

ORIGINAL ARTICLE

Knowledge, Attitude, and Practice Towards Dental Ergonomics of Undergraduate Students From Faculty of Dentistry, Manipal University College Malaysia.

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ABSTRACT

Introduction: Ergonomics, a crucial aspect in dentistry, addresses the interaction between individuals and their work environment, aiming to prevent musculoskeletal disorders (MSDs). The aim of the present study was to assess the KAP of dental students in a university college in Malaysia. **Material & methodology:** A cross-sectional study was conducted, involving 207 students from Years 2 to 5, using a self-administered validated 27-item questionnaire assessing the KAP towards ergonomics among dental students at Manipal University College Malaysia (MUCM). The KAP of various academic years was compared and association between knowledge, attitude and practice was assessed using chi-square test. Bonferroni post-hoc comparison test was done to identify which academic years are significantly different from each other. **Results:** The respondents were distributed across academic levels as follows: 25.12% in Year 2, 21.74% in Year 3, 28.50% in Year 4, and 24.64% in Year 5. Only 17.2% of students demonstrated adequate knowledge, yet 59.6% maintained a positive attitude towards ergonomics. However, a concerning 81.3% exhibited poor ergonomic practices. There was significant difference in knowledge ($p \leq 0.001$) and attitude ($p \leq 0.001$) across the years, however, difference in the practice ($p = 0.562$) was not statistically significant. A strong association was found between knowledge, attitude and practice. **Conclusion:** The knowledge of dental ergonomics among undergraduate dental students at MUCM is fair. Academic year has an influence on knowledge and attitude but not on practice. However generally students with better knowledge about dental ergonomics tend to have better attitude and practice towards the same.

Malaysian Journal of Medicine and Health Sciences (2026) 22(2): 1-7.doi:10.47836/mjmhs.v22.i2.1549

Keywords: Ergonomics, Musculoskeletal Diseases, Occupational Dentistry, Health Knowledge, Attitudes, Practice

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INTRODUCTION

Ergonomics, the science of optimizing human performance and well-being in their working environment, is crucial in professions like dentistry. Many studies between dental ergonomics and musculoskeletal disorders (MSDs) have been studied upon, which many have found MSDs to be a significant occupational hazard within the dental profession and is an issue that needs to be addressed that should be

combat with proper use of dental ergonomics [1,2]. The annual prevalence of musculoskeletal disorders in any body site ranges from 68% to 100% predominantly affecting the lower back (29% to 94.6%), shoulder (25% to 92.7%), and neck (26% to 92%). The implementation of ergonomic principles in dentistry encompasses various aspects, including the positioning of the dentist, patient, and assistant during procedures. It also involves considering posture, vision, lighting, and magnification to optimize working conditions, control and ergonomic practices in dentistry extend to the selection and use of examination, control, and working instruments.

The recommended posture for oral health professionals incorporates various elements such as the position of

the head, torso, upper arms, elbows, shoulders, wrists, fingertips, seated position, feet, and the placement of the rheostat. Important ergonomic considerations include maintaining relaxed shoulders, a straight back, and keeping the feet flat on the floor. Ergonomics can greatly improve and prevent future MSDs [3]. According to Yamalik N. in 2007, to reduce MSDs from cumulative trauma injury, ergonomics plays a vital role, as it is well known that balanced musculoskeletal health helps prevent and reduce MSDs [4,5,6]. It has been shown in a study by Bedi HS. et.al in 2015, all 23 respondents agreed that applied ergonomics have helped them to achieve a reduction in musculoskeletal pain and discomfort after 3 months [7,8,9,]. It is also clear that by employing dental ergonomics, it would save the dentist from injuries that may be hazardous in his career [4].

Young and budding dentists are not spared from MSDs either, as 70% of dental students as early as the third year into dental training began to elicit signs of neck, shoulder, and lower back pain according to Rising DW et.al in 2005 [10,11,12,13]. Yamalik N. thus recommends the inclusion of dental ergonomics as part of the curricula and continuing professional development programs, as it has also been shown that lower back pain is less prone to occur among dentists with clinical ergonomic education [4]. In short, a targeted healthcare protocol is necessary to avoid MSDs, for the benefit of professional figures such as dentists [14,15,16,17,18]. Also, it was seen that gaining awareness at an institutional level and at continuous dental health programs by providing education on ergonomics shows a positive impact in the long run of the profession [19,20,21,22].

