

Original Research Article

Dental ergonomics among dental students of a teaching hospital in the Koshi Province: a questionnaire survey

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ABSTRACT

Background: The present study was conducted to assess knowledge, attitude, and practice of dental ergonomics among dental undergraduates (UGs), interns, and postgraduate students (PGs) in a teaching hospital in the Koshi province.

Methods: A cross-sectional questionnaire-based study was conducted in a tertiary care center. The questionnaire was distributed to 228 dental students to assess their knowledge, attitude, and practice related to dental ergonomics. The responses obtained were presented in terms of frequency and percentage.

Results: In the surveyed population, 211 (92.54%) students were aware of musculoskeletal disorders related to dental practice, while 175 (76.75%) students knew about dental ergonomics. The study highlights a notable prevalence (77 students; 33.8%) of musculoskeletal disorders (MSDs) among dental students, which they believed were related to their profession. Regarding habits, 144 (63.16%) students practiced both sitting and standing dentistry, while 83 (36.40%) students performed only sitting dentistry. Only 59 (25.88%) participants practiced 4-handed dentistry and 88 (52.07%) students of those who did not practice it swiveled to better access the area. The majority, 217 (95.18%) students, suggested integrating dental ergonomics into their academic curriculum, while 212 (93%) students expressed interest in participating in workshops focused on dental ergonomics.

Conclusions: The study highlights the awareness among dental students about musculoskeletal disorders and dental ergonomics. However, the notable prevalence of musculoskeletal disorders during dental practice emphasizes the importance of addressing ergonomic practices within the profession and the importance of incorporating dental ergonomics into the academic curriculum.

Keywords: Dental students, Dental education, Ergonomics, Musculoskeletal diseases, Occupational health

INTRODUCTION

The International Ergonomics Association defines ergonomics as the scientific study of the relationships between humans, main beliefs and the methods of designing workplaces to enhance human comfort and primarily system performance.¹

Dentistry is a profession characterized by clinically operational skills that are confined to a small area, specifically the mouth, which spans just a few tens of

millimeters and requires frequent strength while providing oral health. Such conditions often necessitate a prolonged and uncomfortable posture, which is a potential source of work-related musculoskeletal disorders for dentists.²

Research has shown that dentists have a high incidence of work-related musculoskeletal disorders in the neck, shoulders, upper extremities, and lower back.³ Types of work-related musculoskeletal disorders commonly reported among dental professionals include back

problems, neck, shoulder, and hand and wrist problems (Carpal Tunnel Syndrome, Guyon's Canal Syndrome, De Quervain's Disease, and Trigger Finger).⁴ Burke et al found that work-related musculoskeletal disorders were the leading cause of early retirement among dentists.⁵

Finsen et al studied the muscle activity levels of dentists engaged in three common tasks: dental examinations, tooth cleaning, and dental fillings. They found that dentists often maintain prolonged non-neutral postures and exhibit high levels of static muscular activity, which may increase the risk of musculoskeletal disorders. Since muscle activity levels were similar across all three tasks, simply alternating tasks would not effectively reduce the incidence of work-related disorders.⁶

Dental students perform the same physical tasks as licensed professional dentists. In a typical clinic setting, students can be observed reaching for various instruments, bending, twisting, and contorting their bodies to get closer to the treatment area.⁷ Hence, during the undergraduate training period, students tend to adopt habits and practices that harm their occupational health.

Therefore, the present study aims to evaluate the knowledge, attitude, and practice of ergonomics perception, practice, and attitude about dental ergonomics among dental undergraduates, interns, and postgraduate students in a dental school and to suggest necessary preventive measures to develop work-related musculoskeletal disorders in their practice.

METHODS

A descriptive cross-sectional study was carried out among students at the College of Dental Surgery, BP Koirala Institute of Health Sciences (BPKIHS) from January to March 2024, lasting a total of 3 months. Using a structured self-administered questionnaire, the research aimed to gather data on various aspects related to musculoskeletal disorders and ergonomic practices among dental students. Purposive sampling was used, including undergraduates (3rd, 4th, and final year), interns, and postgraduates. The inclusion criteria included undergraduate clinical students, interns, and postgraduate students of Dentistry at BPKIHS, while the exclusion criteria consisted of students who were unwilling to participate in the study.

