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ASSOCIATION BETWEEN WORK-RELATED MUSCULOSKELETAL DISORDERS AND QUICK EXPOSURE CHECK RESULTS IN DENTISTS

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ABSTRACT

Objective: *The objective of this study is to determine the frequency of musculoskeletal disorders and factors that may be related to dentists and the body regions that may be at risk due to the job using the Quick Exposure Check (QEC) method and to determine their relationship with musculoskeletal disorders.*

Material and Method: *The population of the cross-sectional study includes 200 dentists who provide outpatient services actively. Data collection consists of three parts (Nordic Musculoskeletal Questionnaire, Sociodemographic Characteristics/Working Conditions and Survey Containing Variables Related to Health, QEC Employee and Observer Form).*

Results: *The majority of the participants reported that they had musculoskeletal disorders in the last 12 months (92.1%): back (74.7%), lower back (74.7%), and neck (70%). QEC shoulder–arm and work load scores were medium; neck, waist, hand/wrist, and vibration scores were high; and stress scores were extremely high. The risk of experiencing musculoskeletal pain in the last 12 months was 4.1 times higher in dentists who did not exercise regularly compared to dentists who exercised regularly.*

Conclusion: *The frequency of musculoskeletal disorders is found to be extremely high in dentists. According to the findings of the study, the risk of pain was higher in those with high risk assessment scores in the relevant region. An ergonomic program should be developed to reduce risk scores, and dentists should be encouraged to perform regular physical activities.*

Keywords: *Musculoskeletal pain, dentistry, ergonomics, risk factors, work.*

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DİŞ HEKİMLERİNDE İŞE BAĞLI KAS-İSKELET SİSTEMİ RAHATSIZLIKLARI İLE HIZLI MARUZİYET DEĞERLENDİRME SONUÇLARININ İLİŞKİSİ

ÖZET

Amaç: Bu çalışmanın amacı diş hekimlerinde kas-iskelet sistemi şikayetlerinin sıklığı ve ilişkili olabilecek faktörleri saptamak, Hızlı Maruziyet Değerlendirme (HMD) yöntemi ile iş ile ilişkili olabilecek riskli vücut bölgelerini ve bunların kas iskelet sistemi şikayetleri ile ilişkisini belirlemektir.

Materyal ve Metot: Kesitsel tipteki araştırmanın evrenini aktif olarak poliklinik hizmeti veren 200 diş hekimi oluşturmaktadır. Veri toplama üç bölümden oluşmaktadır (İskandinav Kas-İskelet Anketi, Sosyodemografik/Çalışma Koşulları ve Sağlıkla İlgili Değişkenleri İçeren Anket, HMD Çalışan ve Gözlemci Formu).

Bulgular: Katılımcıların çoğu (%92,1) son 12 ayda kas iskelet sistemi ağrıları olduğunu ifade etmiştir: Sırt (%74,7), bel (%74,7) ve boyun (%70). HMD omuz-kol ve iş temposu skorları orta; boyun, bel, el/bilek ve titreşim skorları yüksek; ve stres puanları çok yüksek riskli bulunmuştur. Kas iskelet sistemi ağrısı düzenli egzersiz yapmayan diş hekimlerinde düzenli egzersiz yapanlara göre 4,1 kat yüksek bulunmuştur.

Sonuç: Diş hekimlerinde kas iskelet sistemi yakınma sıklığı oldukça yüksek düzeyde saptanmıştır. Çalışma sonucunda ağrı olma olasılığı ilgili bölge risk değerlendirme skoru yüksek çıkanlarda daha fazla bulunmuştur.Risk skorlarını azaltmak için ergonomik bir program oluşturulmalı ve diş hekimlerinin düzenli fiziksel aktivite yapmaları teşvik edilmelidir.

Anahtar kelimeler: Kas-iskelet sistemi rahatsızlıkları, diş hekimliği, hızlı maruziyet değerlendirme.

INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are common health problems, and combined they are one of the leading causes of physical disability. Musculoskeletal disorders constitute a significant part of work-related health problems, and studies have shown that 63%–93% of dentists suffer from musculoskeletal pain.[1,2] There are different risks associated with different dental practices like repetitive movements of the hands, prolonged static body posture and exerting excessive force while handling dental instruments. Ergonomic risk assessments can be used to identify physical risk factors and which body part is at high risk, this assessment can determine some of the risk monitoring and adequate preventive measures.[3] One of the evaluation methods is the Quick Exposure Check (QEC). QEC assesses physical, organizational and psychosocial risk factors as well as ergonomic risks. While there have been many studies that have examine how often WMSDs occur, only a few studies have used observational scales to assess musculoskeletal disorders and vulnerable regions of the body.[4,5] It would be useful to assess the risk factors and exposure status associated with the musculoskeletal disorders of dentists; determining ergonomic risk factors and vulnerable parts of the body would provide valuable information on how to reduce musculoskeletal disorders in the future.

The objective of the study is to determine the frequency of musculoskeletal disorders, related factors and to investigate ergonomic exposure using the Quick Exposure Check (QEC) technique in dentists.

MATERIAL AND METHOD

This cross-sectional study was carried out in Konak, Izmir, Turkey. Konak is the central district with many public hospitals/clinics which employ the majority of public sector dentists in Izmir and provide services in all fields of dentistry. Dentists with physical disabilities, either congenital or acquired, which included upper and lower limbs, articulate or spinal, and dentists who were pregnant were excluded from the study sample. The sample consists of 200 dentists who provided outpatient services actively. This study intended to reach the entire population. The research was conducted between January and March 2019. The data were collected using face to face interviews by the first author. The questionnaire consists of three parts: Nordic Musculoskeletal Questionnaire, Sociodemographic/Working Conditions and Survey Containing Variables Related to Health, QEC Employee and Observer Form.

Kuorinka *et al*. developed the Nordic Musculoskeletal Questionnaire, which serves as an instrument for the identification and assessment of musculoskeletal disorders.[6] The Turkish version of the study was developed by Kahraman *et al*. by performing validity and reliability study.[7] The questionnaire determines whether there are any complaints (pain, discomfort) in the last week and in the last 12 months in nine specific mapped regions of the body (neck, shoulder, elbow, wrist/hand, back, lower back, hip, knee, and ankle/foot) and whether these complaints affect one's daily life.[8] Data about socio-demographic characteristics, working conditions (area of specialization, work

experience, work time, number of patients per day, working without a break, lunch break, working position, training on occupational risks), and health-related information (Body mass index, dominant hand, smoking, regular exercise, previously diagnosed chronic disease and musculoskeletal disorder) was collected via a questionnaire developed by the researcher. Information on risk status in work-related musculoskeletal disorders was obtained using the Quick Exposure Check (QEC) method. The QEC method, developed by Li and Buckle and updated by David, Wood, and Buckle, observes the change in exposure and exposure to risks for musculoskeletal disorders.[9,10] Ozcan *et al*. carried out the Turkish adaptation and reliability study.[11] The method consisted of two parts: the observer and the employee. The first part involving the observer includes assessing the movements of the lower back, shoulder/arm, hand/wrist, and neck of the employee and the employee's posture during the work from beginning to end.

The second part involving the employee consists of assessing the maximum weight lifted by hand, duration of work, the maximum force applied by one hand, visual attention required for the job, use of vehicle, vibration, work load and work stress. QEC scores are based on a combination of risk factors determined by the observer for each body region and the self-assessment of the employee. The risk score is obtained from the scoring table through the interaction of the two parts. Risk scores indicate a hypothetical relationship between increased exposure levels and possible health outcomes. There are four categories of exposure scores for lower back, shoulder/arm, wrist/hand and neck: low, medium, high and very high. There are three categories of exposure scores for driving, vibration and work speed: low, medium and high. There is a fourth category for stress: very high.

