




ORIGINAL ARTICLE / ORIJİNAL MAKALE

Evaluation of the working posture and upper extremity musculoskeletal complaints among dentistry students

Diş hekimliği öğrencilerinde çalışma postürlerinin ve üst ekstremitelerde kas iskelet sistemi şikayetlerinin değerlendirilmesi

 Nurcan Altaş^a,  Zeynep Çukurova Yılmaz^b,  Erdem Veli Uzun^c

^a Asst. Prof., İstanbul Medipol University, Faculty of Dentistry, Department of Periodontology, İstanbul, Turkey.

^b Asst. Prof., İstanbul Medipol University, Faculty of Dentistry, Department of Oral and Maxillofacial Surgery, İstanbul, Turkey.

^c PhD., İstanbul Medipol University, Faculty of Dentistry, Department of Periodontology, İstanbul, Turkey.

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ABSTRACT

Objective: The prevalence of musculoskeletal disorders (MSDs) among dentists is high and adversely affects the quality of life. In this study, we aimed to evaluate musculoskeletal complaints, working postures, and the risk of MSDs among dentistry students across different departments. **Methods:** 180 dentistry students were divided into six groups according to their departments. For evaluation of the musculoskeletal complaints, we used the standardized Nordic musculoskeletal disorders questionnaire. The working postures and the potentiality of MSDs were evaluated using the 'Rapid Upper Limb Assessment' (RULA). **Results:** We found that 92.8% of the students had musculoskeletal pain during the last 12 months, and the highest prevalence of symptoms was reported for the neck (68.3%) and the upper back (62.2%). The mean RULA score of the students was 5.02 ± 1.31 , indicating a high risk of MSDs. The highest RULA mean score was in the pedodontics group. **Conclusion:** Our study found a high prevalence of musculoskeletal complaints and high RULA scores among all the dentistry students. Therefore, ergonomic solutions should be developed to regulate their working postures according to the relevant department to prevent future disorders and if necessary, students should encourage to seek professional medical help.

Keywords: Dental Students, ergonomics, musculoskeletal pain, RULA

Correspondence: Nurcan ALTAŞ, İstanbul Medipol University, Faculty of Dentistry, Department of Periodontology, İstanbul, Türkiye.

E-mail: naltas@medipol.edu.tr **Tel:** +90 212 444 70 44

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ÖZ

Amaç: Diş hekimleri arasında kas-iskelet sistemi (KIS) rahatsızlıklarının görülme sıklığı yüksektir ve yaşam kalitesini olumsuz etkilemektedir. Bu çalışmanın amacı farklı branşlarda çalışan diş hekimliği öğrencilerinde KIS ile ilgili şikayetleri, öğrencilerin çalışma postürlerini ve KIS rahatsızlıklarının gelişme riskini değerlendirmektir. **Yöntem:** 180 diş hekimliği öğrencisi bölümlerine göre altı gruba ayrıldı. Kas-iskelet sistemi şikayetlerinin değerlendirilmesi için, standardize edilmiş İskandinav kas-iskelet sistemi hastalıkları anketi kullanıldı. Çalışma duruşları ve KIS rahatsızlıklarının gelişim potansiyeli “Hızlı Üst Ekstremitte Değerlendirmesi” (RULA) kullanılarak değerlendirildi. **Bulgular:** Diş hekimliği öğrencilerinin 92.8%’i son 12 ay içinde kas-iskelet sistemi ağrısı yaşamıştır ve en fazla semptom boyunda (68.3%) ve üst sırtta (62.2%) bildirilmiştir. Öğrencilerin ortalama RULA skoru 5.02 ± 1.31 olup KIS hastalıkları için ‘yüksek risk’ olarak kategorize edilmişti. En yüksek RULA skor ortalaması pedodonti bölümünde bulunmuştur. **Sonuç:** Çalışmamız, öğrencilerde yüksek oranda KIS şikayetleri ve yüksek RULA skorları bulmuştur. Bu nedenle ileride oluşabilecek rahatsızlıkları önlemek için çalışma duruşlarını ilgili bölüme göre düzenleyecek ergonomik çözümler geliştirilmeli ve gerekirse öğrenciler profesyonel tıbbi yardım almaya teşvik edilmelidir.

