departments due to the COVID-19 pandemic, dental residents who were studying for the board exam at the time of this study and did not do clinical work, dental students and residents who had underlying musculoskeletal disease, and students who did not complete their questionnaires. Four questionnaires were used in this study. The body map questionnaire examines nine body parts to determine musculoskeletal symptoms and disorders [22]. The neck disability index (NDI) questionnaire was created to measure disability in patients with neck pain. This scale expresses how daily activities are affected due to pain. The scale includes ten items to assess pain intensity, personal care, lifting objects, study-

ing, headache, concentration, working, driving, sleeping, and recreation. Using this system, a score of 0%-20% is a sign of mild disability, a score of 21%-40% is a sign of moderate disability, a score of 41%-60% is a sign of severe disability, and a score of more than 60% is a sign of total disability (paralysis) [23]. In addition, the neck pain and disability scale (NPDS) consists of 21 questions with an emphasis on the level of neck pain and the interference of pain in daily life [24]. The validity and reliability of the NDI and NPDS questionnaires were investigated in a study by Mousavi et al. and the Cronbach  $\alpha$  coefficient for the NPDS was 0.88, and for the four subsets of the disability index questionnaire, including neck pain severity, neck pain disorders, neck pain effect on emotions and interference with daily life activities were calculated between 0.74 and 0.94 [25]. The WAI questionnaire is designed to measure the workability of people in work environments.

The WAI score is the sum of the points of the items in seven areas, including current work ability compared with lifetime best, workability concerning the demands of the job, number of current diseases diagnosed by a physician, estimated work impairment due to diseases, sick leave during the past 12 months, the individual prognosis of work ability two years from now, and mental resources. The reproducibility of this questionnaire in its various dimensions was  $>0.7$ , which confirms its appropriate reproducibility. The Cronbach  $\alpha$  coefficient regarding the components of workability concerning job needs, diseases currently diagnosed by the doctor and intellectual and mental abilities were 0.777, 0.521 and 0.829, respectively, which indicates that this questionnaire has an acceptable internal consistency [26, 27]. The information obtained from each questionnaire was entered into the SPSS software, version 25. The descriptive statistics test was used to analyze the demographic variables and the prevalence of musculoskeletal disorders. The Kolmogorov-Smirnov test was used to check whether the data were normal. The Spearman correlation test was used to analyze the correlation between variables. A  $P < 0.05$  was considered statistically significant.

## Results

A total of 108 individuals with an average age of  $27.30 \pm 2.44$  years participated in this study, and the most significant number (65.7%) was in the age range of 26-30 years. Meanwhile, 51 participants (47.2%) were male and 57 (52.8%) were female. In addition, 41.7% of the participants were senior dental students, and others were dental residents. Other demographic characteristics of the participants are reported in Table 1. A total of 85

**Table 1.** Demographic features of the participants

Demographic Features		No. (%)	Mean±SD
Department	University clinic	80(74.1)	-
	University clinic and private office	28(25.9)	
Specialty/Field	Senior student	45(41.7)	-
	Orthodontic resident	11(10.2)	
	Esthetic and restorative dentist	13(12)	
	Periodontics resident	11(10.2)	
	Oral and maxillofacial surgery resident	16(14.8)	
	Oral and maxillofacial radiology resident	4(3.7)	
	Endodontics resident	8(7.4)	
Gender	Male	51(47.2)	
	Female	57(52.8)	
Age (y)	20-25	29(26.9)	27.30±2.44
	26-30	71(65.7)	
	>30	8(7.4)	
Education	Student	45(41.7)	-
	Resident	63(58.3)	
BMI	<18.5	3(2.8)	23.82±3.46
	18.5-24.9	72(66.7)	
	25-29.9	28(25.9)	
	30≤	5(4.6)	
Work experience (y)	<5	78(72.2)	4.43±2.30
	5-10	27(25)	
	>10	3(2.8)	
2 <sup>nd</sup> job	Yes	28(25.9)	-
	No	80(74.1)	
Working (hours per day)	<5	16(14.8)	7.90±2.88
	6-10	75(69.4)	
	>10	17(15.7)	
Sleep hours	<5	12(11.1)	7.90±2.88
	5-8	83(76.9)	
	>8	13(12)	

