

# Investigating the Effect of Educational Intervention on Musculoskeletal Disorders in Dentists

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## Abstract

**Background and Objective:** Work-related musculoskeletal disorders (MSDs) are highly common and considered as the main factor leading to lost work time, increased costs, and hazards of manual labour work. Dentists are predisposed to work-related MSDs due to their job and methods of service delivery. Surveys have indicated that ergonomic design of job equipment and environment, proper posture, regular rest breaks and stretching exercises between patients can positively effect on the musculoskeletal system of dentists, reducing work-related musculoskeletal disorders. The aim of the present study was to evaluate the effect of educational intervention on musculoskeletal disorders in dentists who work in private dental clinics in Tehran, Iran during 2016.

**Materials and Methods:** This study was carried out on 84 dentists working in private dental clinics in Tehran using before-after method. The data were gathered using demographic characteristics questionnaire and standardized Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Educational intervention was implemented distributing educational pamphlets among all participants. Data were re-measured 2 months after educational intervention using CMDQ. Data and changes in them were tested before and after educational intervention using SPSS 22 Software, Wilcoxon Signed Rank Test, McNemar test, and Linear Regression test.

**Findings:** 51 male and 33 female dentists participated in this research. 86.9% of dentists reported some problems in at least one part of the body during the last week. There were larger numbers of dentists with

musculoskeletal pain in neck, low back, right shoulder, and upper back. There was a significant reduction in musculoskeletal pain in neck, right shoulder, left shoulder, upper back, and right wrist ( $P < 0.05$ ) after implementing educational intervention in terms of good body posture and stretching exercises, while there was not any considerable change in other considered limbs. Findings obtained from the study indicated a significant statistical relationship between short break in appointments and musculoskeletal disorders ( $P < 0.05$ ); in this case, the expanded break time between appointments resulted in less musculoskeletal disorders.

**Conclusion:** Work-related musculoskeletal disorders are more prevalent among dentists and can be reduced by educational interventions teaching proper posture, regular rest breaks and stretching exercises between working hours. Therefore, it is essential to perform further educational interventions to promote occupational health among dentists.

**Key words:** Musculoskeletal Disorders, Ergonomics, Posture, Dentists

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## Introduction

Musculoskeletal disorders caused by work are a major health, social, and economic problem in all communities; this problem is created because of various ergonomic reasons such as imposed force (lifting or pulling objects), repeating gestures, static and fixed posture, vibration and environmental factors such as heat [1-2]. Musculoskeletal disorders are common and costly occupational harm since one-third of work-related harm comes from such disorders annually [3-4]. Work-related musculoskeletal disorders are considered as the most significant reason for lost work time, increased costs, and hazards of manual labor [5]. Researchers have revealed since 1950 that dentists are at risk of musculoskeletal disorders because of harmful factors related to routine dentistry so pain and musculoskeletal disorder can be seen among dental care staff. Repetitive activities in abnormal postures deviating from the normal skeletal position, long-term static spasm in muscles of neck, back and limbs, strong gestures in hand, non-ergonomic and unsuitable equipment, improper design of work office, and disarrangement of work instruments can be mentioned as some reasons leading to musculoskeletal disorders in this occupational group [6-8]. Some of these disorders occur because of non-observance of ergonomic principles, non-standard conditions of work environment and the occupational process of individuals. It can be expressed obviously that not only ergonomic issues in work environments lead to musculoskeletal damage but also cause dropped efficiency and productivity, increased errors, fatigue, lack of comfort and environmental stresses [9]. Dentistry is a job full of repetitive movements, long-run and continuous activity in static and fixed positions, inappropriate position of body, such as long bending posture, careful work, and low break time leading to musculoskeletal disorders such as pain and dysfunction in various parts of the body. Prevalence of musculoskeletal disorders among dentists has been reported by research carried out in different areas of the world [10]. Nokhostin et al. (2016) conducted a study entitled "Musculoskeletal problem: Its prevalence among Iranian dentists" on 600 dentists and showed that 67.5% of participants had musculoskeletal disorders. These problems were reported mostly in neck (51.87%) and less in shoulder (7.40%). There was a direct relationship between age ( $p=0.0001$ ), high body mass index (BMI) ( $p=0.021$ ), number of patients per day ( $p=0.002$ ), low physical activity ( $p=0.0001$ ) and musculoskeletal problems [11]. Ancuța et al. (2016) carried out a study about ergonomics and prevention of work-related musculoskeletal harm in dentists; they conducted a prospective study on 30 dentists (20 female dentists) at age range of 30-60 during 12 months to examine occupational disorders in hand using CMDQ. There was a wide range of hand-related job occupational disorder among dentists due to various occupational factors such as occupational posture, work experience, and quality of tools and instruments. According to the results obtained after 12 months, those dentists who had performed 30-minute kinetic exercises 5 days a week had no musculoskeletal pain in their hands compared to the group who had no physiotherapy; hence, it is concluded that such exercises had a positive effect on their quality of life and ability [12].