Anahtar Kelimeler: Diş hekimliği öğrencileri, ergonomi, kas-iskelet ağrısı, RULA

Introduction

Work-related musculoskeletal disorders (MSDs) are one of the most common occupational health problems worldwide and develop as a result of injury to the bones, muscles, tendons, joints, and supporting structures. Symptoms of MSDs are pain, stiffness, swelling, numbness, and tingling, and may be exacerbated by some tasks such as lifting, pushing, and pulling.¹ Dentists are at higher risk of MSDs than other medical professionals due to their improper repetitive movements in static positions, awkward postures, and long working hours without rest periods.²

When sitting or working in an unsupported position on a conventional chair for a long time, the natural “s” shape curve of the upper body tends to convert the spine into a “c” shape so that collapse is monitored.³ This flexible, kyphosis posture that will be encountered during work life for several years is not suitable for postural health. In contrast, maintaining the natural curvature of the lumbar spine while sitting is known to reduce intradiscal pressure, ligament tension, and thus disc degeneration.⁴ Haddad et al.

found that combined chest and arm supports were effective in reducing a dentist’s muscle activity levels in the trapezius muscle while working in the sitting position.⁵

Many postural faults among dentists are caused by craning and/or excessive bending and twisting of the neck, bending forward from the waist, elevation of shoulders, and general bending or twisting of the back and neck. Limited workspace and scope of movement in dental clinics and limited visual field access to the oral cavity lead to a high risk of neck and lower backache. Incorrect posture will lead to MSDs, which result in a reduction in the productivity of dentists. It is necessary to prioritize musculoskeletal comfort in dental trainees or dental practitioners.

The prevalence of MSDs among dentists ranges between 63% and 92% and affects mostly the lower back (36.3–60.1%) and the neck (19.8–85.0%).^{6,7} Chronic pain, spasm, or stiffness of joints in some parts of the body may adversely affect dentists’ quality of lives and job performances. Cumulative physiological damage can also lead to the

early resignation of dentists.^{8,9} According to Brown et al., the most common cause of retirement due to ill health among dentists is MSDs.¹⁰

Similarly, dentistry students also experience muscular pain and fatigue in their educational lives due to inappropriate working postures, inadequate ergonomic factors, and lack of awareness about proper working postures.¹¹ Caballero et al. reported that 80% of a sample of 83 dentistry students suffered from muscular pains.¹² Another study showed that 33% of a sample of 82 dentistry students had lower back pain, 28% had neck pain, and 10% had both.¹³

Different results have been obtained in previous studies that were conducted in different branches of dentistry. In some studies, the riskiest departments for MSDs were endodontics and reconstruction, while some studies found that the most pain was experienced by dentists working in endodontics and pedodontics. Other studies showed that dentists working in surgery or prosthodontics reported the most pain.¹⁴⁻¹⁶ As the results of the studies evaluating working postures in different departments were controversial, this study was designed to investigate the prevalence of musculoskeletal complaints, analyze working postures, and assess the risk of development of MSDs in the upper limbs across different dentistry departments. The results could be used to develop ergonomic interventional programs for the prevention of MSDs during dental education and for the improvement of dentists' working conditions.

Methods

This cross-sectional study was granted ethical approval by the Ethical Committee of Medipol University of Medical Sciences (Protocol number: 10840098-604.01.01-E.12596, Decision Date: 22.03.2019) and was conducted in accordance with the guidelines of the Helsinki Declaration of 1975, as revised in 2000. All the fourth- and fifth-grade dentistry students who were present at the day of study were considered as the sample size. A total of 218 students with clinical experience, randomly selected

through the lottery method, participated in this study. Before determining the study groups, conditions and diseases that may have affected pain were evaluated. Subjects were excluded from the study if they had been diagnosed with MSDs such as arthritis or chronic backache, any trauma to spinal regions such as whiplash injury, surgical operations in upper extremities, and any conditions or deformities that may have had adverse effects on the spine such as kyphosis in the past year. To achieve data standardization, left-handed students were not included in this study and additionally, students who did not want to cooperate in completing the questionnaire were also not included. Out of the 218 participants, 180 met the inclusion criteria. All students and the patients treated by these students signed written informed consent forms before starting the study. Confidentiality and privacy were guaranteed during the entire study.

Subjects were divided into six groups according to their departments (Endodontics=E Group, n=30; Conservative Dentistry=CD Group, n=30; Periodontics=PR Group, n=30; Oral and Maxillofacial Surgery=OMS Group, n=30; Prosthodontics=PS Group, n=30; and Pedodontics=PD Group, n=30), and all the participants in the same groups performed similar procedures according to their department during the first month of their clinical practice. In the E group, students performed root canal therapy for 1 month; in the CD Group, students restored caries with composite restorations; in the PR Group, students performed scaling and root planning; in the OMS Group, students performed extractions; in the PS Group, students performed tooth preparations; and in the PD group, students undertook pulpotomy procedures. These procedures were the most frequently performed in each department and were chosen by the course director. Dental equipment such as a dental chair, seat, and light reflector was adjusted according to individual measurements of each participant.