Demographic Features		No. (%)	Mean±SD
Sleep quality	Very good	16(14.8)	-
	Relatively good	60(55.6)	
	Relatively bad	21(19.4)	
	Very bad	11(10.2)	
Workload	Light	6(5.6)	-
	Moderate	37(34.3)	
	Somewhat heavy	48(44.4)	
	Heavy	17(15.7)	
Occupational accident	Yes	27(25)	-
	No	81(75)	
Exercise	No	50(46.3)	-
	Once a week	58(53.7)	
	Two or three times a week	0	
	Everyday	0	
Smoking	Yes	37(34.3)	-
	No	71(65.7)	

individuals (78.7%) reported at least one musculoskeletal disorder in the organs mentioned in Table 2, among which the frequency of pain was more than in other organs in the neck (45.4%), back (36.1%) and right shoulder (31.5%), respectively. The intensity and incidence of pain in different organs are illustrated in Figures 1 and 2. According to these two figures, 12% of the participants reported neck pain with low intensity, 23.2% with moderate intensity, 5.6% with high intensity, and 4.6% with severe intensity. Also, 24.1% of the participants have neck pain only sometimes, 15.7% usually, 4.6% often, and 0.9% always have neck pain. The NPDS and the NDI questionnaires were distributed among 49 participants who were suffering from neck pain. According to the NPDS scale, 71.4% of the participants experienced mild pain, 26.5% reported moderate pain, and only 1.2% had severe pain in different situations (Figure 3). Based on the NDI questionnaire, 89.8% of the participants experienced mild neck disability and 10.2% experienced moderate disability (Figure 4). According to WAI, 1.6% of the participants in their work environment had poor ability, 26.5% had an average ability, 57.1% had a good ability, and 10.2% had an excellent ability level (Figure 5). The results of the Spearman correlation test indicated

that there was a relatively high positive and significant relationship between the severity of neck pain and the inability to perform daily tasks ( $R=0.717$ ,  $P\leq 0.01$ ). In other words, as the intensity of neck pain increases, the inability to perform daily tasks also increases. Also, according to the correlation test, the severity of neck pain and the ability to work in work environments had an inverse and significant relationship ( $R=-0.384$ ,  $P\leq 0.01$ ). Accordingly, with the increase in neck pain intensity, the ability to work in the workplace decreases significantly. There is no significant relationship between most of the demographic features and the NPDS, NDI and WAI indices. The only relationship was the inverse and significant relationship between education (general dentistry and residency fields) and the WAI ( $R=-0.288$ ,  $P\leq 0.05$ ) (Table 3).

## Discussion

Dentists are exposed to harmful occupational factors and musculoskeletal diseases due to their inappropriate position in work environments. Neck bending, wrist rotation, and standing for long periods lead to a reduction of the working capacity and, in severe cases will lead to

