BMC Musculoskeletal Disorders

RESEARCH

Open Access

Relationship between work-related musculoskeletal symptoms and burnout symptoms among preclinical and clinical dental students: a cross-sectional study

Berkant Sezer[1*] and Duygu Sıddıkoğlu[2]

Abstract

Background The demanding nature of dental education exposes students to a high risk of burnout symptoms, characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment. Similarly, work-related musculoskeletal symptoms are prevalent among dental students, posing significant occupational health challenges. This study aimed to evaluate the relationship between work-related musculoskeletal symptoms and burnout symptoms among preclinical and clinical dental students.

Methods A total of 248 dental students participated in this cross-sectional study, and a three-part questionnaire was administered. The first section included sociodemographic and health-related questions. The second section utilized the Nordic Musculoskeletal Questionnaire, in which participants indicated "yes" or "no" responses regarding the presence of musculoskeletal symptoms in nine specific body regions (neck, shoulders, upper back, elbows, wrists/hands, lower back, hips/thighs, knees, and ankles/feet) over the past 7 days and 12 months. The third section employed the Maslach Burnout Inventory, which assesses three dimensions of burnout: emotional exhaustion, depersonalization, and personal accomplishment. Participants responded to items on a 7-point Likert scale. Relationships between work-related musculoskeletal symptoms and burnout symptoms were analyzed using generalized linear models and linear regression analyses.

Results The mean age of the participants was 20.73 ± 1.42 years, and 58.9% were female. Statistically significant relationships were found between emotional exhaustion and neck pain experienced in the past 12 months ($B = 3.700$, $p < 0.001$), as well as pain-related incapacity in the lower extremities in the past 12 months ($B = 2.584$, $p = 0.002$). Depersonalization was significantly associated with lower extremity pain in the past 12 months ($B = 1.620$, $p = 0.001$). Additionally, being a clinical dental students was a significant predictor of emotional exhaustion ($B = 2.981$, $p = 0.007$). All presented B coefficient estimates were adjusted for age, sex, clinical education level, and work-related musculoskeletal symptoms-related variables.

*Correspondence:
Berkant Sezer
berkant.sezer@comu.edu.tr; dt.berkantsezer@gmail.com

Full list of author information is available at the end of the article

Conclusions The findings revealed significant associations between clinical education level, neck and lower extremity pain in the past 12 months, pain-related incapacity, and burnout symptoms among dental students. These results suggest that emotional exhaustion and depersonalization in dental students may be influenced by work-related musculoskeletal symptoms.

Keywords Dental education, Dental students, Work related musculoskeletal symptoms, Work related musculoskeletal disorders, Musculoskeletal symptoms, Musculoskeletal disorders, Burnout symptoms, Burnout syndrome, Emotional exhaustion, Depersonalization, Personal accomplishment

Background

Ergonomic working conditions, which aim to prevent work-related injuries, accidents, and performance-related errors such as inefficiencies or mistakes in task execution, are essential across many professions [1–4]. A mismatch between physical demands and physical capacity often leads to work-related musculoskeletal symptoms (WMSs), which refer to injuries affecting tendons, muscles, joints, ligaments, nerves, bones, and other related structures. These injuries can cause discomfort, pain, swelling, and even disability in the affected body parts [5–8]. Key contributing factors to WMSs include prolonged static postures, repetitive movements, sustained muscle contractions, and improper body alignment [6, 9]. Poor ergonomic conditions and the resulting WMSs have far-reaching consequences, including decreased productivity, workforce attrition, increased healthcare costs, and adverse physical and emotional effects [6, 10]. Among healthcare professionals, including dentists, WMSs are recognized as significant and pressing occupational health concerns due to their high prevalence and impact [11–13]. Notably, studies indicate that WMSs are more common among dental practitioners compared to other occupational groups [11, 14–16]. A systemic review [14] revealed that the prevalence of musculoskeletal pain among dentists ranges from 64 to 93%. The neck and back are the most commonly affected regions [11, 16, 17], primarily due to the unbalanced positioning of the head, neck, and trunk during dental procedures [16, 18]. Dental students, however, are particularly vulnerable to WMSs. Compared to licensed dentists, they possess fewer coping strategies and face additional challenges, such as the intense clinical training process, the absence of dental assistants during practice, and unique physical and psychosocial stressors inherent to dental education [16, 19–21].

Burnout is broadly defined as a state characterized by depersonalization, a loss of empathy, emotional exhaustion, and diminished personal accomplishment [22–24]. Burnout symptoms are commonly observed in health service professions, where constant interaction with people and exposure to high levels of stress are inherent aspects of the job [23–27]. Burnout manifests through various symptoms, including emotional symptoms such as depression, helplessness, nervousness, hopelessness, and irritability; cognitive symptoms such as a loss of meaning or purpose, cognitive impairments, and difficulties in concentration; behavioral symptoms such as absenteeism, procrastination in decision-making, and avoidance of responsibilities; and social symptoms such as reduced professional commitment, strained personal relationships, and social withdrawal [26, 28, 29]. The healthcare sector imposes significant pressures on its providers, stemming from demanding clinical responsibilities, time constraints, limited autonomy over work processes, and conflicting roles and relationships with leadership [28]. Additional contributors to burnout include the intensity of working conditions, physical exhaustion resulting from these demands, and the impact of WMSs [28, 30–36]. Dental students, as a subset of healthcare providers, are particularly vulnerable to burnout symptoms and psychosocial stressors due to the reasons outlined in the previous paragraph. Inadequate coping strategies further exacerbate their susceptibility, leading to poorer academic performance and adverse psychological outcomes [37, 38].

The relationship between burnout symptoms and WMSs has been explored in various occupational groups, particularly among healthcare professionals and students in health-related fields [39–44]. Existing studies highlight that the high physical and psychosocial demands of healthcare professions significantly contribute to both WMSs and burnout symptoms. Dental students, as future healthcare providers, represent a population exposed to both academic and clinical stressors. Despite evidence linking WMSs to burnout in other groups, there is a lack of studies examining this relationship specifically among dental students, who face distinct challenges such as prolonged static postures, intensive training schedules, and limited ergonomic support. In this study, a novel approach was adopted by grouping dental students according to their clinical education levels. The aim of this study was to evaluate the relationship between WMSs and burnout symptoms among preclinical and clinical dental students. The null hypothesis was that there is no relationship between WMSs and burnout symptoms in this population.