Each student at the clinic completed a questionnaire of personal and occupational

characteristics including sex, age, education year, height and weight, daily working and sleeping hours, and exercising information. In this study, regular exercise refers to physical activities such as walking or swimming for at least half an hour a day, more than 3 hours per week.¹⁷ We used the standardized Nordic musculoskeletal disorders questionnaire (NMQ) to evaluate the musculoskeletal complaints such as pain and discomfort in nine different body parts (neck, shoulders, upper back, lower back, elbows, wrist/hand, hips/thighs, knees, and ankles/feet) during the past 12 months and 1 week, and number of visits to the doctor and daily activity limitations owing to musculoskeletal complaints during the past 12 months.¹⁸ The NMQ was voluntarily completed in five minutes by students in the lecture theater under the observation of researcher 1. The reliability and validity of the Turkish version of the NMQ had already been confirmed (Cronbach's alpha=0.896).¹⁹

We used the Rapid Upper Limb Assessment (RULA) to evaluate the working postures and the potentiality of upper extremity MSDs of each student.²⁰ All the students were videotaped with a smartphone using a tripod from the front, left, and right angles by researcher 2 while they were treating patients. The videos were then examined for 15 minutes, and the longest-running posture for each procedure was evaluated by researcher 3, who was trained by a physical therapist for one week.²¹

RULA is one of the observational methods used to analyze work postures and was developed to reveal upper limb disorders related to work.²² This tool was developed based on a scoring system to evaluate the

working postures of workers exposed to musculoskeletal loads that may cause upper limb disorders. The posture to be evaluated can be chosen according to the most frequent working position or the posture where the highest loads occur. In our study, most sustained posture was selected for evaluation. Based on this method, we divided body limbs into two groups: A, consisting of the upper arm, lower arm, and wrist; and B, consisting of the neck, trunk, and legs. After noting scores for groups A and B, we separately added the muscle use score and the exerted force scores to Score A and Score B, and then we obtained a final score that ranged from 1 to 7 (Table 1).²⁰ The reliability and validity of the Turkish version of the RULA had been already confirmed.²³

In this study, we performed the statistical analyses using the Number Cruncher Statistical System 2007 Statistical Software (Utah, USA). In addition to descriptive statistical methods (mean, standard deviation), we used the Shapiro-Wilk normality test to evaluate the distribution of the variables. We used the one-way ANOVA test to compare variables showing normal distributions and Newman Keuls test for subgroup comparisons. We used the chi-square test for the comparisons of the qualitative data. The results were evaluated at significance levels of $p < 0.05$.

Results

This study was carried out among 180 dentistry students in Istanbul, Turkey, 70 of which were male (38.9%) and 110 of which were female (61.1%). The personal characteristics and working hours of the subjects are presented in Table 2. Based on the data collected, 38.3% of the participants

Table 1: RULA action levels

RULA Score	Action Level	Risk Level	Action
1-2	1	Low	Acceptable working postures.
3-4	2	Moderate	Further investigation is needed, and changes may be required.
5-6	3	High	Investigation and changes are required soon.
7	4	Very High	Investigation and changes are required immediately.

RULA- Rapid Upper Limb Assessment

had a regular (at least weekly) exercise program, and 61.7% were not exercising regularly. Based on the body mass index (BMI) values, 14 participants (7.7%) were underweight, 132 participants (73.3%) were of normal weight, 25 participants (13.8%) were overweight, and 9 participants (5.0%) were obese.

Figure 1 shows the prevalence, in percentage, of the complaints concerning different body parts and activity limitations in the past 12 months. Musculoskeletal complaints were reported by the study subjects in the following body parts: the neck (68.3%), the upper back (62.2%), the shoulders (57.8%), the lower back (53.3%), the wrists (38.9%), and the knees (20%). The overall prevalence of musculoskeletal complaints and activity limitations among the students

were estimated to be 92.8% and 48.3%, respectively.

Figure 2 shows the number of visits to the doctor, in percentage, owing to musculoskeletal complaints in the past 12 months. According to the results, 34% of the students visited the doctor, mostly because of discomfort in the lower back (16.1%) and neck (15%). The thighs, ankles, and elbows had the lowest prevalence of discomfort as well as experienced the lowest activity limitations; the number of visits to the doctor for discomfort in these regions was also the least.