Dehghan et al. (2013) carried out a study to investigate the effect of a multifaceted ergonomic intervention program on reducing musculoskeletal disorders in dentists. This interventional study was conducted on 102 male dentists working in dental clinics in Tehran. Prevalence of musculoskeletal disorders in both groups (case and control) was measured before intervention, 3 months and 6 months after intervention using Nordic Musculoskeletal Questionnaire (NMQ). Results showed reduced musculoskeletal disorders in neck, shoulder, forearm, wrist, waist, hip, knee and lower leg ( $P<0.05$ ) after educational intervention. On the other hand, prevalence of musculoskeletal disorders was increased in neck, shoulder, forearm, wrist, waist, hip, and knees of individuals in control group. According to the results obtained from this study, multi-dimensional ergonomic intervention consisting of improving work circumstances, exposing ergonomic risk factors, regular exercises, and group discussion could positively reduce prevalence of musculoskeletal disorders among dentists [13]. Morshedi et al. (2014) conducted a study under the title of "Assessment of effectiveness of an educational intervention using the theory of planned behavior to modify posture of operating room personnel in Qazvin educational hospitals". They selected 130 staff from the operating room from 4 educational hospitals in Qazvin using random sampling method and assigned them to experimental (65 members) and control (65 members) groups. Demographic information questionnaire, 31-item questionnaire of Planned Behavior Theory, Ergonomic Awareness Questionnaire, and Nordic Musculoskeletal Disorders Frequency Measurement Questionnaire, Pain Intensity Tool with REBA method for posture status measurement were used as data collection tools. Data were measured at three time sections before, immediately and 3 months after educational intervention. Results obtained from this study in the experimental group showed a significant increase ( $P<0.05$ ) in attitude, abstract norms, perceived behavioral control, and behavioral intention after intervention. Moreover, mean score of REBA was reduced among operating room staff within the third appraisal ( $P<0.05$ ) indicating reduced level of risk in terms of body posture. In addition, pain intensity and frequency of musculoskeletal disorders in wrist, neck, shoulder, arms and lower back of the experimental group were significantly reduced after intervention ( $P<0.05$ ) [14]. Saremi et al. (2006) carried out a study under the title of "The effects of ergonomic intervention on musculoskeletal disorders among dentists". Nordic Musculoskeletal Questionnaire and ergonomic appraisal method of REBA (Rapid Entire Body Assessment) were filled out before and after intervention. According to the results obtained from this study, more than 90% of dentists had problems in at least one of their limbs within the last year. Most of the complaints were in neck and shoulder so that these pains put 83% and 62% of individuals at risk, respectively. Results obtained from REBA method indicated 94% of dentists at risk of such disorders; 60% needed certain ergonomic actions, and 34% needed essential ergonomic actions. To modify existing conditions, human-based ergonomic principles were taught. There was a significant reduction ( $P<0.05$ ) in scores and risk rate obtained from REBA method after intervention; in addition, there