Methods

Study design and ethical approval

This study was conducted as a cross-sectional questionnaire-based study among students enrolled at the School of Dentistry, Çanakkale Onsekiz Mart University, during the 2022–2023 academic year. Ethical approval was obtained from the Ethical Committee of the School of Graduate Studies, Çanakkale Onsekiz Mart University (Decision No. 07/26, March 31, 2022). As dental students are considered as a vulnerable group according to the Declaration of Helsinki [45], the study strictly adhered to all ethical principles and obligations outlined therein. Prior to the commencement of the study, the principal investigator (B.S.) provided detailed information regarding the study's objectives, methodology, and ethical considerations, with special emphasis on the rights of vulnerable groups. To ensure voluntary participation, students were explicitly informed that their involvement was entirely optional, with no incentives offered or penalties imposed. This clarification was particularly emphasized because the principal investigator was also a faculty member in undergraduate teaching. Ethical responsibilities were thoroughly outlined in the informed consent form provided to participants. Students who agreed to participate completed the questionnaire forms accurately and thoroughly after receiving comprehensive explanations about the study.

Study population

The study population consisted of dental students from the first to fifth years of study at the School of Dentistry, Çanakkale Onsekiz Mart University. In Türkiye, dental education spans ten semesters. During the first three years, students undergo preclinical training, which focuses on foundational and laboratory-based education. In the fourth and fifth years, they progress to clinical education, where they gain practical experience by performing various treatment procedures on patients [46]. Accordingly, the students were categorized into two groups: preclinical students (first, second, and third years) and clinical students (fourth and fifth years).

Data collection

Following a face-to-face briefing about the study provided by the principal investigator (B.S.) in the classroom, informed consent forms containing detailed study information were distributed to the dental students. Sufficient time was allowed for participants to read and understand the forms, after which they were asked to sign them and complete the questionnaires accurately. Upon completion of the questionnaires, the height and weight of consenting participants were measured by the principal investigator using a standardized Health-O-Meter (HY-RGZ160 Scale, China). Body Mass Index (BMI) values were then calculated and categorized into four groups: underweight (< 18.5), normal (18.5–24.9), overweight (25–29.9), or obese (> 30) [47]. The measurements were recorded in the designated section of each participant's form.

Instruments

A three-part questionnaire was administered to the participants. The first part included questions assessing sociodemographic characteristics and health-related information. The second part comprised the Nordic Musculoskeletal Questionnaire (NMQ), which evaluated WMSs. The third and final part included the Maslach Burnout Inventory (MBI), which measured participants' levels of burnout.

Sociodemographic and health-related information

The first part of the questionnaire collected sociodemographic data, including participants' age, sex, academic year, and parental education levels. Age was recorded as a continuous variable (in years). Sex was assessed by asking participants to select either "female" or "male." Academic year was initially recorded according to the participants' year of study (first to fifth years) and later categorized into two groups: preclinical (first, second, and third years) and clinical (fourth and fifth years). Parental education levels were recorded separately for mothers and fathers, with participants selecting one of three options: "primary school," "high school," and "university or higher." Health-related information included questions about regular smoking habits, alcohol consumption, use of regular medication, and the presence of diagnosed psychiatric, musculoskeletal, and/or chronic disorders. Each health-related variable was assessed using a binary (yes/no) response format. For analysis, all categorical variables were grouped as described.

Work-related musculoskeletal symptoms

The second part of the questionnaire consisted of the NMQ, which was used to assess the prevalence and impact of WMSs among participants. The Turkish version of the NMQ has been validated and demonstrates robust psychometric properties, including test-retest reliability (prevalence-adjusted bias-adjusted kappa coefficients ranging from 0.57 to 0.90), internal consistency (Cronbach's alpha = 0.896), and construct validity ($p < 0.001$ for all body regions) [48]. Participants were asked whether they had experienced musculoskeletal pain or pain-related incapacity in the following nine body regions: neck, shoulders, elbows, wrists and hands, upper back, lower back, hips and thighs, knees, and ankles and feet. For each body region, four binary ("yes" or "no") questions were asked regarding:

1. Pain occurrence in the past 12 months,

2. Incapacity to work due to pain in the past 12 months,
3. Visit the physician due to pain in the past 12 months,
4. Pain occurrence in the past 7 days.

Burnout symptoms

The third and final part of the questionnaire assessed participants' burnout symptoms using the MBI, which is widely regarded as the gold standard for evaluating the severity of burnout. First developed in the 1980s, this self-administered inventory examines burnout across three sub-scales: emotional exhaustion (9 items), depersonalization (5 items), and personal accomplishment (8 items), totaling 22 questions. Emotional exhaustion refers to feelings of being emotionally overextended and depleted of emotional resources. Depersonalization reflects an unfeeling and impersonal response towards recipients of one's service of care. Personal accomplishment measures feelings of competence and successful achievemnt in one's work. Each item is rated on a 7-point Likert scale, where 0 represents "never" and 6 represents "every day" [49, 50]. Scores for each subscale were calculated by summing the responses to the relevant items, and the three subscale scores were analyzed separately as ordinal variables to examine their associations with other study variables. Higher scores in emotional exhaustion and depersonalization indicate greater burnout, while lower scores in personal accomplishment suggest higher levels of burnout symptoms [49]. The reliability and validity of the MBI for healthcare professionals in Türkiye were established by Çam [51], who reported Cronbach's alpha coefficients of 0.81 for emotional exhaustion, 0.70 for depersonalization, and 0.77 for personal accomplishment. Permission to use the MBI was obtained from Mind Garden, Inc.

Statistical analyses

Categorical variables were expressed as frequencies and percentages (%), while continuous variables were presented as medians and first and third quartiles (Q1 and Q3) due to their non-normal distribution. The Shapiro–Wilk test was used to assess the normality of continuous variables. Descriptive and univariate analyses were performed for each subgroup and questionnaire factor. The Mann–Whitney U test and Kruskal–Wallis test were used to compare participant responses across relevant cohorts, as appropriate. A general linear model (GLM) was constructed to predict the dependent variable—burnout status (total scores for emotional exhaustion, depersonalization, and personal accomplishment)—using sociodemographic, health-related, and WMSs-related characteristics, along with significant independent variables identified univariate analyses. All significant variables were initially included in the model, but only those remaining statistically significant were retained. To facilitate interpretation of the regression results, WMSs-related variables were grouped into four main body regions: neck, upper extremities (shoulders, elbows, wrists, and hands), trunk (upper and lower back), and lower extremities (hips and thighs, knees, and ankles and feet) [16]. This grouping enabled a more precise evaluation of the effects of WMSs in different body regions on burnout symptoms. First-level interactions among the retained variables were also examined and included in the model if significant. Finally, a linear regression model was developed using significant predictors, including age, sex, clinical education level, pain occurrence in the neck in the past 12 months, incapacity to work due to pain in the lower extremities in the past 12 months, and pain occurrence in the lower extremities in the past 12 months. The significance level was set at $\alpha = 0.05$. All statistical analyses were conducted using SPSS version 26.0 (IBM Co., Armonk, NY, USA).