Various studies on knowledge, attitude, practice (KAP) towards ergonomics have been done in other parts of the world, and most have shown a similar finding that is bad practice [23,24,25,26]. In India, 78.1% bad practice [27] and other studies conducted also showed similar results [28, 29, 30, 31]. In Malacca, Malaysia, the prevalence of MSDs was high (86.9%) among dental students, with a minimal to moderate perception of risk factors [32]. In Indonesia the prevalence of MSDs was around 63.5% among young dentists. [33]

Introducing ergonomic principles to dental college students and incorporating them into the curriculum is essential. Unfortunately, this critical matter often receives inadequate attention. Therefore, this study aims to assess knowledge, attitude and practice among dental students throughout their training, check the association between training year and KAP and also association between different components of dental ergonomics KAP.

Material and methods:

Ethical approval was obtained from Institutional Ethical Committee- MUCM/FOD/AR/B10/E C2022[05].

Informed consent was obtained from all participants, and all data was kept confidential. A cross-sectional study was conducted among dental students from Year 2, 3, 4 and 5 of MUCM to determine their KAP towards dental ergonomics. Universal sampling was used including all undergraduate dental students from Year 2, 3, 4 and 5. Year 2 students were included in the study as they start their preclinical training on phantom heads in year 2.

Sample size calculation: Based on a total undergraduate student population of 207, the required sample size was calculated using Cochran's formula with a 95% confidence level, 5% margin of error, and an assumed response distribution of 50%. The minimum required sample size was 135. To account for potential non-response or incomplete data, a final sample size of 149 students was targeted.

Study tool: A 27-item validated questionnaire was used to assess knowledge, attitude, and practice with 16, 5 and 6 items for assessment of knowledge, attitude, and practice respectively [23]. 3 questions were included about the sociodemographic data. Knowledge was gauged through questions focusing on the principles of ergonomics in routine dental procedures. Attitude was assessed using a 5-point Likert scale ranging from "definitely yes" to "definitely no," while practice was assessed on a similar scale ranging from "always " to "never". For scoring, the knowledge questions answered as yes, to some extent, and no answer and scored as 2, 1, and 0. The total score of knowledge ranged from 0 to 32. Those who achieved $\geq 75\%$ from the total score (≥ 24) were considered to have good knowledge, those from $50\text{--}75\%$ (16–23) were categorized as having fair knowledge, and those scoring below 50% (below 16) were considered as having poor knowledge. For attitude, total score ranged from 0 to 20. Those who achieved $\geq 75\%$ from the total score (≥ 15) were considered to have a positive attitude while less than 75% (less than 15) considered having a negative attitude. For practice the total score ranged from 0 to 24. Those who achieved $\geq 75\%$ from the total score (≥ 18) considered as having a good practice while those who achieved less than 18 as having bad ergonomic practice.

Statistical Analysis

Data entry and analysis will be done using Epi Info version 7. The KAP of various academic years was compared and association between knowledge, attitude and practice was assessed using chi-square test. Bonferroni post-hoc comparison test was done to identify which academic years are significantly different from each other. Less than 5% significance will be adopted in this study ($p < 0.05$).

RESULTS

Table I shows the socio demographic profile of the participants. Majority of participants were aged 20-

22 years (73.91%) and were females (73.36%). The academic year was uniformly distributed among the cohort.

Table I: Descriptive statistics/ sociodemographic characteristics of participants (n=207)

Variable	n (%)
Age	
20-22	153 (73.91)
23-25	54 (26.09)
Gender	
Female	156 (73.36)
Male	51 (24.64)
Academic level	
2 nd year	52 (25.12)
3 rd year	45 (21.74)
4 th year	59 (28.50)
5 th year	51 (24.64)

Table II shows the distribution of participants with good, fair and poor knowledge, positive and negative attitude & good and bad practice related dental ergonomics. Only 17.2% participants had good knowledge about ergonomics in dentistry. While 43.3% had poor knowledge. 59.6% participants had positive attitude towards dental ergonomics but merely 5% had good practice.

Table III: Comparison of KAP among different academic levels

Academic level	Knowledge			χ^2 (p-value)	Attitude		χ^2 (p-value)	Practice		χ^2 (p-value)
	Poor n (%)	Fair n (%)	Good n (%)		Positive n (%)	Negative n (%)		Good n (%)	Bad n (%)	
2 nd year	41 (78.8)	10 (19.2)	1 (1.9)	46.05 (0.001)	24 (46.2)	28 (53.8)	18.15 (0.001)	2 (3.8)	50 (96.2)	2.01 (0.562)
3 rd year	16 (35.6)	21 (46.7)	8 (17.8)		37 (82.2)	8 (17.8)		2 (4.4)	43 (95.6)	
4 th year	15 (25.4)	34 (57.6)	10 (16.9)		45 (76.3)	14 (23.7)		6 (10.2)	53 (89.8)	
5 th year	16 (31.4)	19 (37.3)	16 (31.4)		37 (72.5)	14 (27.5)		3 (5.9)	49 (94.1)	

To explore which years specifically contributed to the statistical difference in knowledge and attitude, Bonferroni post hoc test was performed, and the results are shown in table IV. Post hoc test revealed that there was statistically significant difference in knowledge and attitude of year 2 with year 3, 4 as well as year 5. No other years had significant differences between either knowledge or attitude.