The study anticipated a sample size of 228 students (134 UGs, 41 Interns, and 53 PGs), encompassing all eligible participants. The questionnaire consisted of inquiries on demographic details, knowledge, attitudes, and practices regarding ergonomic principles in dental practice. Written consent was obtained from every participant before the distribution of the questionnaire. Ethical clearance was obtained from the Departmental Research Unit, College of Dental Surgery, BPKIHS (DRU/87/023), and confidentiality of the collected data was ensured. Data were entered in Microsoft Excel 2019 and exported to the

statistical package for the social sciences (SPSS) software version 26 for statistical analysis, which encompasses descriptive statistics such as frequency, percentages, mean, median, and standard deviation. Also, data regarding participants' knowledge and understanding of dental ergonomics were tabulated and graphed.

RESULTS

A total of 228 (N) participants [134 (n₁) UGs, 41 (n₂) Interns, and 53 (n₃) PGs] responded to the questionnaire and the majority were female (127; 55.7%) (Figure 1, 2). The mean age of the study participants was 25.22±3.19 years, ranging from 20 to 36 years. Of the total participants, 77 (33.8%) students reported experiencing general health problems in recent years, which they considered were related to their profession; the majority, 61 (79.22%) students reported back pain, followed by 6 (7.79%) students reporting neck pain, while the remaining 10 (12.98%) students reported experiencing headaches, wrist pain, shoulder pain, eye strain, etc.

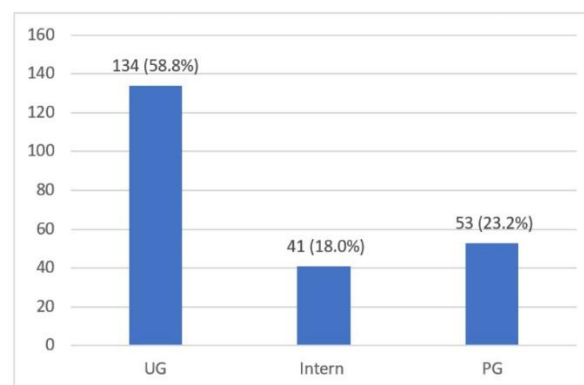


Figure 1: Total number of dental students (n=228).

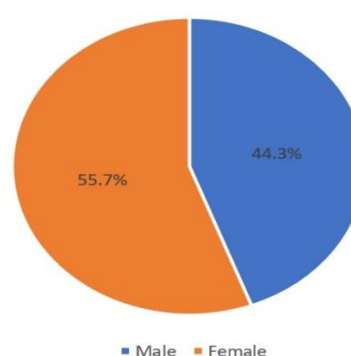


Figure 2: Gender distribution of the study population.

Of the total students, 211 (92.54%), and 175 (76.75%) students were aware of musculoskeletal disorders occurring due to dental practice and dental ergonomics, respectively. Out of the total students, undergraduate students were less aware of dental ergonomics and ergonomic exercises, as compared to the interns and PG students (Table 1).

Table 1: Knowledge about musculoskeletal disorders and dental ergonomics among dental students (n=228).

Questions	Response	UG (n ₁) (%)	Intern (n ₂) (%)	PG (n ₃) (%)	Total (%)
Are you aware of musculoskeletal disorders due to dental practice?	Yes	118 (88.06)	40 (97.56)	53 (100)	211 (92.54)
	No	16 (11.94)	1 (2.44)	0 (0.00)	17 (7.46)
Are you aware of dental ergonomics (study of human performance and work place design)?	Yes	87 (64.93)	38 (92.68)	50 (94.34)	175 (76.75)
	No	47 (35.07)	3 (7.32)	3 (5.66)	53 (23.25)
Are you aware of ergonomic exercises?	Yes	45 (33.58)	28 (68.29)	35 (66.04)	108 (47.37)
	No	89 (66.42)	13 (31.71)	18 (33.96)	120 (52.63)

Most dental students; 216 (94.74%), practiced right-handed dentistry, while 12 (5.26%) students practiced left-handed dentistry. Regarding clinical working hours, nearly half of the participants (112 students; 49.12%) spent between 5 to 8 hours, followed by 94 (41.23%) students spent less than 5 hours, and 22 (9.65%) students spent more than 8 hours. However, among the UG students, the majority of them (85 students; 63.44%), worked less than five hours per day. During a dental procedure, more than two-thirds (158 students; 69.30%) of the dental students adjusted their operating chairs according to the patient's position. Of the total, 162 (71.05%) students adjusted their chair in such a way that the mouth of their patient i.e., the working area must be at elbow level. In terms of posture in dental practice, 83 (36.40%) students exclusively practiced sitting dentistry, 144 (63.16%) students practiced both sitting and standing dentistry, and 1 (0.44%) student exclusively practiced standing dentistry. The percentage of students practicing both sitting and standing dentistry was found to be

55.22% (74 students), 90.24% (37 students), and 62.26% (33 students) among the UG, interns, and PG students, respectively.