Results

Description of participants

Out of 307 dental students invited to participate in the study, 59 were excluded due to declining participation, failure to provide informed consent, or submission of incomplete or incorrect questionnaire responses. This resulted in a final sample of 248 participants, yielding a participation rate of 80.8% for this cross-sectional analysis. The mean age of the participants was 20.73 ± 1.42 years (mean ± SD). Of the participants, 146 (58.9%) were female and 102 (41.1%) were male. Based on BMI classifications, 29 participants (11.7%) were underweight, 175 (70.6%) were of normal weight, 34 (13.7%) were overweight, and 10 (4.0%) were obese. Regarding clinical education level, 138 students (55.6%) were in preclinical education, while 110 students (44.4%) were in clinical education. In terms of health-related characteristics, 79 participants (31.9%) reported regular smoking, and 141 participants (56.9%) reported regular alcohol consumption. Regular medication use was reported by 38 participants (15.3%), and 43 participants (17.3%) indicated having a diagnosed psychiatric, musculoskeletal, and/or chronic disorder. A detailed summary of the sociodemographic and health-related characteristics of the participants is presented in Table 1.

Distribution and frequency of work-related musculoskeletal symptoms

Table 2 presents the distribution and frequency of WMSs across different body regions based on the NMQ responses. Over the past 12 months, the neck (76.2%), lower back (75.4%), and upper back (73.4%) were the regions with the highest prevalence of reported pain. Similarly, the highest rates of incapacity to work due to pain were observed in the neck (48.8%), lower back

Table 1 Sociodemographic and health-related characteristics of the participants

	Mean ± SD
Age	20.73 ± 1.42
	N (%)
Sex	
Male	102 (41.1)
Female	146 (58.9)
Body Mass Index (BMI)	
Underweight	29 (11.7)
Normal	175 (70.6)
Overweight	34 (13.7)
Obese	10 (4)
Clinical education level	
Preclinical	138 (55.6)
Clinical	110 (44.4)
Mother's education level	
Primary school	95 (38.3)
High school	89 (35.9)
University or higher	64 (25.8)
Father's education level	
Primary school	66 (26.6)
High school	89 (35.9)
University or higher	93 (37.5)
Regular smoking	
Yes	79 (31.9)
No	169 (68.1)
Regular alcohol consumption	
Yes	141 (56.9)
No	107 (43.1)
Use of regular medication	
Yes	38 (15.3)
No	210 (84.7)
Presence of diagnosed psychiatric, musculoskeletal, and/or chronic disorders	
Yes	43 (17.3)
No	205 (82.7)

SD: Standard deviation, N: number.

Table 3 Distribution and frequency of symptoms among main body regions

Nordic Musculoskeletal Questionnaire items	Frequency of WMSs *N* (%)			
	Neck	Upper extremities	Trunk	Lower extremities
Pain occurrence in the past 12 months	189 (76.2)	183 (73.8)	210 (84.7)	135 (54.4)
Incapacity to work due to pain in the past 12 months	121 (48.8)	122 (49.2)	140 (56.5)	87 (35.1)
Visit the physician due to pain in the past 12 months	20 (8.1)	23 (9.3)	21 (8.5)	27 (10.9)
Pain occurrence in the past 7 day	136 (54.8)	129 (52)	163 (65.7)	78 (31.5)

WMSs: Work-related Musculoskeletal Symptoms, N: Number

(47.1%), and upper back (44.8%). Physician visits for musculoskeletal pain in the past 12 months were most commonly associated with the neck (8.1%), lower back (7.3%), upper back (5.6%), and shoulders (5.6%). Pain experienced over the past 7 days followed a similar distribution, with the neck (54.8%), lower back (51.6%), and upper back (50.8%) being the most frequently affected regions.

The distribution and frequency of WMSs across the four main body regions—neck, upper extremities, trunk, and lower extremities—are presented in Table 3. The body regions with the highest prevalence of pain during both the past 12 months and the past 7 days were as follows: trunk (84.7% and 65.7%), neck (76.2% and 54.8%), upper extremities (73.8% and 52%), and lower extremities (54.4% and 31.5%), respectively. Regarding incapacity to work due to pain in the past 12 months, the trunk (56.5%) showed the highest prevalence, followed by the upper extremities (49.2%), neck (48.8%), and lower extremities (35.1%). Physician visits due to pain in the past 12 months were most frequently recorded for the lower extremities (10.9%), followed by the upper extremities (9.3%), trunk (8.5%), and neck (8.1%).

Table 2 Distribution and frequency of symptoms among body regions regarding the Nordic Musculoskeletal Questionnaire

Nordic Musculoskeletal Questionnaire items	Frequency of WMSs *N* (%)								
	Neck	Shoulders	Elbows	Wrists and hands	Upper back	Lower back	Hips and thighs	Knees	Ankles and feet
Pain occurrence in the past 12 months	189 (76.2)	157 (63.3)	39 (15.7)	116 (46.8)	182 (73.4)	187 (75.4)	66 (26.6)	83 (33.5)	80 (32.3)
Incapacity to work due to pain in the past 12 months	121 (48.8)	92 (37.1)	32 (12.9)	80 (32.3)	111 (44.8)	117 (47.1)	35 (14.1)	55 (22.1)	46 (18.5)
Visit the physician due to pain in the past 12 months	20 (8.1)	14 (5.6)	3 (1.2)	9 (3.6)	14 (5.6)	18 (7.3)	7 (2.8)	16 (6.5)	8 (3.2)
Pain occurrence in the past 7 days	136 (54.8)	114 (46)	21 (8.5)	57 (23)	126 (50.8)	128 (51.6)	36 (14.5)	44 (17.7)	39 (15.7)

WMSs: Work-related Musculoskeletal Symptoms, N: Number

Association between sociodemographic and health-related factors and burnout status

Table 4 summarizes the associations between sociodemographic and health-related factors and MBI scores. Emotional exhaustion scores were significantly higher among females than males ($p = 0.041$), whereas no significant associations were observed between BMI and any of the burnout sub-dimensions ($p > 0.05$). Clinical dental students reported significantly higher scores in emotional exhaustion, depersonalization, and personal accomplishment compared to preclinical students ($p < 0.001$, $p = 0.009$, $p = 0.026$, respectively). Moreover, individuals with a diagnosed psychiatric, musculoskeletal, and/or chronic disorders had significantly higher depersonalization scores than those without such conditions ($p = 0.010$).

Association between work-related musculoskeletal symptoms and burnout status

Table 5 presents the associations between WMSs across different main body regions and MBI scores. Emotional exhaustion and depersonalization scores were significantly higher among participants who reported pain occurrence in the past 12 months and the past 7 days, as well as incapacity to work due to pain in the past 12 months, in all main body regions ($p < 0.05$). Furthermore, depersonalization scores were significantly higher among those who visited a physician for trunk pain in the past 12 months ($p = 0.047$). No statistically significant associations were observed between personal accomplishment scores and WMSs in any of the body regions ($p > 0.05$).