Table IV: Academic year-wise comparison of knowledge and attitude

Academic year	Knowledge p-value	Attitude p-value
2 nd year vs. 3 rd year	.000047 *	.000245 *
2 nd year vs. 4 th year	.00001 *	.001095 *
2 nd year vs. 5 th year	.00001 *	.006421 *
3 rd year vs. 4 th year	.479693	.461581
3 rd year vs. 5 th year	.301037	.26046
4 th year vs. 5 th year	.077795	.654942

* Bonferroni adjustment $p < 0.0083$ is statistically significant.

Table II: Knowledge, Attitude, and Practice towards dental ergonomics (n=207)

Variable	Category	n (%)
Knowledge	Good	35 (17.2)
	Fair	84 (41.2)
	Poor	88 (43.3)
Attitude	Positive	143 (59.6)
	Negative	64 (26.7)
Practice	Good	13 (5.4)
	Bad	195 (81.3)

Among the four academic levels, year 2 students had the poorest knowledge and a negative attitude towards dental ergonomics. Irrespective of academic level almost all students had bad practices.

Table III shows comparison of KAP among different academic levels. There was significant difference in knowledge and attitude between the various academic years. However, no difference was observed in the practice of ergonomics between the different academic year.

Association between the three KAP components was also checked (Table V). Results showed that participants with more knowledge were more likely to have better attitude ($p=0.0001$) and practice ($p=0.0001$) towards dental ergonomics. Also, participants with better attitudes tend to have better ergonomic practice ($p=0.011$).

Table V: The association between knowledge, attitude, and practice towards ergonomics

	Attitude		χ^2 (p-value)	Practice		χ^2 (p-value)
	Positive n (%)	Negative n (%)		Good n (%)	Bad n (%)	
Knowledge						
Poor	48 (54.5)	40 (45.5)	15.36 (0.0001)	2 (2.3)	86 (97.7)	27.03 (0.0001)
Fair	66 (78.6)	18 (21.4)		2 (2.4)	82 (97.6)	
Good	29 (82.9)	6 (17.1)		9 (25.7)	26 (74.3)	
Attitude						
Positive			6.21 (0.011)	13 (9.1)	130 (90.9)	
Negative				0 (0.0)	64 (100.0)	

DISCUSSION

Dentists often overlook the importance of dental ergonomics. They tend to prioritize having a clear view of the operating area over their own comfort, resulting in prolonged disregard for ergonomics and consequent musculoskeletal issues [27,34,35]. Several studies have explored the link between dental ergonomics and MSDs, with many highlighting MSDs as a significant occupational risk in dentistry. [1,2,36,37,38].

This study aims to assess the dental ergonomic KAP of dental students throughout their training, check the association between training year and KAP and association between different components of dental ergonomics KAP. 207 dental student responses have been recorded for these specific variables.

Referring to table 1, the 207-participant student's sociodemographic in our study were mostly undergraduates aged between 20-22 (n=153, 73.91%), females (n=156, 73.36%), with evenly distributed academic years among year 2,3,4,5 students. In other similar KAP studies, the study population was of 3rd, 4th year dental undergraduates and house officers with a sample size of 384 [23]. Another study had a study population of mean age 30 years old, mostly female, and minimal 1 year experience with a sample size of 343 [27].

In this study on average students have fair knowledge (16.38), positive attitude (15.77) and bad practice (11.78) towards ergonomics. The findings of the study were as expected, as similar studies have shown comparable findings. Among undergraduates in Tanta University from Egypt, it has been shown that nearly half of the students had fair knowledge, while 85% of students had positive attitudes, whereas only 4.6% of students had good practice [23]. Karachi, Pakistan dental students and practitioners have shown poor knowledge of (40.1%) while also similarly having bad practice of (76.6%) Talha [36]. A study on South Indian dental practitioners has also shown similar findings in which dental professionals had predominantly fair to good knowledge, positive attitudes, and a high proportion of bad practices [34]. The similarity in results may be due to similar education and training regarding dental ergonomics, which can lead to similar levels of knowledge, attitude, and practices. Moreover, dental professionals often work in similar clinical settings, with similar equipment and patient population, which can result in similar ergonomic challenges.

In this study, a significant association is noted ($p=0.0001$) between knowledge and attitude as well as between knowledge and practice ($p=0.0001$) towards ergonomics of year 2, 3, 4 and 5 dental students from Faculty of Dentistry, MUCM. Moreover, there is also a significant association noted between the attitude and practice

($p=0.011$) of dental ergonomics among the students.