was a significant reduction ( $P < 0.05$ ) in musculoskeletal disorders in neck, shoulder and upper back while there was not any considerable change in other limbs ( $P > 0.05$ ) [15]. Sharma et al. (2010) carried out a study under the title of "Awareness among Indian dentists regarding the role of physical activity in prevention of work related musculoskeletal disorders". The applied instrument was a questionnaire consisting of some questions related to physical volume of work, public health and musculoskeletal problems. 80 male and 22 female dentists at age range of 36.2 participated in this study. Most of reported work-related musculoskeletal disorders in the past 6 months were related to lower back, neck, and shoulder so that more than 97 dentists were looking for medical advice in order to reduce these disorders and 74 dentists set appointments with physiotherapists to follow ergonomic advice and exercises. There was a direct relationship between number of physical activities and improved symptoms. According to the results obtained from this study, not only work-related musculoskeletal disorders in dentists reduce their power but also are important concerns among them [16]. Rahnamaye Tamrooyi et al. (2015) carried out a study under the title of "A survey on Prevalence of Musculoskeletal Disorders in Dentists of Tehran and their posture assessment by RULA method". Data were collected referring to dental clinics, taking pictures, and recording films. Postures were evaluated in two ways, manual and automatic (use of software) after data collection using Cornell's questionnaire. The highest prevalence of musculoskeletal disorders was reported in neck (78.3%) and shoulder (76.4%) and the lowest prevalence was related to elbow (47.6%). According to statistical analysis, there was a significant relation between gender, height, weight, number of patients per day, obesity, marital status, and prevalence of musculoskeletal disorders ( $P > 0.05$ ) while there was not any significant relation between work hours per week, work experience, training experience in field of ergonomics and prevalence of musculoskeletal disorders ( $P < 0.05$ ). Findings showed the suitable interventions such as re-design of work place and instruments, creation of basic information about proper posture, and introducing the role of body posture and biomechanics in prevalence of musculoskeletal disorders to dentists and passing ergonomics by dentistry students are essential actions regarding reduction in musculoskeletal disorders and increase in dentists' productivity [17]. Dentists are at risk of more occupational musculoskeletal disorders due to their job and services. Researches have indicated that optimal and correct posture can positively effect on the musculoskeletal system leading to improved performance and reduced occupational events and harm [9]. To prevent musculoskeletal harm, it is essential to be aware of role of biomechanical factors such as awkward or fixed posture, imposed force and repetitive actions in order to find controlling strategies [18-19]. Besides sufficient teaching and design of work experience and instruments, ergonomically, regular aerobic exercises and stretching between work hours are recommended to prevent musculoskeletal disorders [20].

## Methodology

This study was conducted using before-after method and convenient sampling method among dentists working in Tehran. In this regard, a list of private healthcare centers with dental clinics was prepared and the 84 dentists who were working in these centers were asked to fill out questionnaires after obtaining their consent. The brand of dental unit and chair of dentist was recorded at the next step. Questionnaires consisted of the following parts: demographic characteristics questionnaire and standardized Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). Primitive status of musculoskeletal disorders was determined and recorded using CMDQ. An educational program was performed through brief face-to-face teaching and distributing pamphlets. Data were re-measured 2 months after educational intervention. Disorders were tested again after performing educational interventions using Wilcoxon Signed Rank Test, McNemar, and Linear Regression test.

## Findings

51 male and 33 female dentists participated in this research; they were at age of  $43.99 \pm 8.86$  with BMI of 35 that was at normal range of (18.5-24.9). 4 members were overweight (25-29.9kg overweight) and 9 members were obese (30kg and above). Selected members had average work experience of  $17.14 \pm 8.43$  years. Of them, 59 members were general dentists and 25 members were specialized and a large number of them were periodontists (6 members). Average number of patients per day was equal to  $10.24 \pm 6.63$  and work hours reported to  $37.43 \pm 15.99$  weekly. 32 dentists had no short break between treatments as follows: 24 dentists once per day, 10 dentists twice per day and 16 dentists more than two breaks per day. 41 dentists had regular exercise weekly and 40 dentists had no regular exercise activities weekly.