Table 4 Comparing the burnout status scores by the demographic and health-related charachteristics of the participants

		Maslach Burnout Inventory Scales [Median (Q1– Q3)]		
		Emotional Exhaustion	**Depersonalization**	**Personal Accomplishment**
Sex	*Male*	23.00 (17.00–27.00)	7.00 (4.00–10.00)	17.50 (14.00–22.00)
	Female	24.00 (19.00–29.00)	7.00 (4.00–10.00)	17.00 (14.00–20.00)
	p-value	**0.041**	0.558	0.490
Body Mass Index (BMI)	*Underweight*	24.00 (18.00–29.00)	6.00 (3.50–9.50)	19.00 (16.50–21.00)
	Normal	24.00 (18.00–27.00)	7.00 (4.00–10.00)	17.00 (14.00–20.00)
	Overweight	24.50 (19.75–28.50)	7.00 (4.00–11.50)	16.00 (12.00–23.00)
	Obese	26.00 (19.75–32.00)	6.50 (3.25–10.25)	18.50 (14.00–21.00)
	p-value	0.689	0.517	0.307
Clinical education level	*Preclinical*	21.50 (17.00–26.00)	6.00 (4.00–9.00)	17.00 (13.00–20.00)
	Clinical	25.00 (22.00–29.25)	8.00 (4.75–11.00)	18.00 (15.75–21.00)
	p-value	**< 0.001**	**0.009**	**0.026**
Mother's education level	*Primary school*	24.00 (18.00–29.00)	6.00 (4.00–10.00)	17.00 (14.00–21.00)
	High school	24.00 (18.00–28.00)	7.00 (4.00–10.00)	17.00 (14.00–21.00)
	University or higher	24.00 (19.25–27.00)	8.00 (4.25–10.00)	17.50 (14.00–20.00)
	p-value	0.928	0.636	0.939
Father's education level	*Primary school*	24.00 (18.75–29.25)	7.00 (4.00–9.25)	17.00 (14.00–20.00)
	High school	24.00 (18.00–28.50)	7.00 (4.00–10.00)	18.00 (14.00–21.00)
	University or higher	24.00 (19.00–27.00)	7.00 (4.00–10.00)	17.00 (14.00–20.00)
	p-value	0.862	0.932	0.874
Regular smoking	*No*	24.00 (18.00–28.00)	7.00 (4.00–10.00)	18.00 (14.00–20.50)
	Yes	25.00 (20.00–29.00)	7.00 (4.00–10.00)	17.00 (14.00–21.00)
	p-value	0.191	0.166	0.950
Regular alcohol consumption	*No*	24.00 (18.00–27.00)	7.00 (4.00–10.00)	18.00 (15.00–21.00)
	Yes	24.00 (19.00–29.00)	7.00 (4.00–10.00)	17.00 (14.00–20.50)
	p-value	0.298	0.315	0.221
Use of regular medication	*No*	24.00 (18.00–27.25)	7.00 (4.00–10.00)	18.00 (14.00–21.00)
	Yes	24.50 (19.75–29.25)	8.50 (3.00–11.00)	16.00 (13.50–20.00)
	p-value	0.266	0.208	0.210
Presence of diagnosed psychiatric, musculoskeletal, and/or chronic disorders	*No*	24.00 (18.00–28.00)	6.00 (4.00–9.50)	17.00 (14.00–21.00)
	Yes	24.00 (20.00–28.00)	8.00 (6.00–11.00)	17.00 (14.00–20.00)
	p-value	0.605	**0.010**	0.624

Q: Quartile, Bold values mean statistically significant (p < 0.05).

Table 5 Comparing the burnout status scores by the Nordic Musculoskeletal Questionnaire data of the participants

			Maslach Burnout Inventory Scales [Median (Q1– Q3)]		
			Emotional Exhaustion	**Depersonalization**	**Personal Accomplishment**
Neck	***Pain occurrence in the past 12 months***	*No*	20.00 (13.00–24.00)	5.00 (3.00–8.00)	16.00 (13.00–22.00)
		Yes	25.00 (20.00–29.00)	7.00 (4.00–10.00)	18.00 (14.00–20.00)
		p-value	**< 0.001**	**0.005**	0.602
	Incapacity to work due to pain in the past 12 months	*No*	22.00 (16.00–26.00)	6.00 (4.00–9.00)	17.00 (14.00–21.00)
		Yes	25.00 (20.00–30.00)	8.00 (5.00–11.00)	18.00 (14.00–20.00)
		p-value	**< 0.001**	**0.001**	0.876
	Visit the physician due to pain in the past 12 months	*No*	24.00 (19.00–28.00)	7.00 (4.00–10.00)	17.00 (14.00–21.00)
		Yes	22.50 (18.25–28.75)	8.00 (5.25–10.00)	17.50 (15.25–20.75)
		p-value	0.852	0.409	0.627
	Pain occurrence in the past 7 days	*No*	22.00 (17.00–26.00)	6.00 (4.00–9.00)	17.00 (14.00–21.00)
		Yes	25.00 (20.00–29.75)	8.00 (4.00–10.00)	18.00 (14.00–20.00)
		p-value	**< 0.001**	**0.012**	0.875
Upper Extremities (Shoulders, elbows, wrists and hands)	***Pain occurrence in the past 12 months***	*No*	21.00 (14.50–26.00)	5.00 (3.00–9.00)	16.00 (12.00–21.00)
		Yes	24.00 (20.00–29.00)	7.00 (4.00–10.00)	18.00 (15.00–20.00)
		p-value	**< 0.001**	**0.003**	0.093
	Incapacity to work due to pain in the past 12 months	*No*	22.50 (16.00–26.00)	6.00 (4.00–9.00)	17.00 (14.00–21.00)
		Yes	25.00 (20.00–30.00)	8.00 (4.00–11.00)	18.00 (14.00–20.00)
		p-value	**< 0.001**	**0.001**	0.925
	Visit the physician due to pain in the past 12 months	*No*	24.00 (19.00–28.00)	7.00 (4.00–10.00)	17.00 (14.00–21.00)
		Yes	26.00 (18.00–32.00)	8.00 (6.00–11.00)	18.00 (15.00–21.00)
		p-value	0.261	0.076	0.485
	Pain occurrence in the past 7 days	*No*	22.00 (17.00–26.00)	6.00 (4.00–9.00)	17.00 (14.00–21.00)
		Yes	25.00 (20.00–30.00)	8.00 (4.50–10.50)	17.00 (14.00–20.00)
		p-value	**< 0.001**	**0.003**	0.732
Trunk (Upper back and lower back)	***Pain occurrence in the past 12 months***	*No*	18.00 (12.25–24.25)	5.00 (2.00–8.25))	14.50 (12.00–22.25)
		Yes	24.00 (20.00–29.00)	7.00 (3.00–10.00)	18.00 (14.00–21.00)
		p-value	**< 0.001**	**0.012**	0.179
	Incapacity to work due to pain in the past 12 months	*No*	23.00 (17.00–26.00)	6.00 (4.00–9.00)	17.00 (13.00–20.00)
		Yes	24.00 (20.00–29.00)	7.00 (4.25–10.00)	18.00 (15.00–21.00)
		p-value	**0.003**	**0.013**	0.168
	Visit the physician due to pain in the past 12 months	*No*	24.00 (18.00–28.00)	7.00 (4.00–10.00)	17.00 (14.00–20.00)
		Yes	26.00 (19.50–29.00)	9.00 (6.50–11.50)	19.00 (14.50–21.00)
		p-value	0.370	**0.047**	0.312
	Pain occurrence in the past 7 days	*No*	22.00 (16.00–26.00)	6.00 (4.00–9.00)	16.00 (13.00–21.00)
		Yes	24.00 (20.00–29.00)	7.00 (4.00–10.00)	18.00 (15.00–21.00)
		p-value	**0.001**	**0.015**	0.090
Lower Extremities (Hips and thighs, knees, ankles and feet)	***Pain occurrence in the past 12 months***	*No*	22.00 (17.00–26.00)	6.00 (4.00–9.00)	17 (14.00–20.50)
		Yes	25.00 (20.00–30.00)	8.00 (5.00–10.00)	17 (14.00–21.00)
		p-value	**< 0.001**	**0.001**	0.734
	Incapacity to work due to pain in the past 12 months	*No*	23.00 (18.00–26.00)	6.00 (4.00–9.00)	18.00 (14.00–21.00)
		Yes	26.00 (22.00–30.00)	8.00 (5.00–11.00)	17.00 (14.00–20.00)
		p-value	**< 0.001**	**0.001**	0.404
	Visit the physician due to pain in the past 12 months	*No*	24.00 (18.00–27.50)	7.00 (4.00–10.00)	17.00 (14.00–20.00)
		Yes	26.00 (20.00–30.00)	8.00 (4.00–13.00)	18.00 (14.00–22.00)
		p-value	0.096	0.311	0.523
	Pain occurrence in the past 7 days	*No*	23.00 (18.00–27.00)	7.00 (4.00–9.00)	17.00 (14.00–20.00)
		Yes	25.00 (20.75–30.00)	8.00 (4.00–12.00)	17.00 (15.00–21.50)
		p-value	**0.004**	**0.016**	0.289