Among dental students, 179 (78.50%) students used an operator stool with 4 to 5 casters. Interestingly, only 59 (25.88%) participants practiced 4-handed dentistry out of which 47 (79.66%) students ensured that their assistants sat with their eye level 4 to 6 inches above the clinician's. The highest number of PG students, 20 (37.74%), practiced four-handed dentistry in their clinical area as compared to UGs and Interns. Among individuals who did not practice four-handed dentistry, 88 (52.07%) students swiveled the operating chair when needing to turn for instruments or a handpiece, while 81 (47.93%) students rotated their bodies to face the treatment area. The study also found that most of the PG students, 27 (50.94%) and 30 (56.60%), do some stretching and perform exercises to relieve tension and improve posture, respectively (Table 2).

Table 2: Responses to clinical and dental ergonomic practice among dental students (n=228).

Questions	Response	UG (n ₁) (%)	Intern (n ₂) (%)	PG (n ₃) (%)	Total (%)
Are you right- or left-handed	Right	128 (92.52)	39 (95.12)	49 (92.45)	216 (94.74)
	Left	6 (4.48)	2 (4.88)	4 (7.55)	12 (5.26)
Number of clinical working hours you practice per day?	<5 h	85 (63.44)	3 (7.32)	6 (11.32)	94 (41.23)
	5-8 h	47 (35.07)	34 (82.92)	31 (58.49)	112 (49.12)
	>8h	2 (1.49)	4 (9.76)	16 (30.19)	22 (9.65)
Which one do you practice to maintain the low back curve	Sit close to the patient and position knees under the patient's chair with feet flat at the floor.	70 (52.24)	23 (56.09)	31 (58.50)	124 (54.39)
	Sit close to the patient and position knees away from the patient's chair with feet flat at the floor.	47 (35.07)	14 (34.15)	15 (28.30)	76 (33.33)
	Sit close to the patient and position knees under the patient's chair with feet at the dental stool.	8 (5.97)	1 (2.44)	5 (9.43)	14 (6.14)
	Sit close to the patient and position knees away from the patient's chair with feet flat at the dental stool	9 (6.72)	3 (7.32)	2 (3.77)	14 (6.14)

Continued.

Questions	Response	UG (n ₁) (%)	Intern (n ₂) (%)	PG (n ₃) (%)	Total (%)
Which one do you follow?	Positioning the patient first and then adjusting the operator chair.	97 (72.39)	26 (63.41)	35 (66.04)	158 (69.30)
	Adjusting operator chair first and then positioning patient.	37 (27.61)	15 (36.59)	18 (33.96)	70 (30.70)
What is your posture during treatment procedure?	Only sitting dentistry	59 (44.03)	4 (9.76)	20 (37.74)	83 (36.40)
	Only standing dentistry	1 (0.75)	0 (0.00)	0 (0.00)	1 (0.44)
	Both	74 (55.22)	37 (90.24)	33 (62.26)	144 (63.16)
Does the operator stool you use have 4 to 5 casters?	Yes	92 (68.66)	40 (97.56)	47 (88.68)	179 (78.50)
	No	42 (31.34)	1 (2.44)	6 (11.32)	49 (21.50)
Which one do you follow while working?	The patient's mouth at your elbow level	92 (68.66)	21 (51.22)	49 (92.45)	162 (71.05)
	The patient's mouth below your elbow level	42 (31.34)	20 (48.78)	4 (7.55)	66 (28.95)
Do you follow 4-handed dentistry?	Yes	30 (22.39)	9 (21.95)	20 (37.74)	59 (25.88)
	No	104 (77.61)	32 (78.05)	33 (62.26)	169 (74.12)
If yes, the assistant will be seated	With eye level 4 to 6 inches above the clinician's eye level	22 (73.33)	7 (77.78)	18 (90.00)	47 (79.66)
	With eye level 4 to 6 inches below the clinician's eye level	5 (16.67)	2 (22.22)	0 (0.00)	7 (11.86)
	With eye level at the clinician's eye level	3 (10.00)	0 (0.00)	2 (10.00)	5 (8.48)
If "No" in case if you need to turn to take instruments or hand piece while at work you	Swivel the operating chair to face the area	52 (50.00)	17 (53.13)	19 (57.58)	88 (52.07)
	Twist yourself to face the area	52 (50.00)	15 (46.87)	14 (42.42)	81 (47.93)
Do you perform your work with good access, light, and visibility?	Yes	108 (80.60)	39 (95.12)	48 (90.57)	195 (85.53)
	No	26 (19.40)	2 (4.88)	5 (11.63)	33 (14.47)
Do you perform stretching exercise during microbreaks?	Yes	64 (47.76)	26 (63.41)	27 (50.94)	117 (51.32)
	No	70 (52.24)	15 (36.59)	26 (49.06)	111 (48.68)
Do you carry out exercises to relieve tension and improve posture?	Yes	69 (51.49)	30 (73.17)	30 (56.60)	129 (56.58)
	No	65 (48.51)	11 (26.83)	23 (43.40)	99 (43.42)
Do you practice ergonomics to prevent occupational diseases?	Yes	77 (57.46)	30 (73.17)	33 (62.26)	140 (61.40)
	No	57 (42.54)	11 (26.83)	20 (37.74)	88 (38.60)