According to the results obtained from CMDQ, dentists had musculoskeletal problems in their neck (64.3%), lower back (51.2%), right shoulder (41.7%), and upper back (39.3%); so that negative effect of these problems in neck (45.2%), lower back (40.5%), upper back (31%), and right shoulder (28.6%) interfered with their ability to work. Right wrist (33.3%) and left shoulder (31%) were at next importance in terms of creating musculoskeletal disorders. In case of pain intensity (score of 0-90), dentists reported more intensive pain in neck (score of  $10.97 \pm 20.44$ ), right shoulder ( $8.85 \pm 19.76$ ), upper back ( $6.92 \pm 17.59$ ), and lower back ( $6.90 \pm 14.33$ ) (Table 1).

86.9% of participants had problems in at least one of the mentioned limbs before intervention and only 13.09% of them expressed no pain in their limbs. 19% of participants reported no pain in mentioned limbs after intervention. There was a significant reduction ( $P < 0.05$ ) in intensity of musculoskeletal pains in neck, right shoulder, left shoulder, upper back, and right wrist after educational intervention using Wilcoxon Signed Rank Test while there was not any considerable change in other limbs. There was not any significant difference in frequency of dentists with



**Table 1: Distribution of dentists based on intensity of musculoskeletal disorders before and after intervention considering the involved body area**

Intensity of musculoskeletal disorders (score 0-90)	before intervention		after intervention		P value
	Mean	Standard deviation	Mean	Standard deviation	
neck	10.97	20.44	7.91	17.01	0.004
right shoulder	8.85	19.76	5.24	13.51	0.003
left shoulder	5.80	17.21	2.95	9.33	0.008
upper back	6.92	17.59	4.53	14.35	0.003
right upper arm	1.98	7.51	1.17	5.36	0.200
left upper arm	1.78	10.34	0.79	3.30	0.609
lower back	6.90	14.33	6.54	15.83	0.692
right forearm	3.03	12.16	1.42	7.20	0.123
left forearm	2.96	14.51	1.29	7.04	0.305
right wrist	5.12	13.35	3.81	12.96	0.028
left wrist	3.79	14.73	2.55	11.98	0.099
hip	0.92	4.21	1.11	5.44	0.906
right thigh	1.21	5.35	0.51	2.31	0.191
left thigh	1.65	10.36	0.26	1.20	0.440
right knee	3.27	14.07	2.35	8.66	0.300
left knee	3.22	12.94	3.73	14.75	0.776
right lower leg	1.95	7.15	1.17	5.19	0.090
left lower leg	1.78	5.79	1.04	4.97	0.108

musculoskeletal disorders in different parts of the body before and after intervention using McNemar test.