Q: Quartile, Bold values mean statistically significant (p < 0.05).

Table 6 Summary of generalized linear models predicting the burnout status

	Emotional Exhaustion					Depersonalization				
			95% Wald Confidence Interval					95% Wald Confidence Interval		
	B	Std. error	Lower	Upper	*p*-value	*B*	Std. error	Lower	Upper	*p*-value
Constant	20.312	7.573	5.470	35.153	**0.007**	5.978	4.796	-3.421	15.377	**0.021**
Age	-0.129	0.375	-0.864	0.607	0.732	-0.010	0.237	-0.476	0.455	0.966
Sex ***(reference: male)***	0.558	0.838	-1.084	2.201	0.505	0.046	0.495	-0.925	1.017	0.926
Clinical education level (reference: preclinical)	2.981	1.100	0.824	5.138	**0.007**	1.065	0.696	-0.298	2.429	0.126
Pain occurrence in neck in the past 12 months	3.700	0.996	1.749	5.651	**< 0.001**					
Incapacity to work due to pain in lower extremity in the past 12 months	2.584	0.822	0.972	4.196	**0.002**					
Pain occurrence in lower extremity in the past 12 months						1.620	0.505	0.630	2.610	**0.001**
Adjusted R^2	0.190					0.100				

Std.: Standard; B: unstandardized regression coefficient. Bold values mean statistically significant (p < 0.05).

Effects of work-related musculoskeletal symptoms on burnout status

Table 6 summarizes the results of the regression analyses examining the effects of WMSs and other independent variables on burnout dimensions. Personal accomplishment was excluded from the main regression model due to the absence of statistically significant associations with the predictors; however, the results for this subscale are provided in the **Supplementary Material** to ensure completeness.

The regression coefficients (*B*) reported in Table 6 represent adjusted estimates, controlling for age, sex, clinical education level, and WMS-related variables. The final model predicting emotional exhaustion statistically significant overall fit (Likelihood Ratio Chi-Square = 53.275, df = 5, $p = 0.001$; Akaike Information Criteria = 1638.1), accounting for approximately 19% of the variance in emotional exhaustion scores (adjusted $R^2 = 0.190$). Three independent variables were significantly and positively associated with emotional exhaustion: pain occurrence in the neck in the past 12 months ($B = 3.700$, $p < 0.001$), clinical education level ($B = 2.981$, $p = 0.007$), and incapacity to work due to pain in the lower extremities in the past 12 months ($B = 2.584$, $p = 0.002$). Among these, pain in the neck was the most influential predictor, indicating that students experiencing neck pain reported markedly higher levels of emotional exhaustion, independent of other factors.

Regarding depersonalization, the final model also demonstrated a significant fit (Likelihood Ratio Chi-Square = 18.763, df = 4, $p = 0.001$; Akaike Information Criterion = 1404.8), explaining approximately 10% of the variance in depersonalization scores (adjusted $R^2 = 0.100$). The only significant predictor in this model was pain occurrence in the lower extremities in the past 12 months ($B = 1.620$, $p = 0.001$), suggesting that individuals with lower extremity pain were more likely to report higher levels of depersonalization. No other variables were found to be significantly associated with depersonalization in the final model.

Discussion

Work-related musculoskeletal symptoms (WMSs) are a well-documented occupational hazard in dentistry, affecting both practitioners and students [11, 14–16]. Dental students, due to their limited experience and coping mechanisms, are particularly vulnerable to these issues [16–18]. Moreover, the demanding nature of dental education further increases their susceptibility to burnout symptoms, which is influenced by a range of internal and external stressors [52, 53]. This study investigated the associations between sociodemographic characteristics, health-related variables, and WMSs in predicting burnout among dental students. The key findings revealed that pain occurrence in the neck and lower extremities, as well as incapacity due to pain occurrence in lower extremities, significantly contributed to emotional exhaustion and depersonalization. These results highlight the pivotal role of WMSs in the development of burnout symptoms and emphasize the need for targeted interventions. Accordingly, the null hypothesis of this study was rejected.

Numerous studies have demonstrated that individuals in dentistry exhibit a higher prevalence of WMSs across various body regions compared to those in other professions [54]. Consistent evidence indicates that the neck, upper back, and lower back are the most commonly affected body regions among dental students, largely

due to the repetitive use of the hands, arms, and related musculoskeletal structures during both clinical and preclinical training [16, 55]. A study conducted among Brazilian dental students reported that over 75% experienced musculoskeletal pain or fatigue after treating a patient, with nearly half suffering from pain in multiple regions, and most not seeking medical attention [56]. Similarly, a study among Turkish dental students identified the neck, upper back, and lower back as the most frequently affected regions [16]. Another study comparing students at different academic levels found that WMSs were most prevalent in the shoulders, neck, upper back, and lower back, with higher rates among preclinical and senior clinical students [57]. Research focusing specifically on clinical dental students confirmed these trends, highlighting similar body regions as being the most commonly affected [55]. The findings of the current study are align with previous research, demonstrating that the neck, lower back, and upper back are the most frequently affected regions. These results reinforce the notion that the physical demands of dental education and clinical practice pose considerable risks to musculoskeletal health, particularly in these regions.