Ethical approval was obtained from the Clinical Research Ethics Committee (date and number of document: 20.06.2018-E.177130/292), and informed consent was obtained from the dentists participating in the research. The data were analyzed using IMB SPSS Statistics 21. Significance level was accepted as $p<0.05$, while confidence interval was calculated to be 95%. Descriptive findings; number and percentage distributions for categorical variables were given as average, standard deviation, largest and smallest values for numerical variables. The relationship between the musculoskeletal pain and categorical independent variables was assessed via chi-square analysis. For the assessment of the relationship between musculoskeletal disorders and numerical independent variables; the Student's T test/Mann-Whitney U test were used in two categorical groups, and Kruskal-Wallis test analysis was used in more than two categorical groups. Logistic regression analysis which is an advanced analysis, was used to determine the relationship between the musculoskeletal disorder and independent variables.

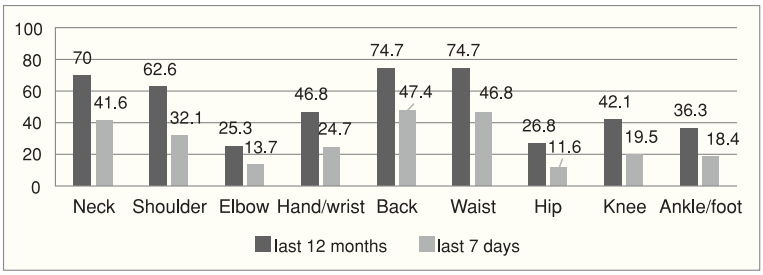

Figure. Work-related musculoskeletal disorders of dentists during last 7 days and last 12 months

RESULTS

Ninety five percent of the research population (190 people) participated in the study. The variables of the research group related to socio-demographic characteristics, health, and working conditions are shown in Table 1. The mean age of the dentists is 43.81±9.08 (25-62, median 45).

Table 2 shows the exposure level for different body regions and for environmental and organizational factors.

The majority of the participants reported that they suffered musculoskeletal disorders in the past 12 months (92.1%), and 53.2% reported that these disorders prevented them from performing their usual work. The study found that the most common disorder was back pain (74.7%) and lower back pain (74.7%), followed by neck pain (70%) and shoulder pain (62.6%) (Figure).

Presence musculoskeletal disorders in dentists, QEC results, and other factors that may be related were examined, and regression models were developed to determine the variables that can be predictors of musculoskeletal disorders (Table 3). The risk of having a musculoskeletal disorder is 4.1 times higher in those who cannot exercise regularly. The risk of having neck pain is 2.6 times higher in women compared to men and 6.2 times higher in those with child care. A one-point increase on the QEC neck risk score increases the risk of neck pain 1.3 times. The risk of shoulder pain is 2.1 times higher in women than in men. Working in a standing position provides 0.4 times more protection than sitting against risk of shoulder pain. The risk of elbow pain is 7.5 times higher in the 35-44 age group and 9.2 times higher in the ≥45 age group than in the 25-34 age group. Those with child