The results showed that 40.6% of participants had a final RULA score of 3–4, which indicates a moderate-level risk of developing MSDs. In contrast, 45.6% of

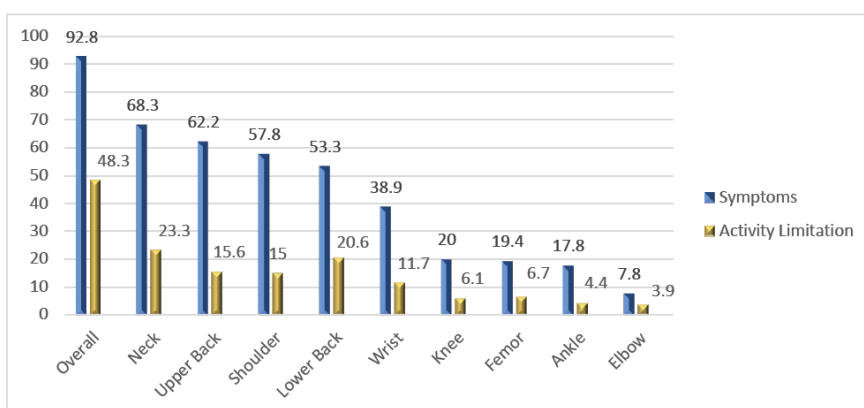


Figure 1: Prevalence of musculoskeletal complaints and daily activity limitations in the participants (n=180) in the past 12 months.

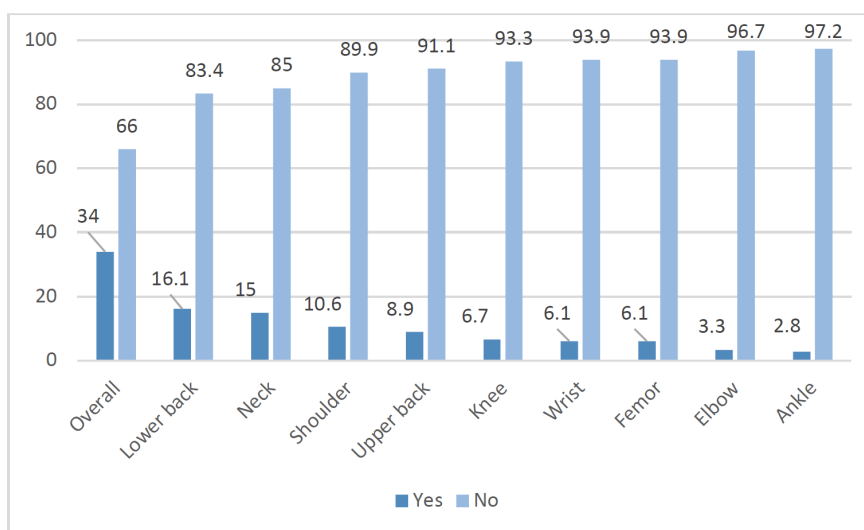


Figure 2: Percentage of visits to doctors due to musculoskeletal complaints for different body parts.

Table 2: Demographic data of the participants

Variables	Mean±SD	Median	Minimum	Maximum
Age (year)	23.4±1.56	23	21	35
Height (cm)	171±0.09	1.7	1.5	1.99
Weight (kg)	66.6±14.9	63	45	126
BMI	22.7±3.77	22.11	16.14	41.62
Work hours per week	14.6±4.79	15	4	30
Sleeping hours in a day	6.97±1.27	7	2	14

participants had a high-level risk, and 13.9% of them had a very high-level risk of developing MSDs. The mean RULA score of the students was 5.02 ± 1.31 , also indicating a high risk of MSDs. There was no significant relationship between the RULA scores and gender ($p=0.984$), BMI ($p=0.272$), exercising ($p=0.165$), weekly hours of work ($p=0.729$), and sleeping hours ($p=0.282$).

Table 3 shows the relationship between the musculoskeletal complaints in different parts of the body and the risk levels from the RULA scores. Table 4 shows the RULA mean values and risk levels for the students based on clinical activities they undertook. The PD group had the highest RULA score, whereas the PS and PR groups had the lowest scores.

According to the multiple comparison test, the mean RULA score for the PS group was significantly lower than that of the PD ($p=0.001$), E ($p=0.023$), CD ($p=0.006$), and OMS groups ($p=0.006$). The mean RULA score of the PR group was found to be significantly lower than the PD Group ($p=0.017$). However, no significant differences were found between the other groups.