Burnout symptoms among dental students has been widely associated with various sociodemographic, health-related, and work-related factors. For instance, a study examining preclinical dental students—a critical phase preceding the transition to clinical education—reported a progressive increase in emotional exhaustion from the first to the third year [58]. Similarly, research conducted in Brazil found that burnout was significantly associated with academic performance, regular medication use, and thoughts of dropping out [59]. A large-scale study in Colombia highlighted that senior students, older and married individuals, those who had not completed all required courses, and students who had not initially selected dentistry as their preferred field of study were more likely to experience burnout [60]. In Korea, a study among dental students revealed high levels of both burnout and depression, with academic overload identified as a significant contributing factor [61]. In line with these findings, the present study examined the associations between burnout and various sociodemographic and health-related variables, including sex, BMI, clinical education level, parental education, smoking and alcohol consumption, medication use, and chronic disorders. Emotional exhaustion scores were significantly higher among female students (24.00, $p = 0.041$), while clinical students demonstrated significantly higher scores across all MBI subscales compared to their preclinical counterparts (25.00, $p < 0.001$ for emotional exhaustion; 8.00, $p = 0.009$ for depersonalization; 18.00, $p = 0.026$ for personal accomplishment), reflecting the heightened stress associated with clinical training. Moreover, participants with diagnosed psychiatric, musculoskeletal, and/or chronic conditions exhibited significantly elevated depersonalization scores (8.00, $p = 0.010$), further emphasizing the multifactorial origins of burnout in dental students.

Numerous studies have investigated the relationship between WMSs and burnout across various occupational groups. For instance, a study among commercial janitors found that burnout fully mediated the relationship between job demands and musculoskeletal complaints [62]. Similarly, among hospital nurses, burnout was positively associated with musculoskeletal symptoms [63]. A large-scale Norwegian study involving multiple professions—including lawyers, physicians, and teachers—also reported a positive correlation between burnout and musculoskeletal pain across all groups, with the strength of the association ranging from moderate to strong [40]. In Taiwan, research on healthcare workers identified a strong association between burnout and neck and shoulder pain [41]. Consistent with these findings, the current study demonstrated that WMSs and related symptoms significantly predict burnout among dental students. Specifically, pain in the neck and incapacity to work due to pain in the lower extremities in the past 12 months emerged as significant predictors of emotional exhaustion ($B = 3.700$, $p < 0.001$ and $B = 2.584$, $p = 0.002$), while pain in the lower extremities predicted higher levels of depersonalization ($B = 1.620$, $p = 0.001$). These results reinforce the established link between WMSs and burnout, indicating that musculoskeletal symptoms in specific body regions contribute meaningfully to burnout in dental students.

Like other occupational groups, dental students are affected by a variety of factors that contribute to burnout symptoms. This study has several limitations inherent to its scope and design. First, although it focused on spesific sociodemographic and health-related factors, it was not feasible to account for all potential contributors to burnout. Second, while psychiatric disorders are known to influence both burnout and musculoskeletal pain, the study was unable to comprehensively examine the interplay between these conditions, representing a notable limitation. Moreover, the categorization of participants' conditions into psychiatric, musculoskeletal, and/or chronic disorders may have led to some overlap or ambiguity. Additionally, the cross-sectional nature of the study limits causal inferences, and the relatively small sample size and single-center design may affect the generalizability of the findings. Despite these limitations, the study offers several strengths. The use of validated and reliable questionnaires enhances the robustness of the data, and the distinction between preclinical and clinical dental students provides valuable insights into the influence of educational stage on burnout. These findings contribute to the growing body of literature on the relationship

between WMSs and burnout in dental students and can inform future research and preventive strategies.

Conclusions

The findings of the present study demonstrate that burnout symptoms among dental students are influenced by various sociodemographic and health-related factors. Emotional exhaustion was significantly associated with being in the clinical phase of dental education, pain occurrence in neck within the past 12 months, and incapacity to work due to pain in lower extremities during the same period. Furthermore, depersonalization was significantly linked to pain occurrence in lower extremities in the past 12 months. These results underscore the substantial role of work-related musculoskeletal symptoms—particularly in the neck and lower extremities—in contributing to burnout. Understanding these associations is essential for developing targeted preventive strategies and interventions to reduce burnout and promote the well-being of dental students.

Abbreviations

BMI	Body Mass Index
GLM	General Linear Model
IBM Co.	International Business Machines Corporation
Inc.	Incorporated
IQR	Interquartile Range
MBI	Maslach Burnout Inventory
NMQ	Nordic Musculoskeletal Questionnaire
NY	New York
SD	Standard Deviation
SPSS	Statistical Package for the Social Sciences
USA	United States of America
WMSs	Work-related Musculoskeletal Symptoms

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-025-08796-5.

Supplementary Material 1

Acknowledgements

The authors extends their gratitude to dental students İlkay Doğan, Gizem Ateş, and Mehmet Can Taşdemir for their technical support and assistance throughout the study.

Author contributions

Conceptualization: Berkant Sezer; Methodology: Berkant Sezer; Formal analysis and investigation: Berkant Sezer and Duygu Sıddıkoğlu; Writing- original draft preparation: Berkant Sezer; Writing - review and editing: Berkant Sezer and Duygu Sıddıkoğlu.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

The data used in this study are available upon reasonable requests to the corresponding author (B.S.).

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethical Committee of the School of Graduate Studies, Çanakkale Onsekiz Mart University (Decision No. 07/26, March 31, 2022). The study was conducted in accordance with all ethical principles and responsibilities of the Declaration of Helsinki. Informed consent for participation was obtained from all study participants.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Clinical trials number

Not applicable.