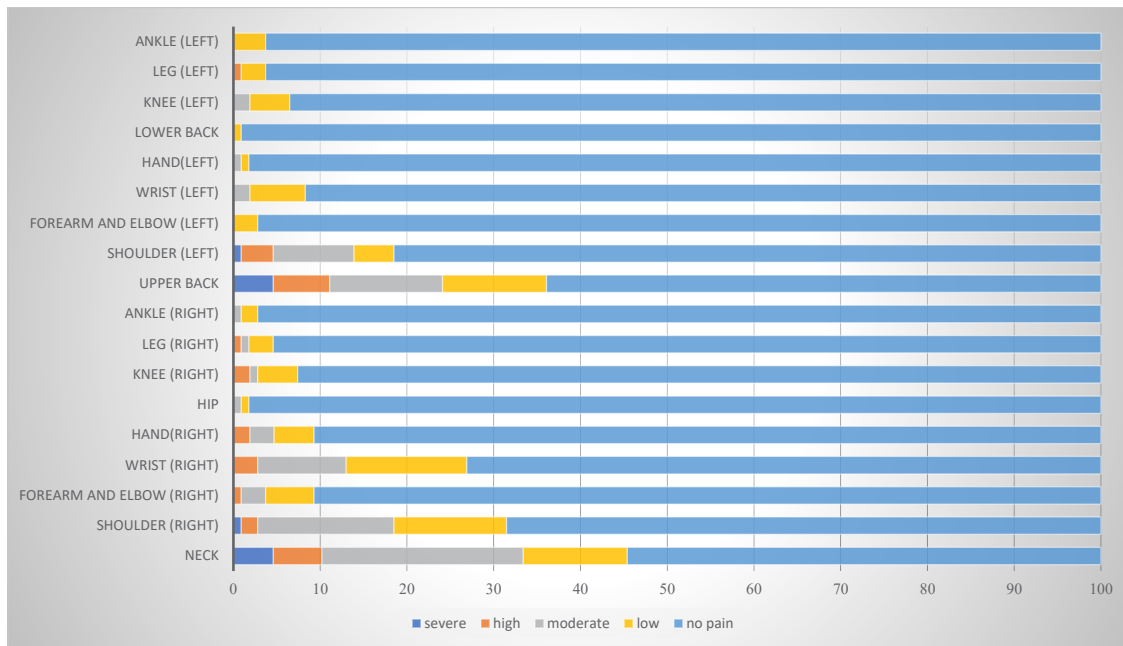


Figure 1. The frequency of pain intensity regarding organs

early retirement, early disability and irreparable physical, psychological and social consequences. According to our findings, 78.7% of participants had a musculoskeletal disorder in at least one organ, which indicates the high prevalence of WMSDs among dental students. In a meta-analysis study conducted by Lietz et al. the prevalence of WMSDs among dentists was estimated between 10.8% and 97.9% [17]. The results of other studies were in parallel with our finding, which indi-

cated a high prevalence (64%-93%) of WMSDs among dentists [20, 28]. The prevalence of WMSDs among dentists in Shiraz [29], Sari [18], Bojnourd [30] and Mashhad [31] cities, in Iran, was 91.9%, 75.6%, 90.5%, and more than 90%, respectively which was consistent with our study. The result of the current study indicated that most reported pains were in the neck (45.4%), back (36.1%), and right shoulder (31.5%), respectively. The prevalence of neck pain is common among dentists, and