Table 3: Attitude to dental ergonomics among dental students (n=228).

Questions	Response	UG (n ₁) (%)	Intern (n ₂) (%)	PG (n ₃) (%)	Total (N) (%)
Would you like to include ergonomics in academics?	Yes	124 (92.54)	41 (100)	52 (98.11)	217 (95.18)
	No	10 (7.46)	0 (0.00)	1 (1.89)	11 (4.82)
Would you like to practice workshops on dental ergonomics?	Yes	122 (91.04)	39 (95.12)	51 (96.22)	212 (92.98)
	No	12 (8.96)	2 (4.88)	2 (3.78)	16 (7.02)

Of the total students, 217 (95.18%) students mentioned that they would like to include ergonomics in academics; while 212 (92.88%) students mentioned that they would prefer to practice workshops on dental ergonomics (Table 3).

DISCUSSION

Studies conducted in different parts of the world highlighted a greater incidence of work-related musculoskeletal disorders among dental professionals and students.⁸⁻¹⁰ Occasional back or neck pain may not raise

immediate concern; persistent pain that remains unaddressed could potentially lead to injuries or potentially career-ending disabilities.¹¹

In the current study, it was found that the majority of dental students are knowledgeable about musculoskeletal disorders (MSDs), while roughly three-fourths are aware of dental ergonomics. These findings align with previous studies conducted by Shaik et al, Garbin et al, and El-sallamy et al.¹²⁻¹⁴

In Nepal, dental students begin hands-on clinical work in their third year.¹⁵ Students in dental schools perform various procedures independently, such as scaling, restorations, extractions, and prosthetic replacements. They manage tasks such as maintaining a sterile environment, preparing materials, and processing X-rays, thus increasing the risk of musculoskeletal disorders (MSDs).¹¹

Most dental schools are equipped with adjustable doctor's stools with 4 to 5 casters, adaptable patient treatment dental chairs, and overhead operating lights for optimal visibility. Hand instruments and dental materials are placed within the reach of students, who are trained in both sitting and standing dentistry.¹¹

The human spine has four inherent curves when observed from the side: cervical lordosis, thoracic kyphosis, lumbar lordosis, and sacral kyphosis.¹⁶ These curves work together, and changes in one region affect adjacent regions. Any alteration in one curve will affect adjacent to it. The lumbar and cervical curves are generally more flexible but also more vulnerable to injury. When the lumbar curves of the spine become flattened or exaggerated, the body relies on muscles, ligaments, and soft tissues to maintain an upright posture, leading to tension in these structures. Furthermore, excessive lumbar lordosis or cervical lordosis can cause the nucleus pulposus to shift backward toward the spinal cord, weakening the posterior annulus fibrosus and increasing the likelihood of disk herniation.¹⁷

Consequently, dental students and professionals must be aware of strategies to preserve these natural spinal curves. Maintaining lumbar lordosis involves tilting the seat angle of the dental operator's stool by approximately 5° to 15°, the hips should be somewhat higher than the knees, and the patient should be closer.^{18,19} Our study found that dental students manipulate their posture sitting or standing according to the dental procedure.