Table 1. Socio demographic, health and working conditions of dentists

	n	(%)
Age		
25-34 years	38	20.0
35-44 years	53	27.9
≥45 years	99	52.1
Gender		
Female	128	67.4
Male	62	32.6
Marital Status		
Married /stable relationship	136	71.6
Single	54	28.4
BMI		
Underweight (<18,5)	5	2.6
Normal weight (18,5-24,9)	114	60.0
Overweight (25-29,9)	58	30.5
Obesity (>30)	13	6.8
Dominant hand		
Right	172	90.5
Left	18	9.5
Smoking		
Never smoked	108	56.8
Formerly smoked	33	17.4
Currently smoke	49	25.8
Exercise regularly		
Yes	78	41.1
No	112	58.9
Previously diagnosed chronic disease		
Yes	27	13.7
No	163	86.3
Previously diagnosed musculoskeletal disease		
Yes	67	35.3
No	123	64.7
Situation that would put a burden on the musculoskeletal system		
Yes	90	48.3
No	100	51.7
Specialization/Doctorate		
Yes	38	20.0
No	152	80.0
Work year		
<20	82	43.2
≥20	108	56.8
Work time		
<8 h/day	45	23.7
8 h/day	126	66.3
>8 h/day	19	10.0
Number of patients		
<25/day	81	42.6
≥25 /day	109	57.4
Worked without a break		
Yes	127	66.8
No	63	33.2
Lunch break		
<1 hour	24	12.6
≥1 hour	166	87.4
Working position		
Generally sitting	87	45.8
Generally standing	51	26.8
Both	52	27.4
Training on occupational risks		
Yes	117	61.6
No	73	38.4
Risks of musculoskeletal diseases in the working environment		
No risk	1	0.5
Little risky	7	3.7
Risky	84	44.2
Very risky	98	51.6

BMI: Body mass index

Table 2. Level of risk exposure of dentists calculated from the Quick Exposure Check (QEC)

	Low (%)	Moderate (%)	High (%)	Very High (%)
Back (static)	0.5	25.3	66.8	7.4
Shoulder/Arm	5.3	79.5	13.2	2.1
Wrist/Hand	2.1	42.6	53.2	2.1
Neck	2.1	23.2	74.2	-
Vibration	13.2	32.1	54.7	-
Work Speed	6.8	64.2	28.9	-
Stress	0.5	3.2	38.4	57.9

care responsibility are 4.8 times more likely to have elbow pain than those without. Those who are left-handed are 3.8 times more likely to have hand/wrist pain than those who are right-handed. The risk of wrist pain is 2.6 times higher in those who engage in activities that put load on the musculoskeletal system outside of work in their daily life. A one-point increase in the QEC wrist risk score increases the risk of hand/wrist pain by one-fold. A one-point increase in the QEC work load risk score increases the risk of wrist pain by 1.1 times. Women are 3 times more likely to suffer from back pain and 2.3 times more likely to have lower back pain than men. A one-point increase in the QEC lower back (static) risk score increases the risk of lower back pain by 1.1 times.

DISCUSSION

Dentists represent a very vulnerable group of workers for work-related musculoskeletal disorders. This study found that the percentage of dentists with musculoskeletal disorders was very high (92.1%), and the most common disorder was back pain and lower back pain (74.7%) and neck pain (70%). The results of many studies on dentists have shown that the prevalence of musculoskeletal disorders in the lower back, neck, and back regions of dentists is high.[12–17] This study found that the risk of neck pain in female dentists was 2.6 times higher than in male dentists, the risk of shoulder pain was 2.1 times higher, the risk of back pain was three times higher and the risk of waist pain was 2.3 times higher in female dentists than in male dentists. Studies show that women are more likely to develop musculoskeletal disorders than men.[12,17–19] The difference between the genders can be related to lower muscle volume and strength in women as well as women's gender role in daily life. Women's daily working hours are 1.5 times longer than those of men because their professional roles are combined with the invisible work they perform at home, which increases ergonomic risks that result in musculoskeletal disorders.

Table 3. Multivariate regression model showing the variables associated with the existence of musculoskeletal disorders