Author details

[1]Department of Pediatric Dentistry, School of Dentistry, Çanakkale Onsekiz Mart University, Çanakkale, Türkiye
[2]Department of Biostatistics, School of Medicine, Çanakkale Onsekiz Mart University, Çanakkale, Türkiye

Received: 16 September 2023 / Accepted: 22 May 2025
Published online: 05 June 2025

References

1. Schlossmacher R, Amaral FG. Low back injuries related to nursing professionals working conditions: a systematic review. Work. 2012;41:5737–8.
2. Eyvazlou M, Asghari A, Mokarami H, Bagheri Hosseinabadi M, Derakhshan Jazari M, Gharibi V. Musculoskeletal disorders and selecting an appropriate tool for ergonomic risk assessment in the dental profession. Work. 2021;68:1239–48.
3. Lietz J, Ulusoy N, Nienhaus A. Prevention of musculoskeletal diseases and pain among dental professionals through ergonomic interventions: A systematic literature review. Int J Environ Res Public Health. 2020;17:3482.
4. Marklund S, Huang K, Zohouri D, Wahlström J. Dentists working conditions - factors associated with perceived workload. Acta Odontol Scand. 2021;79:296–301.
5. Ho TT, Hamill CS, Sykes KJ, Kraft SM. Work-related musculoskeletal symptoms among otolaryngologists by subspecialty: A National survey. Laryngoscope. 2018;128:632–40.
6. Zenbaba D, Sahiledengle B, Dibaba D, Tufa T, Mamo A, Atlaw D. Work-related musculoskeletal symptoms and associated factors among academic staff in Ethiopian universities. Environ Health Insights. 2022;16:11786302221131690.
7. Momeni Z, Choobineh A, Razeghi M, Ghaem H, Azadian F, Daneshmandi H. Work-related musculoskeletal symptoms among agricultural workers: A cross-sectional study in Iran. J Agromedicine. 2020;25:339–48.
8. Oluka CD, Obidike E, Ezeukwu AO, Onyeso OK, Ekechukwu END. Prevalence of work-related musculoskeletal symptoms and associated risk factors among domestic gas workers and staff of works department in Enugu, Nigeria: a cross-sectional study. BMC Musculoskelet Disord. 2020;21:587.
9. Al Shammari M, Hassan A, Al Dandan O, Al Gadeeb M, Bubshait D. Musculoskeletal symptoms among radiologists in Saudi Arabia: a multi-center cross-sectional study. BMC Musculoskelet Disord. 2019;20:541.
10. Tan NE, Wortz BT, Rosenberg ED, Radcliffe NM, Gupta PK. Impact of heads-up display use on ophthalmologist productivity, wellness, and musculoskeletal symptoms: A survey study. J Curr Ophthalmol. 2022;34:305–11.
11. Alnaser MZ, Almaqsied AM, Alshatti SA. Risk factors for work-related musculoskeletal disorders of dentists in Kuwait and the impact on health and economic status. Work. 2021;68:213–21.
12. Liu F, Jia N, Wu C, Sun J, Li G, Zhang H, et al. The association between adverse ergonomic factors and work-related musculoskeletal symptoms among medical staff in China: a cross-sectional study. Ergonomics. 2023;66:2212–22.
13. Soo SY, Ang WS, Chong CH, Tew IM, Yahya NA. Occupational ergonomics and related musculoskeletal disorders among dentists: A systematic review. Work. 2023;74:469–76.
14. Hayes M, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. Int J Dent Hyg. 2009;7:159–65.