Discussion

Our study indicated that 92.8% of the dental students suffered from work-related musculoskeletal complaints during the last 12 months and the highest prevalence of symptoms among students were reported for the neck (68.3%), the upper back (62.2%), and the shoulders (57.8%), findings

Table 3: The relationship between musculoskeletal complaints in different body parts during the last 12 months and the RULA risk levels

Body Part		Modarete Risk Level	High Risk Level	Very High Risk Level	p			
Neck	No	15	20.6%	30	36.6%	12	48.0%	<0.05
	Yes	58	79.5%	52	63.4%	13	52.0%	
Shoulder	No	30	41.1%	30	36.6%	16	64.0%	0.052
	Yes	43	58.9%	52	63.4%	9	36.0%	
Upper Back	No	32	43.8%	27	32.9%	9	36.0%	0.369
	Yes	41	56.2%	55	67.1%	16	64.0%	
Elbow	No	67	91.8%	75	91.5%	24	96.0%	0.747
	Yes	6	8.2%	7	8.5%	1	4.0%	
Wrist	No	41	56.2%	50	61.0%	19	76.0%	0.214
	Yes	32	43.8%	32	39.0%	6	24.0%	
Lower Back	No	27	37.0%	40	48.8%	17	68.0%	<0.05
	Yes	46	63.0%	42	51.2%	8	32.0%	
Thighs	No	57	78.1%	65	79.3%	23	92.0%	0.292
	Yes	16	21.9%	17	20.7%	2	8.0%	
Knees	No	60	82.2%	62	75.6%	22	88.0%	0.332
	Yes	13	17.8%	20	24.4%	3	12.0%	
Ankle	No	60	82.2%	65	79.3%	23	92.0%	0.346
	Yes	13	17.8%	17	20.7%	2	8.0%	

*, Chi square test; †, RULA—Rapid Upper Limb Assessment

Table 4: The risk levels of musculoskeletal disorders and the need for corrective actions in dentistry students in different fields

	N	Mean Rula Score	Risk Level	Action
Pedodontics	30	5.53	High	Necessary
Endodontics	30	5.33	High	Necessary
Conservative dentistry	30	5.33	High	Necessary
Oral Surgery	30	5.20	High	Necessary
Periodontics	30	4.50	Moderate	May be necessary
Prosthodontists	30	4.20	Moderate	May be necessary
p	0.0001			

*, One-way ANOVA; †, RULA—Rapid Upper Limb Assessment

which are consistent with those of previous studies.^{8,24} Our study showed that neck pain was the most common complaint and caused more activity limitations during the past 12 months among students. However, Hosseini et al. and Valachi et al. pointed out that the body parts of dentists mostly affected by MSDs were the wrists, the upper back, and the elbows.^{17,25} The authors associated the higher hand-wrist complaints in dentists, who use their hands more frequently than other occupations, with the repetitive and constant exposure of this part of the body to high forces. Except for the upper back, the high prevalence of wrist and elbow complaints were inconsistent with our findings. The different findings in our study are probably due to the fact that the students have been treating patients in a very short time. Hand-wrist complaints are likely to increase as the duration of patient care increases.

The frequency of pain in the neck and shoulders results from the difficulties in practicing dentistry and working postures. Leaning forward at an angle of 15° to 30° or raising the shoulders for a long time exerts excess pressure on the neck and shoulders.^{26,27} Additional muscular strain is required for static positions, which may result in the inhibition of blood flow and reduced tissue recovery. If static strains persist for a long time, injury risk of muscles, joints, and other tissues increases.²⁸

In our study, exercising regularly did not show any significant relationship with the RULA scores, which was contrary to findings in previous studies by Shirzaei et al. and Katez et al.^{9,29} They reported that regular exercise

has a protective effect against MSDs of the upper body. This may be due to the broad categorization of the term 'exercise' rather than subcategorizing into activities like spinning, pilates, jogging, and bodybuilding. In this study, the RULA scores were not associated with gender, BMI, working hours, or sleeping hours, which was consistent with the study by Lindfors et al.³⁰ However, Rafie et al., Pejicic et al., and Bylund et al. found that the presence of pain was significantly higher among female dentists, which may have been associated with the lower muscle volume and strength in females, and among dentists who had long working hours and sleeping problems.^{14,31,32} Although the number of women in our study was higher than that of men, this association was not found in our study. This may be because all participants were in the fourth and fifth grade of their dentistry courses and had just begun their clinical practice. Additionally, it has been reported that most of the dentists work an average of 8 hours a day.²⁴ In our study, dental students work an average of 14.5 hours per week. Therefore, MSDs may not have fully emerged due to shorter working hours compared to dentists.