Musculoskeletal Disorder		Standard Error	OR (95% CI)
Gender (R: Male)	Female	0.61	2.38 (0.71-7.94)
Exercise regularly (R: Yes)	No	0.64	4.13 (1.15-14.73)
Musculoskeletal disease (R: No)	Yes	4584.8	1.44(-)
Risks of musculoskeletal diseases in the working environment (R: No Risk/little risk)	Risky/Very Risky	0.92	4.30 (0.69-26.46)
Worked without a break (R: No)	Yes	0.61	2.48 (0.74-8.25)
QEC work tempo risk score		0.13	1.19 (0.91-1.55)
Neck pain		**Standard Error**	**OR (95% CI)**
Gender (R: Male)	Female	0.37	2.65 (1.26-5.67)
Musculoskeletal disease (R: No)	Yes	0.44	0.81 (0.34-1.92)
Cervical hernias (R: No)	Yes	1.10	19.39 (2.23-168.20)
Child care. (R: No)	Yes	0.78	6.26 (1.35-28.9)
QEC neck risk score		0.11	1.34 (1.06-1.68)
QEC work tempo risk score		0.07	1.10 (0.95-1.27)
Shoulder pain		**Standard Error**	**OR (95% CI)**
Gender (R: Male)	Female	0.36	2.15 (1.06-4.36)
Chronic disease (R: No)	Yes	0.55	2.02 (0.68-5.93)
Situation that would put a burden on the musculoskeletal system (R: No)	Yes	0.35	1.77 (0.88-3.57)
Worked without a break (R: No)	Yes	0.34	1.77 (0.89-3.50)
Working position (R: Sitting)	Both	0.40	0.57 (0.25-1.27)
	Standing	0.40	0.44 (0.20-0.98)
Risks of musculoskeletal diseases in the working environment (R: No Risk/little risk)	Risky/Very Risky	0.88	2.55 (0.45-14.33)
Elbow pain		**Standard Error**	**OR (95% CI)**
Age (R: 25-34)	35-44	0.81	7.55 (1.51-37.61)
	≥45	0.80	9.22 (19.1-44.39)
Child care. (R: No)	Yes	0.52	4.88 (1.74-13.66)
Worked without a break (R: No)	Yes	0.44	2.08 (0.87-4.96)
Risks of musculoskeletal diseases in the working environment (R: No Risk/little risk)	Risky/Very Risky	136	-
QEC work tempo risk score		0.07	1.08 (0.94-1.24)
Hand/wrist pain		**Standard Error**	**OR (95% CI)**
Dominant hand (R: Right)	Left	0.60	3.80 (1.15-12.50)
Musculoskeletal disease (R: No)	Yes	0.34	1.48 (0.76-2.90)
Situation that would put a burden on the musculoskeletal system (R: No)	Yes	0.33	2.60 (1.35-5.01)
Lunch break (R: ≥1 h)	<1 h	0.53	3.27 (1.16-9.25)
QEC wrist risk score		0.03	1.09 (1.02-1.16)
QEC work tempo risk score		0.06	1.16 (1.02-1.33)
Back pain		**Standard Error**	**OR (95% CI)**
Gender (R: Male)	Female	0.41	3.08 (1.38-6.89)
Marital Status (R: Single)	Married/stable relationship	0.40	1.96 (0.89-4.30)
Exercise regularly (R: Yes)	No	0.37	1.75 (0.84-3.66)
Musculoskeletal disease (R: No)	Yes	0.42	2.17 (0.94-4.99)
Situation that would put a burden on the musculoskeletal system (R: No)	Yes	0.43	1.36 (0.58-3.17)
Child care (R: No)	Yes	1.11	5.38 (0.60-47.6)
QEC waist (static) risk score		0.06	1.12 (0.98-1.28)
Lower back pain		**Standard Error**	**OR (95% CI)**
Gender (R: Male)	Female	0.37	2.30 (1.10-4.82)
Exercise regularly (R: Yes)	No	0.37	1.67 (0.81-3.46)
Musculoskeletal disease (R: No)	Yes	0.45	0.8 (0.36-2.12)
Lumbar hernias (R: No)	Yes	1.09	9.96 (1.16-85.6)
Worked without a break (R: No)	Yes	0.38	1.66 (0.78-3.52)
Risks of musculoskeletal diseases in the working environment (R: No Risk/little risk)	Risky/Very Risky	0.82	2.59 (0.51-13.0)
QEC waist(static) risk score		0.07	1.17 (1.01-1.37)