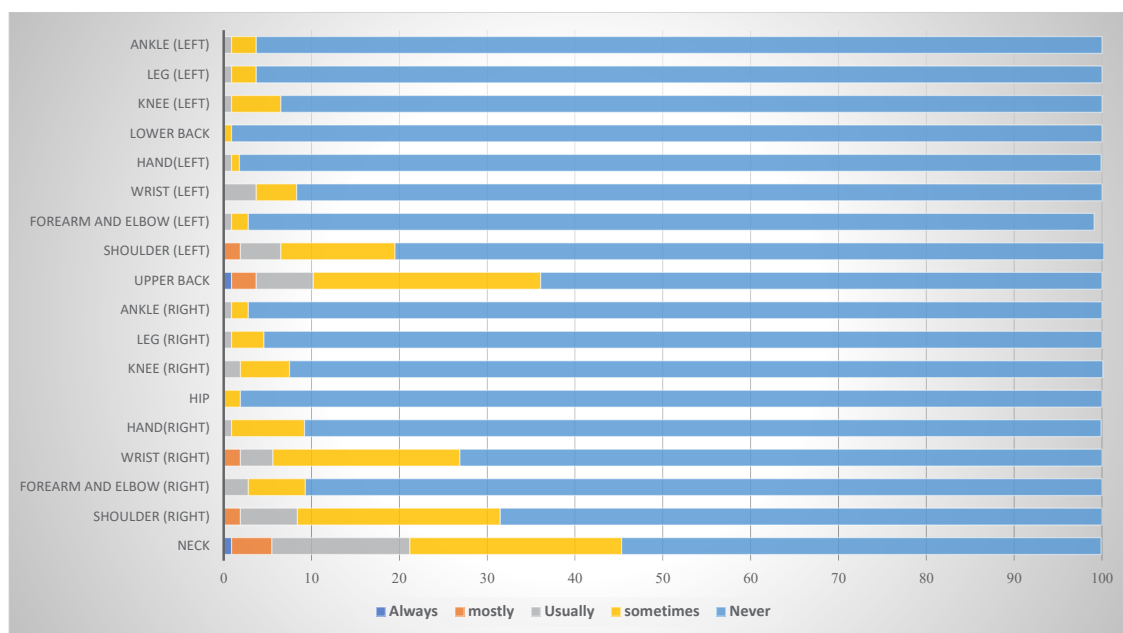


Figure 2. The percentage of time of pain occurrence of pain regarding organs

**Table 2.** Frequency distribution of the presence and absence of pain in the organs of the participants

Organs	No. (%)		Total
	Yes	No	
Neck	49(45.4)	59(54.6)	108(100)
Shoulder (right)	34(31.5)	74(68.5)	108(100)
Forearm and elbow (right)	10(9.3)	98(90.7)	108(100)
Wrist (right)	29(26.9)	79(73.1)	108(100)
Hand (right)	10(9.3)	98(90.7)	108(100)
Hip	2(1.9)	106(98.1)	108(100)
Knee (right)	8(7.4)	100(92.6)	108(100)
Leg (right)	5(4.6)	103(95.4)	108(100)
Ankle (right)	3(2.8)	105(97.2)	108(100)
Upper back	39(36.1)	69(63.9)	108(100)
Shoulder (left)	20(18.5)	88(81.5)	108(100)
Forearm and elbow (left)	3(2.8)	105(97.2)	108(100)
Wrist (left)	9(8.3)	99(91.7)	108(100)
Hand (left)	2(1.9)	106(98.1)	108(100)
Lower back	1(0.9)	107(99.1)	108(100)
Knee (left)	7(6.5)	101(93.5)	108(100)
Leg (left)	4(3.7)	104(96.3)	108(100)
Ankle (left)	4(3.7)	104(96.3)	108(100)
Total (pain at least one organ)	85(78.7)	23(21.3)	108(100)

it is considered the second most common musculoskeletal disorder in dentists [19]. The prevalence of WMSDs in the neck and shoulder can be due to the exposure of dentists to vibrating tools frequent shoulder and hand movements, and the improper position of the neck for a long time, which are known as occupational risk factors in this profession. Bending the neck for a long time and keeping the arms extended and away from the body leads to unfavorable tension on the muscles of the upper part, especially the trapezius muscle, which is associated with fatigue and increased pain, and ultimately leads to WMSDs in neck and shoulder [32]. Similarly, in studies conducted by Koochak Dezfouli et al. [18], Yazdaniyan et al. [33], Ohlendorf et al. [34] and Zafar et al. [35], the highest prevalence of WMSDs was reported in the neck. The mean of NDI was measured as  $16.97 \pm 8.92$ , which

is classified in the range of mild disability. All the participants in this study who reported WMSDs in the neck experienced some level of disability to perform daily activities, of whom 89.9% had mild and 10.2% had a moderate disability. In the study by Chitara et al. 42% of dental students had neck pain, of whom 37% had a mild disability and 5% had a moderate disability [36]. In the study conducted by Babar et al. it was noticed that half of the dental population has mild neck disability [19]. Also, a study carried out by Majeed et al. showed that more than half of the dentists in the city of Lahore in Pakistan experienced mild to complete disability due to neck pain. In this study, the average WAI was  $37.73 \pm 4.97$  (ranged 37-44), which indicates that the participants had a relatively good level of ability in the work environment [37]. In the study conducted among dental professionals



**Table 3.** The results of the Spearman correlation test between demographic variables with NPDS, NDI and WAI

	Variables	Spearman Coefficient	P
NPDS	Gender	-0.022	0.882
	Age	-0.087	0.553
	BMI	0.003	0.981
	Education	-0.033	0.820
	Specialty/Field	0.013	0.929
	Working hours per day	0.071	0.627
NDI	Gender	0.087	0.552
	Age	-0.281	0.051
	BMI	0.073	0.617
	Education	-0.288	0.045
	Specialty/Field	-0.273	0.057
	Working (hours per day)	0.068	0.643
WAI	Gender	-0.125	0.393
	Age	0.064	0.660
	BMI	0.125	0.392
	Education	-0.018	0.901
	Specialty/Field	0.021	0.886
	Working hours per day	0.126	0.388

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Abbreviations: NPDS: Neck pain and disability scale; NDI: Neck disability index; WAI: Work ability index; BMI: Body mass index.