15. Leggat PA, Kedjarune U, Smith DR. Occupational health problems in modern dentistry: a review. Ind Health. 2007;45:611–21.
16. Sezer B, Kartal S, Sıddıkoğlu D, Kargül B. Association between work-related musculoskeletal symptoms and quality of life among dental students: a cross-sectional study. BMC Musculoskelet Disord. 2022;23:41.
17. Hashim R, Salah A, Mayahi F, Haidary S. Prevalence of postural musculoskeletal symptoms among dental students in united Arab Emirates. BMC Musculoskelet Disord. 2021;22:30.
18. Valachi B, Valachi K. Preventing musculoskeletal disorders in clinical dentistry: strategies to address the mechanisms leading to musculoskeletal disorders. J Am Dent Assoc. 2003;134:1604–12.
19. Thornton LJ, Barr AE, Stuart-Buttle C, Gaughan JP, Wilson ER, Jackson AD, et al. Perceived musculoskeletal symptoms among dental students in the clinic work environment. Ergonomics. 2008;51:573–86.
20. Felemban RA, Sofi RA, Alhebshi SA, Alharbi SG, Farsi NJ, Abduljabbar FH, et al. Prevalence and predictors of musculoskeletal pain among undergraduate students at a dental school in Saudi Arabia. Clin Cosmet Investig Dent. 2021;13:39–46.
21. Pejčić N, Petrović V, Đurić-Jovičić M, Medojević N, Nikodijević-Latinović A. Analysis and prevention of ergonomic risk factors among dental students. Eur J Dent Educ. 2021;25:460–79.
22. Galaiya R, Kinross J, Arulampalam T. Factors associated with burnout syndrome in surgeons: a systematic review. Ann R Coll Surg Engl. 2020;102:401–7.
23. Maresca G, Corallo F, Catanese G, Formica C, Lo Buono V. Coping strategies of healthcare professionals with burnout syndrome: A systematic review. Med (Kaunas). 2022;58:327.
24. Gil-Calderón J, Alonso-Molero J, Dierssen-Sotos T, Gómez-Acebo I, Llorca J. Burnout syndrome in Spanish medical students. BMC Med Educ. 2021;21:231.
25. Velando-Soriano A, Ortega-Campos E, Gómez-Urquiza JL, Ramírez-Baena L, De La Fuente EI. Cañadas-De La Fuente GA. Impact of social support in preventing burnout syndrome in nurses: A systematic review. Jpn J Nurs Sci. 2020;17:e12269.
26. Ge MW, Hu FH, Jia YJ, Tang W, Zhang WQ, Chen HL. Global prevalence of nursing burnout syndrome and Temporal trends for the last 10 years: A meta-analysis of 94 studies covering over 30 countries. J Clin Nurs. 2023;32:5836–54.
27. Hämmig O. Explaining burnout and the intention to leave the profession among health professionals - a cross-sectional study in a hospital setting in Switzerland. BMC Health Serv Res. 2018;18:785.
28. Bridgeman PJ, Bridgeman MB, Barone J. Burnout syndrome among healthcare professionals. Am J Health Syst Pharm. 2018;75:147–52.
29. Pradas-Hernández L, Ariza T, Gómez-Urquiza JL, Albendín-García L, De la Fuente EI. Cañadas-De La Fuente GA. Prevalence of burnout in paediatric nurses: A systematic review and meta-analysis. PLoS ONE. 2018;13:e0195039.
30. Dyrbye LN, Varkey P, Boone SL, Satele DV, Sloan JA, Shanafelt TD. Physician satisfaction and burnout at different career stages. Mayo Clin Proc. 2013;88:1358-67.
31. O'Connor P, Lydon S, O'Dea A, Hehir L, Offiah G, Vellinga A, et al. A longitudinal and multicentre study of burnout and error in Irish junior Doctors. Postgrad Med J. 2017;93:660–4.
32. Sajjadi S, Norena M, Wong H, Dodek P. Moral distress and burnout in internal medicine residents. Can Med Educ J. 2017;8:e36–43.
33. Alqahtani NH, Abdulaziz AA, Hendi OM, Mahfouz MEM. Prevalence of burnout syndrome among students of health care colleges and its correlation to musculoskeletal disorders in Saudi Arabia. Int J Prev Med. 2020;11:38.
34. Ioannis DA, Pavlina P, Cleo V, George B. Cross-sectional survey on burnout and musculoskeletal disorders in Greek and Cypriot occupational therapists. Occup Ther Ment Health. 2020;36:291–302.
35. Schultz G, Mostert K, Rothmann I. Repetitive strain injury among South African employees: the relationship with burnout and work engagement. Int J Ind Ergon. 2012;42:449–56.
36. Engelbrecht GJ, de Beer LT, Schaufeli WB. The relationships between work intensity, workaholism, burnout, and self-reported musculoskeletal complaints. Hum Factor Ergon Man. 2020;30:59–70.
37. Crego A, Carrillo-Diaz M, Armfield JM, Romero M. Stress and academic performance in dental students: the role of coping strategies and examination-related self-efficacy. J Dent Educ. 2016;80:165–72.
38. Khanagar SB, Al-Ehaideb A, Jamleh A, Ababneh K, Maganur PC, Vishwanathaiah S, et al. Psychological distress among undergraduate dental students in Saudi Arabia and its coping strategies-A systematic review. Healthc (Basel). 2021;9:429.
39. Gholami T, Pahlavian AH, Akbarzadeh M, Motamedzade M, Moghaddam RH. The role of burnout syndrome as a mediator for the effect of psychosocial risk factors on the intensity of musculoskeletal disorders: a structural equation modeling approach. Int J Occup Saf Ergon. 2016;22:283–90.
40. Langballe EM, Innstrand ST, Hagtvet KA, Falkum E, Gjerløw Aasland O. The relationship between burnout and musculoskeletal pain in seven Norwegian occupational groups. Work. 2009;32:179–88.
41. Chen YH, Yeh CJ, Lee CM, Jong GP. Mediation effect of musculoskeletal pain on burnout: sex-related differences. Int J Environ Res Public Health. 2022;19:12872.
42. Chen YH, Yeh CJ, Pan LF, Jong GP. Relationships between alcohol use, musculoskeletal pain, and work-related burnout. Med (Kaunas). 2022;58:1022.
43. Deng H, He D, Li F. Factors influencing job burnout and musculoskeletal disorders among coal miners in the Xinjiang Uygur autonomous region. Pain Res Manag. 2021;2021:6629807.
44. Tuna R, Eskin Bacaksiz F, Kahraman B. Compassion satisfaction, compassion fatigue, burnout, working environments, and musculoskeletal disorders among nurses. Perspect Psychiatr Care. 2022;58:2321–9.
45. World Medical Association Declaration of Helsinki. Ethical Principles for Medical Research involving human subjects. https://www.wma.net/wpcontent/uploads/2018/07/DoH-Oct2008.pdf. Accessed 03 Sep 2023.
46. Sezer B, Kolay D, Şen Yavuz B, Güneyligil Kazaz T, Kargül B. Motivations, attitudes for choosing dental profession and preferred dental specialties amongst Turkish dental students. Eur J Dent Educ. 2022;26:422–33.
47. Centers for Disease Control and Prevention, Living H. About Adult Body Mass Index. https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html. Accessed 03 Sep 2023.
48. Kahraman T, Genç A, Göz E. The nordic musculoskeletal questionnaire: cross-cultural adaptation into Turkish assessing its psychometric properties. Disabil Rehabil. 2016;38:2153–60.
49. Brady KJS, Ni P, Sheldrick RC, Trockel MT, Shanafelt TD, Rowe SG, et al. Describing the emotional exhaustion, depersonalization, and low personal accomplishment symptoms associated with Maslach burnout inventory subscale scores in US physicians: an item response theory analysis. J Patient Rep Outcomes. 2020;4:42.
50. Maslach C, Jackson S, Leiter M. Maslach Burnout Inventory manual. http://www.researchgate.net/profile/Christina_Maslach/publication/277816643_The_Maslach_Burnout_Inventory_Manual/links/5574dbd708aeb6d8c01946d7.pdf Accessed 25 Jun 2021.
51. Cam O. The burnout in nursing academicians in Turkey. Int J Nurs Stud. 2001;38:201–7.
52. Korkmaz C, Dikicier S, Atay A. Assessment of burnout level among clinical dental students during the COVID-19 pandemic. BMC Med Educ. 2023;23:767.
53. Jiménez-Ortiz JL, Islas-Valle RM, Jiménez-Ortiz JD, Pérez-Lizárraga E, Hernández-García ME, González-Salazar F. Emotional exhaustion, burnout, and perceived stress in dental students. J Int Med Res. 2019;47:4251–9.
54. ZakerJafari HR, YektaKooshali MH. Work-related musculoskeletal disorders in Iranian dentists: A systematic review and meta-analysis. Saf Health Work. 2018;9:1–9.
55. Singh VP, Nettem S, Kyaw Soe HH, Babji NAB, Sahari AIB, Yusof LSBM, et al. Perception of risk factors at work associated with musculoskeletal symptoms in dental students of Melaka, Malaysia: A cross-sectional study. Work. 2022;73:969–76.
56. de Carvalho MV, Soriano EP, de França Caldas A Jr, Campello RI, de Miranda HF, Cavalcanti FI. Work-related musculoskeletal disorders among Brazilian dental students. J Dent Educ. 2009;73:624–30.
57. Rayyan MR, Hetou SC, Al Salem RF, Tokhtah HA, Alrajhi AD, Mohamed LH, et al. Work-related musculoskeletal disorders among dental students of different academic levels. J Int Oral Health. 2016;8:471–5.
58. Atalayin C, Balkis M, Tezel H, Onal B, Kayrak G. The prevalence and consequences of burnout on a group of preclinical dental students. Eur J Dent. 2015;9:356–63.
59. Campos JA, Jordani PC, Zucoloto ML, Bonafé FS, Maroco J. Burnout syndrome among dental students. Rev Bras Epidemiol. 2012;15:155–65.
60. Mafla AC, Villa-Torres L, Polychronopoulou A, Polanco H, Moreno-Juvinao V, Parra-Galvis D, et al. Burnout prevalence and correlates amongst Colombian dental students: the STRESSCODE study. Eur J Dent Educ. 2015;19:242–50.
61. Kwak EJ, Ji YA, Baek SH, Baek YS. High levels of burnout and depression in a population of senior dental students in a school of dentistry in Korea. J Dent Sci. 2021;16:65–70.

62. Lee W, Yragui NL, Anderson NJ, Howard N, Lin JH, Bao S. The job demand-control-support model and work-related musculoskeletal complaints in daytime and nighttime janitors: the mediating effect of burnout. Appl Ergon. 2022;105:103836.
63. Jaworek M, Marek T, Karwowski W, Andrzejczak C, Genaidy AM. Burnout syndrome as a mediator for the effect of work-related factors on musculoskeletal complaints among hospital nurses. Int J Ind Ergon. 2010;40:368–75.

Publisher's note