QEC: Quick Exposure Check, **OR:** Odds ratio, **CI:** confidence interval

In this study, the risk of experiencing musculoskeletal pain in the last 12 months was 4.1 times higher in dentists who did not exercise regularly compared to dentists who exercised regularly. Previous studies have shown that physical exercise has a protective role against back, neck, and shoulder pain in dentists.[13,17,20,21] Exercise provides flexibility and coordination by increasing blood flow to the muscles. Regular stretching and flexion exercises are important for strengthening the muscles and preventing pain.[22,23]

In this study, all dentists in the study group are working in the public sector. Since the study group was homogeneous in terms of daily working hours and the number of patients examined, no significant relationship was found between musculoskeletal pain and daily working time. There are many studies claiming that working without a break is associated with musculoskeletal pain.[21,24] The reason for not finding a relationship between working without a break and musculoskeletal pain in this study could be that the majority of the study group (65%) worked without a break or with only a 1–2-minutes break (35%).

Stress scores were very high in terms of exposure to risk factors of musculoskeletal disorder; waist, hand/wrist, neck and vibration scores were high, and shoulder/arm and work load scores were medium. The studies that examined the posture of dentists determined that the risk of developing musculoskeletal problems was high, and the incorrect posture of dentists while working created a significant risk of musculoskeletal disorders.[5,16] According to the results of our study, the increase of QEC neck risk increased the risk of neck pain. During the observation, it was observed that the dentists worked mostly at chairside with their necks extended forward excessively. In a similar study conducted on dentists, it was observed that only 14% of the dentists maintained a neutral position of the neck while working. The head settles inside the body when the neck is tilted forward, the trapezius muscle and the cervical vertebrae cannot overcome the burden of the weight of the head. This situation explains the frequency of neck pain among dentists.[25] According to the results of our study, the increase in the QEC waist risk increases the risk of waist pain. As a result of control on the patient, work in a confined space with insufficient lighting, limited access and stressful procedures for a prolonged period, it was observed that the dentists did not maintain a neutral position. It can be expected to have back and lower back pain in these working positions. According to the results of the study, the increase of QEC hand/wrist risk increased the possibility of developing wrist pain. In a similar study, a significant relationship was found between wrist pain and QEC wrist risk score.[3] Some studies have shown that exposure to ergonomic risk factors and prevalence of musculoskeletal disorders decreased after implementing ergonomic interventions in the workplace environment.[26-27] No relationship was found between the mean QEC stress risk score and the presence of musculoskeletal pain in general and in specific regions in the last 12 months. Intense stress triggers musculoskeletal disorders and can cause contraction and pain especially in the trapezius.[28] As the majority of dentists (96.3%) had a high QEC work stress risk score, no relationship was found between pain symptoms and stress.

One of the strengths of this study is the use of an observational scale to assess the risks related to the musculoskeletal system, which allowed involvement of the employees in the risk assessment. In addition, not only ergonomic risks but also physical and psychosocial risks that can cause musculoskeletal disorders were assessed. Beside this, the research has some limitations. Since the collected data includes participants' self-assessments, response bias may occur. Since the QEC method used in risk assessment assesses only the situation at the observed time, only the risk during the observation can be determined.

The study observed that the frequency of pain in the musculoskeletal system in dentists was very high. The pain was most commonly detected in the back and lower back regions. The study found that the majority of dentists worked without having a break/rest between two patients. In the observational risk assessment results, the risk was high in the waist, neck and hand/wrist regions for WMSDs. According to the QEC results, it was determined that the stress factor was very high, the vibration factor was high for WMSDs risk. Female dentists who did not regularly exercise and those with high risk assessment results were found to have musculoskeletal pain risk in the relevant regions. A work schedule should hence be created to enable cyclical work and regular breaks for dentists. In dental units, suitable arrangements should be made for female dentists to accommodate their height. Dentists should be encouraged to have regular physical activities and exercises. After the arrangements are made, risks and exposure changes should be evaluated with the QEC.

*The authors declare that there are no conflicts of interest.

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