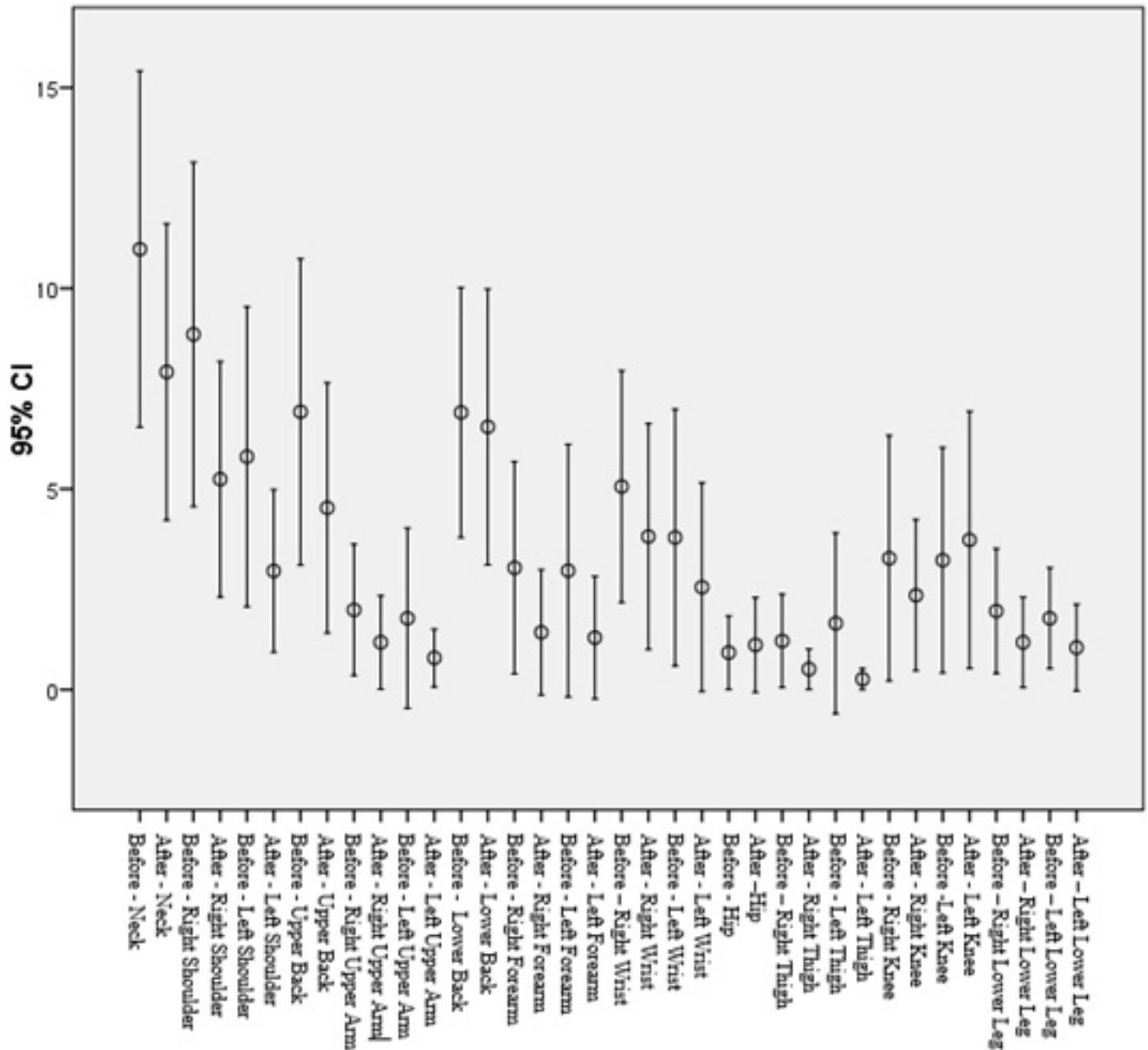
Presence of musculoskeletal disorders (as a separate variable) and its significance was compared with other variables using Linear Regression test and there was a significant relationship between short breaks between patients and presence of musculoskeletal disorders ( $P < 0.05$ ); in this regard, more short breaks between patients led to lower musculoskeletal disorders. Moreover, there was a significant relationship between pain in neck, gender, and age ( $P < 0.05$ ) so that the pain in neck was higher in men and increased age led to more pain in neck. In addition, there was a significant relationship ( $P < 0.05$ ) between intensity of pain in lower back and dominant hand so that left-handed individuals had more pain in lower back. There was not any statistical significant relationship between musculoskeletal disorders and other variables including BMI, smoking, marital status, specialty, regular weekly exercise activities, use of mirror, history of particular disease, history of accident or trauma, history of surgery of the spine and upper and lower extremities, type of dental unit and chair, work experience, number of patients per day, and working hours per week.