and assistants in Southern China, most of whom were exposed to high neck ergonomic risk, the median WAI was  $39.1 \pm 5.8$  (ranged 37-44), which is consistent with our findings [20]. The correlation test results showed an inverse and significant relationship between neck pain and the WAI ( $R = -0.384$ ,  $P \leq 0.01$ ), which means that with the increase in neck pain intensity, the ability to work in the workplace decreases significantly. In the study by Marklund et al. the relationship between reduced WAI and pain in the neck and shoulder was noticed [21]. Also, the results of this study are inconsistent with the studies of Van den Berg et al. [38], Jay et al. [39] and Lin et al. [20]. Our Study has several strengths, including accurate data which was obtained from a face-to-face interview by a trained physician using validated tools, such as NPDI and WAI, and each question were completely understood by participants. Also, the diversity of different fields of residency was noticed. In addition, the current study provides new insights into the impact of

neck pain on productivity and quality of work among dental students, which can inform future research and interventions aimed at improving ergonomics and preventing musculoskeletal disorders in dental education and practice.

## Conclusion

The findings of this study showed that WMSDs are prevalent among dental students of Tehran universities, of which neck pain is the most common disorder. The presence of this disorder affects the ability to perform daily tasks and work in the work environment, which can cause a decrease in productivity, an increase in sick leave, and ultimately early retirement. Accordingly, it is necessary to implement intervention plans and corrective measures.



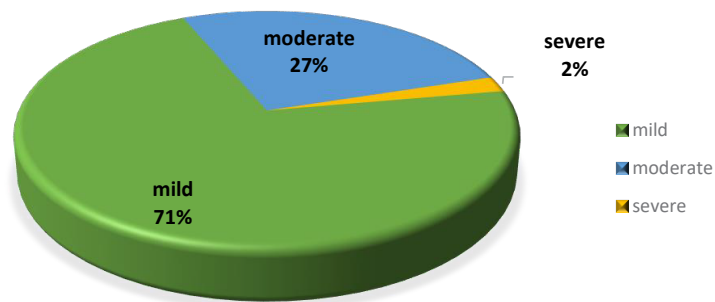


Figure 3. Frequency percentage of pain intensity levels based on NPDS scale

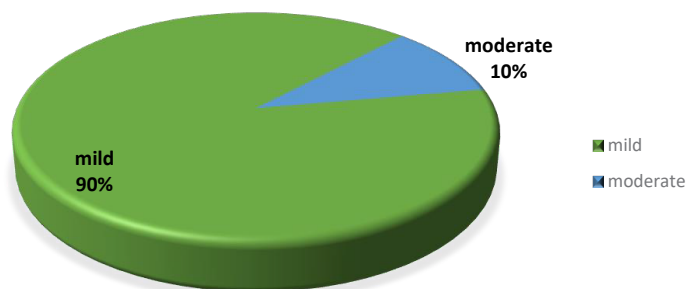


Figure 4. Frequency percentage of neck disability levels among dental students based on NDI index

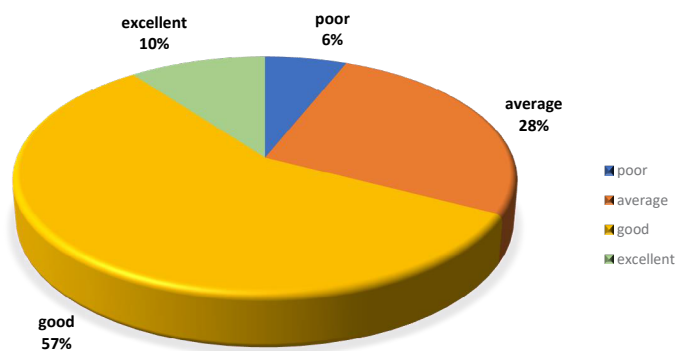


Figure 5. Percentage frequency of work ability levels among dental students based on WAI index

### Study limitations

The limitation of the current study is effectively managing the confounding variables in the current study. We employed stringent inclusion and exclusion criteria, validated questionnaires, and statistical methods, resulting in a reduction of the confounding effect. However, a complete elimination of all confounding factors was not achieved.

### Ethical Considerations

#### Compliance with ethical guidelines

This research approved by the Ethical Committee of [Shahid Beheshti University of Medical Science](#) (Code: IR.SBMU.PHNS.REC.1399.203). A written informed consent form was obtained from all study participants and the study results' confidentiality was also emphasized.

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#### Authors' contributions

All authors equally contributed to preparing this article.

#### Conflict of interest

The authors declared no conflict of interest.

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