Shirzaei et al. evaluated the ergonomic factors of 60 dentistry students using a rapid entire body assessment method (REBA), which is another tool for determining the risks of MSDs.⁹ The REBA score was highest for those in the endodontics department and lowest for those in the reconstructive department. This study revealed that the highest RULA mean scores were in the PD, E, and CD group (Table 4). Another study involving 199 students reported similar results to our

study as greater pain was noted in dentists working in the endodontics and pedodontics fields.¹⁶

The high RULA scores in pediatric dentistry could be associated with difficulties in controlling and positioning the child during treatments.⁷ High scores in the endodontic department could be due to increased bending from the normal position to gain a better vision and high stress levels during root canal treatments.^{12,33}

In the studies by Rafie et al. and Varmazyar et al., the highest prevalence of MSDs occurred in the surgery and prosthodontics groups and may have been associated with the stressful and static work done by dentists in these settings.^{14,15} In our study, even though the MSD risk level for dentists in the surgery department was high, the risk level for those in the prosthodontics department was moderate. The fact that most teeth preparations are made in the anterior region could explain the low risk of MSDs in dentists in the prosthodontics group. The neck and shoulders could remain in relatively appropriate positions while conducting prosthodontics procedures.

When the musculoskeletal complaints in different body parts were compared with the RULA risk levels, 47.2% (n=58) of the students with complaints in the neck had a moderate risk level and 42.3% (n=52) had a high risk (Table 3). These rates were 36.6% (n=41) and 49.1% (n=55) for the upper back, and 41.3% (n=43) and 50% (n=52) for the shoulder, respectively. According to these results, necessary ergonomic changes should be made and working posture should be improved in body regions where complaints are high. Final RULA scores demonstrated that the majority of dentistry students were at moderate- or high-risk levels, which means further investigation and correction may be required. This may cause work-related injuries, decrease concentration during work, and adversely affect the quality of life. Therefore, regulations are required to minimize the risk of the work-related MSDs in dentistry faculties. Gandavadi et al. observed

that the students sitting on ergonomic seats showed relatively acceptable RULA risk scores when compared with students sitting on conventional seats.²⁸ Pejčić et al. recommended massage treatments, regular physical activities, and periodic rest breaks during work to reduce the risk of MSDs.³¹

According to the results of a study conducted in the European population, approximately 12-34% of patients with musculoskeletal pain seek medical help within 1 year or more.³⁴ Similar to this study, only 34% of the students went to the doctor to treat or improve their disorders in the last year, mostly owing to pain or discomfort in the lower back and neck region.

This study has various limitations such as lack of generalizability because the sample only included Turkish dentistry students, possible confounding factors due to the convenience sampling method, social desirability bias due to the self-reported nature of the questionnaire. Relatively short working hours may also have suppressed the potential effects on MSDs.

Conclusion

In this current study, the high prevalence of musculoskeletal complaints and high RULA scores among dentistry students were found, indicating that the working postures of dentistry students should be improved. Although almost every student reported pain or discomfort in some parts of their bodies, most did not seek any professional medical help. According to this study, the neck, upper back, and shoulders were the most affected body parts, and those working in PD, E, and CD departments had the highest RULA scores. Therefore, the working postures of students should be checked and adjusted to prevent the development of MSDs, especially for those working in the aforementioned departments. Additionally, students should be encouraged to visit a medical doctor to prevent their existing discomfort from worsening. The results of this study can guide further studies in developing a comprehensive approach to solving the ergonomic problems that dentistry students

may face in their educational lives and to provide a full understanding of the basic physiological mechanisms that cause problems in routine dental practice to minimize the risk of work-related injuries in dentistry students.

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Ethical Declaration: This cross-sectional study was granted ethical approval by the Ethical Committee of Medipol University of Medical Sciences (Protocol number: 10840098-604.01.01-E.12596, Decision Date: 22.03.2019) and was conducted in accordance with the guidelines of the Helsinki Declaration of 1975, as revised in 2000.

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Author Contribution: Nurcan Altaş: Conception, design, supervision, analysis and interpretation of the data, writing and final review. Zeynep Çukurova Yılmaz: Design, data collection, and writing. Erdem Veli Uzun: Data collection, literature review, and writing. All authors read and approved the final manuscript.

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