Research indicates that dentists who exclusively practice sitting dentistry are more prone to experiencing severe lower back pain compared to those who alternate between standing and sitting practices.^{20,21} Anu et al carried out a similar study, in which the result showed that the majority of dental students engage in sitting and standing dentistry, which matches the study of the current investigation, where approximately two-thirds of dental students engage

in sitting and standing dentistry, while more than one-third exclusively practice sitting dentistry.¹¹ Performing treatments in a standing position engages different muscle groups compared to sitting, and alternating between these positions allows one set of muscles to rest while another set is active. Consequently, incorporating a combination of sitting and standing postures is deemed effective in mitigating the risk of muscle injuries.²²

To maintain the low back curve, it is beneficial for the dental operator to sit closer to the patient and align their knees beneath the patient's chair, if feasible. Using an operator stool in the saddle design can help with this positioning. However, in academic settings where ergonomic stools are unavailable, dental students can be taught to adjust their seats. They should ensure that their hips are positioned slightly higher than their knees and that their weight is evenly distributed by firmly placing their feet on the floor.¹¹ Despite this, only half of the dental students in the present study were observed to sit close to the patient, with their knees positioned under the patient's chair and their feet flat on the floor. Moreover, the study revealed that one in three dental students sits close to the patient while keeping their feet level on the dental stool and their knees away from the patient's chair.

To circumvent issues with sitting posture, it is advisable to adjust the operator's stool before adjusting the patient's chair.¹⁷ A frequent mistake among dental professionals is adjusting their stool after first adjusting the patient's chair. Our study yielded a similar finding, with almost two-thirds of dental students adhering to this practice.

The findings of the current study indicate that nearly one-fourth of dental students engage in 4-handed dentistry, while more than one-third of those who do not practice it instead swivel themselves to face the treatment area. Postgraduate students practiced four-handed dentistry more compared to undergraduates and interns. In a study by Longridge et al, only 49% of dental students had an experience of 4-handed dentistry.²³ Dental students perform precise procedures independently, often resulting in significant trunk twists and frequent shifts in vision to access instruments, which can be attributed to the design of the operatory. Encouraging 4-handed dentistry among dental students can be enhanced by positioning the dental assistant roughly 4 to 6 inches higher than the clinician's eye level.^{17,24} In the absence of a dental assistant, students should keep the instruments within easy reach. During procedures that require students to turn, they should pivot their stools rather than twisting their trunks.¹⁷

Studies indicate that the rise in musculoskeletal disorders (MSDs) among dentists may stem from prolonged work periods without breaks.^{4,9} Many dentists find it challenging to avoid extended static postures. However, incorporating stretching exercises that counteract these prolonged static positions can help prevent pain and musculoskeletal disorders (MSDs).¹⁶ Additionally, stress can contribute to muscle tension, emphasizing the

importance of performing stretching exercises during micro-breaks and engaging in daily yoga to alleviate stress, as suggested by studies.^{25,26} Surprisingly, approximately half of dental students do not engage in such practices, possibly due to a lack of awareness of musculoskeletal disorders (MSDs) and preventive measures.

The present study provides valuable insights into the musculoskeletal disorders (MSDs) experienced by dental students, with one-third of the participants indicating the presence of general health problems they attribute to their profession, whether as causative, exacerbating, or perpetuating factors. However, larger-scale studies in the future that focus on the prevalence of different MSDs among dental students could serve as a wake-up call for the dental community to implement preventive measures promptly. One significant limitation of the present study is its reliance on samples from a single dental institution.

CONCLUSION

The increasing occurrence of musculoskeletal disorders (MSDs) among dental professionals highlights the importance of prioritizing the practice of dental ergonomics. The majority of surveyed dental students showed an understanding of both musculoskeletal disorders and dental ergonomics. However, a significant proportion acknowledged experiencing musculoskeletal disorders while practicing dentistry. Furthermore, half of them practiced dental ergonomics and almost all would like to practice and include dental ergonomics in their curriculum.

During their undergraduate training, students often develop habits and practices that pose risks to their occupational health. Incorporating dental ergonomics into the academic curriculum would be advantageous for future dentists, offering them essential knowledge and skills to promote physical well-being and prevent MSDs.

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