## Discussion

This study was conducted to examine effect of educational intervention on musculoskeletal disorders in dentists working in private healthcare centers of Tehran. For this purpose, we went to a private healthcare center with dentistry clinic in Tehran and selected some participants using convenient sampling method; we spoke with dentists about importance of prevention of musculoskeletal disorders then proposed educational intervention through

face-to-face teaching and distribution of educational pamphlets. Ultimately, results of training effect were evaluated 2 months after intervention. According to findings of this study, 86.9% of dentists had problems in at least one of their limbs before the educational intervention. A study conducted by Ísper Garbin et al. (2017) on 204 dentists [21], a study carried out by Nokhostin and Zafarmand (2016) on 600 Iranian dentists [11], a study of Munshi et al. (2016) on 420 Indian dentists [22], and a study conducted by Abi Aad (2016) on 218 Lebanese dentists [23] showed prevalence of musculoskeletal disorders equal to 81.4%, 67.5%, 90.7%, and 92.7%, respectively. According to the mentioned studies that confirmed the results of each other, there is a considerable prevalence of musculoskeletal disorders among dentists indicating lack of awareness of correct ergonomic principles and lack of stretching exercises between patients. Findings obtained from extant study showed larger number of dentists with musculoskeletal disorders in neck (64.3%), lower back (51.2%), right shoulder (41.7%), and upper back (39.3%) compared to other parts of the body. Musculoskeletal disorders in the right wrist (33.3%) and left shoulder (31%) had lower importance rate. Similar results were obtained in other research. Ísper Garbin et al. (2017) carried out a study on 204 dentists and reported more musculoskeletal disorders in neck, shoulders, and lower back [21]. Munshi et al. (2016) carried out a study on 420 dentists and reported neck (73.8%), lower back (70%), wrist and hand (64%), and shoulders (62.4%) as the most involved parts of body [22]. Abi Aad (2016) conducted a study on 218 dentists and reported lower back (61.8%), neck (51.5%), and shoulders (39.5%) as the most involved parts of the body [23]. Moreover, Nokhostin and Zafarmand (2016) conducted a study on 600 Iranian dentists and reported neck (51.87%), wrist and hand (29.62%), back (11.11%),

**Figure 1: Distribution of dentists based on intensity of musculoskeletal disorders before and after intervention considering the involved body area**



and shoulder (7.40%) as the most involved parts of body [11]. The study carried out by Rahnamaye Tamrooyi et al. (2015) examined 98 dentists in Tehran and reported the highest prevalence of musculoskeletal disorders in neck (78.3%), shoulder (76.4%), wrist (68.5%), and lower back (55.4%) [17]. Sharma and Golcha (2010) conducted a study on 102 dentists and reported the highest prevalence of work-related musculoskeletal disorders in lower back, neck and shoulder within recent 6 months [16].

Saremi et al. (2006) conducted a study on 47 dentists and reported the highest complaint of pain in neck (83%) and shoulder (62%) [15]. Two other studies were carried out in a dentistry school of Islamic Azad University and obtained similar results in this field; Momenabadi (2013) reported the highest prevalence of musculoskeletal problems in neck (50.7%), waist (38.7%), and back

(37.4%) among specialized students in dentistry [24]. Jahangir (2005) reported the highest rate of pain in neck (42.2%) among faculty members of dentistry school of Azad University and Shahid Beheshti University [25]. According to the mentioned studies that confirm each other, musculoskeletal disorders most frequently involve neck, shoulder and back of dentists due to more loads on these muscles because of dentist's type of work and working conditions, awkward body postures and lack of attention to ergonomic principles. Results obtained from the present paper showed a significant relationship ( $P < 0.05$ ) between short break and musculoskeletal disorders so that increased short breaks between patients led to decreased musculoskeletal disorders. In addition, there was a significant relationship between gender, age and pain in neck ( $P < 0.05$ ) so that men feel more pain in their neck because of more working hours they spent in the

clinic. On the other hand, increase in age led to more pain in neck. Also, there was a significant relationship ( $P<0.05$ ) between intensity of pain in lower back and dominant hand so that left-handed dentists had more pain in their lower back because of awkward postures. There was not any statistical significant relationship between musculoskeletal disorders and other variables and this may be related to the small number of samples. Kierklo et al. (2011) conducted a study and reported a significant relationship between musculoskeletal disorders, standing position, lack of short break, and lack of attention to ergonomic principles [9]. According to the study conducted by Abi Aad (2016), chronic pain in different parts of the body was reversely related to physical activity of the person [23]; the reason for such a relationship may be because of regular exercises and physical readiness that lead to flexibility of tendons and more ability of muscles to support the spine [26].