A comparison was made between the attitude and practice towards ergonomics between years 2, 3, 4 and 5 dental students from the Faculty of Dentistry, MUCM. Referring to table 3, in which the analysis was conducted using a chi square test revealed a statistically significant correlation of attitude with practice which is seen at $p < 0.05$. However, this is not in line with a study done by El-Sallamy et al in 2017 where there was no significant association between the students' attitude and practice where only 4.6% of the studied students had good practice. Although there is no significant association between the students' attitude and practice towards dental ergonomics in the study done by El-Sallamy et al in 2017, it still showed that most of the students had a positive attitude towards ergonomics, which is concurrent to our study. The significant association seen in this study between the students' attitude and practice can be attributed to their higher level of awareness regarding the importance of dental ergonomics in preventing musculoskeletal disorders (MSDs), which translates into better practice of ergonomics in the clinics. The study conducted by Siddiqui M et al and Kalghatgi et al shows 10.7% and 55% of participants had good practice [39,40] and the study conducted by Karthikayan et al [41]. Kalghatgi et al [40] shows the level of attitude is 71.4% and 75% participants respectively. A more positive attitude is because of a good reflection of acceptability and willingness to adopt the ergonomic principles in routine dental practice by the participants. In our study most of the students had significant relationship between knowledge(good), attitude(positive), and practice, whereas study conducted by El-Sallamy et al [23] & Galla et al [27] showed no significant association between knowledge, attitude & practice may be because of insufficient knowledge, lack of awareness, negative attitude, and bad practice towards ergonomics.

Reinforcing dental ergonomic protocols is essential to prevent musculoskeletal disorders (MSDs) prevalent among dental professionals. This can be achieved through a combination of education, workstation optimization, posture correction, physical conditioning, and continuous monitoring. Early and ongoing ergonomic education improves awareness of proper posture and positioning, reducing strain during dental procedures [42]. Direct observation tools like the Compliance Assessment of Dental Ergonomic Posture (CADEP) method provide targeted feedback to enhance adherence [43].

Workstation and Equipment Optimization: Adjusting chair heights, instrument placement, and lighting, along with using ergonomic stools, supports neutral postures and reduces asymmetrical stresses [44].

Maintaining neutral spinal alignment, relaxed shoulders,

and alternating working positions minimizes repetitive strain [45]. Proper patient positioning facilitates operator access without awkward postures. Incorporating chairside stretching, myofascial release, and muscular endurance training mitigates muscle imbalances and enhances musculoskeletal health [42]. Regular ergonomic assessments and specialist consultations ensure early detection and management of MSDs, promoting long-term compliance and career longevity [43].

The implications for dental education in reinforcing dental ergonomic protocols are clear and critical. Early Integration into Curriculum should be considered by introducing ergonomics as a fundamental component of dental education starting from preclinical training, ideally during mannequin practice, to develop good postural habits and ergonomic awareness before clinical exposure [46]. Dental curriculum must include both theoretical knowledge and hands-on ergonomic training focused on correct posture, patient and equipment positioning, and four-handed dentistry techniques to reduce physical strain and improve productivity [47]. Regular ergonomic assessments and real-time feedback during clinical training help students internalize proper ergonomic practices, preventing the development of musculoskeletal disorders (MSDs) that often begin during dental school [44]. Training and calibrating faculty members on ergonomic standards ensure consistent evaluation and reinforcement of ergonomic practices among students, fostering a culture of occupational health [47]. Incorporation of digital resources, such as ergonomics apps and self-study modules, can enhance learning efficiency and facilitate the inclusion of ergonomics in already packed dental curriculum [44,46,47].

Conclusion

Only 17.2% of students had good knowledge & more than half of them had positive attitude (59.6%) and bad practice (81.3%). There was significant difference in knowledge and attitude between the various academic years. However, no difference was observed in the practice of ergonomics between the different academic years. The relationship between KAP towards dental ergonomics of dental students showed a significant association between their knowledge with attitude and practice and attitude with practice. A more positive attitude is because of a good reflection of acceptability and willingness to adopt the ergonomic principles in routine dental practice by the participants.

Recommendations

81.3% of the students had bad practice. Good practice should be reinforcing the dental ergonomic protocol. Results from this study may be used to reinforce existing knowledge by conducting awareness sessions on dental

ergonomics for building clinical year students, in hopes to instill the significance of dental ergonomics before they are exposed to longer clinical hours, thus avoiding possible future major ergonomics-related health problems.

ACKNOWLEDGEMENT

The authors would like to acknowledge Prof. Dr. Abdul Rashid Hj Ismail, Dean Faculty of Dentistry, MUCM, for his support and guidance. We would also like to acknowledge students of Bachelor of Dental Surgery (BDS), Batch 10, 11, 12 & 13 of MUCM, for aiding in the data collection.

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