Sharma and Golcha (2010) conducted a study on 102 dentists and reported a significant direct relationship between number of physical activities and improved musculoskeletal symptoms [16]. A study of Nokhostin and Zafarmand (2016) on 600 Iranian dentists indicated a direct relationship between old age, high MBI, number of patients per day, low physical activities, and increased musculoskeletal disorders [11]. There was not any statistical significant relationship between musculoskeletal disorders and variables including age, BMI, number of patients, and physical activity in the present study and this may have been due to small number of sample members. The mentioned research shows that musculoskeletal disorders can be controlled in the case of following ergonomic principles, having short breaks between appointments, having a suitable lifestyle, doing regular exercises and controlling weight. According to the findings obtained from present paper, there was a significant reduction in musculoskeletal disorders in neck, right shoulder, left shoulder, upper back, and right wrist ( $P<0.05$ ); however there was not any significant difference in various parts of body before and after intervention in terms of dentists with musculoskeletal disorders; this case indicates that intervention could significantly reduce intensity of disorders in some parts of the body but was not able to remove them completely since data were re-measured 2 months after intervention and it was a short-term follow up to reveal effects of intervention. Nevertheless, 86.9% (73 members) reported pain in some limbs before receiving educational intervention and this rate dropped to 81% (68 members) after intervention. In general, reduced musculoskeletal disorders in neck, right shoulder, left shoulder, upper back, and right wrist indicated effectiveness of intervention among dentists. Saremi et al. (2006) conducted a study on 47 dentists and reported a significant reduction in musculoskeletal disorders in neck, shoulder, and upper back 4 months after educational intervention ( $P<0.05$ ) [15]. Dehghan et al. (2016) carried out a study to examine effect of educational intervention on reducing musculoskeletal disorders in dentists. Results obtained from this study in case group ( $n=52$ ) indicated reduced musculoskeletal disorders in neck, shoulder, forearm, wrist, waist, tight, knees and lower leg 3 and 6 months after intervention ( $P<0.05$ ) [13]. Ancuța et al. (2013) conducted a study on

30 dentists to examine occupational disorders in the hand and prevention from work-related musculoskeletal harm using exercise and stretching programs. It was revealed in this study that dentists in group A who did 30-minute kinetic exercises 5 days per week reported no musculoskeletal pains in hand after 12 months of intervention compared to group B who did not receive physiotherapy. This study showed effectiveness of stretching exercises in reducing musculoskeletal pain [12]. According to the mentioned studies that confirm each other and that confirm the results of our study, there was considerable effectiveness in reducing musculoskeletal disorders after intervention indicating effects of ergonomic design of work place and instruments, proper posture, regular rest breaks, regular aerobic exercises, and stretching activities between working hours on reducing musculoskeletal disorders. The positive point of our study was implementation of educational intervention to promote musculoskeletal health in dentists leading to effectiveness of training in promotion of occupational health of dentists. Although there have been various studies about musculoskeletal disorders in dentists, few interventional studies have been conducted to reduce these disorders.

## Conclusion

Work-related musculoskeletal disorders are common among dentists; in this case, teaching suitable body posture, regular rest breaks, and doing stretching exercises between working hours can reduce and prevent musculoskeletal harm in dentists so that more rest breaks lead to lower musculoskeletal disorders.

## Problems and limitations

There was poor collaboration of some centers and dentists, too much time spent visiting dental clinics to answer the questionnaires.

## Recommendations

We recommend performing similar interventional research in educational centers and clinics, poster design and installation in the dentists' offices and dental schools, holding retraining courses and workshops for dentists and dental students, Inclusion of ergonomic training course in the educational curriculum of dental students and Sending questionnaires and training tips via email to save time.

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