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Ergonomic Practices and Musculoskeletal Discomfort Among Dental Students in a Private University

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Abstract
Musculoskeletal discomfort, a precursor to musculoskeletal disorders (MSDs), is a common issue among dental practitioners, often stemming from poor ergonomic practices. This study investigates the relationship between dental ergonomic practices and musculoskeletal discomfort among dental students at a private university. A cross-sectional study was conducted using a three-part modified questionnaire distributed to 145 dental students. The questionnaire assessed demographic data, dental ergonomic practices, and the frequency of musculoskeletal discomfort in various body areas. The study aimed to identify whether sex and clinical level influenced this relationship.
Results indicated that the respondents generally exhibited good ergonomic practices, with the most frequent discomfort reported in the lower back, followed by the upper back, shoulder, and wrist. Statistical analysis revealed a significant correlation between ergonomic practices and musculoskeletal discomfort. Furthermore, the study found a significant difference in ergonomic practices and musculoskeletal discomfort between male and female students. However, no significant difference was observed when comparing students at different clinical levels.
This study highlights the importance of implementing proper ergonomic practices in dental education to prevent early-onset musculoskeletal discomfort and the potential development of MSDs. Recommendations include increasing awareness of ergonomics among dental students and ensuring ergonomic compliance to improve their long-term health and career sustainability.

Keywords: Dental Ergonomics, Musculoskeletal Discomfort, Occupational Health

INTRODUCTION

Musculoskeletal discomfort is a prevalent issue among dental professionals due to the physical demands of the profession. Dentists are required to maintain prolonged, awkward postures and perform repetitive motions, which increase the risk of developing musculoskeletal disorders (MSDs). These disorders are not only a source of discomfort but can also lead to early retirement if not addressed early. Dental students, who begin practicing clinical procedures during their training, are particularly vulnerable to these issues. Poor ergonomic practices during dental school can lead to the early onset of musculoskeletal discomfort, which may persist into their professional careers.
This study explores the relationship between dental ergonomic practices and musculoskeletal discomfort among dental students at a private university. By examining how ergonomic practices

influence discomfort levels, the study aims to provide insights into how future dental professionals can prevent MSDs and maintain better long-term health. The study also considers factors such as sex and clinical level to understand whether these variables contribute to differences in discomfort and ergonomic compliance.

As ergonomic awareness becomes increasingly important in dental education, this research seeks to highlight the importance of proper ergonomic practices and their impact on the health and productivity of dental students, ultimately contributing to improved work efficiency and longevity in the dental profession.

LITERATURE REVIEW

Dental Ergonomic Practices and Their Importance

Dental ergonomics is a critical component of dental practice, aiming to optimize the working conditions of dentists to prevent physical strain and enhance productivity. Ergonomics involves the design of dental equipment, workstations, and procedures to fit the practitioner, thus minimizing fatigue, discomfort, and the risk of developing musculoskeletal disorders (MSDs). According to the International Ergonomic Association, ergonomics focuses on human interaction with systems to improve comfort, safety, and productivity. Dental ergonomic principles, such as maintaining proper posture, correct positioning of dental instruments, and adequate lighting, are crucial in reducing the risk of developing MSDs (Das et al., 2018).

In dentistry, the application of ergonomic principles has been found to significantly reduce work-related musculoskeletal problems, which are often the result of prolonged awkward postures and repetitive motions. Ahmad et al. (2020) emphasize the importance of implementing these principles during dental training, as habits formed in dental school carry over into professional practice. Without proper ergonomic training, dental students may be at greater risk of developing long-term physical issues that could impact their ability to work effectively in the future.

Prevalence of Musculoskeletal Discomfort in Dental Students

Musculoskeletal discomfort among dental students is an emerging concern. A high percentage of dental professionals report experiencing musculoskeletal discomfort during their careers, and these issues often begin during their educational training. A study conducted by Abdullah et al. (2020) found that dental students frequently report musculoskeletal symptoms, particularly in the neck, lower back, and shoulders, due to the physically demanding nature of clinical training. These symptoms, if not addressed early, can lead to chronic musculoskeletal disorders, which are among the most common causes of early retirement in dental professionals.

Longridge et al. (2020) highlighted that dental students often lack awareness of proper ergonomic practices, which can lead to improper working postures during clinical procedures. These postures, combined with the repetitive nature of dental work, increase the risk of musculoskeletal discomfort, particularly in the spine, neck, and upper limbs. Dental students may focus intensely on clinical tasks without considering the importance of maintaining proper ergonomic practices, leading to strain and discomfort.

Moreover, research indicates that dental students are more prone to musculoskeletal discomfort compared to their medical counterparts, largely due to the physical nature of dental procedures and the necessity of maintaining static postures for extended periods (Blume et al., 2021). The introduction of ergonomic principles in dental curricula is crucial to preventing these early symptoms from progressing into more severe musculoskeletal disorders later in their careers.

Factors Influencing Ergonomic Practices and Discomfort

Several factors influence the ergonomic practices of dental students and their corresponding musculoskeletal discomfort. These include the students' clinical level, sex, and awareness of ergonomic principles. Studies show that clinical level plays a role in the development of musculoskeletal symptoms, with students in higher clinical levels more likely to report discomfort due to increased workload and clinical responsibilities (Felemban et al., 2021). The transition from pre-clinical to clinical training often brings a significant change in the amount of time spent performing procedures, increasing the likelihood of discomfort due to prolonged static postures and awkward working conditions.

Sex also appears to play a role in the prevalence of musculoskeletal discomfort among dental students. Research suggests that female dental students report higher levels of musculoskeletal discomfort compared to their male counterparts. Almosa and Zafar (2019) found that female students were more prone to musculoskeletal issues, particularly in the neck and shoulders, potentially due to physiological differences and variations in muscle mass between males and females. Ohlendorf et al. (2020) also reported that female dentists experience more frequent and severe musculoskeletal pain, highlighting the need for tailored ergonomic training that takes these sex differences into account.

Impact of Ergonomic Interventions

Implementing ergonomic interventions has been shown to reduce the risk of musculoskeletal discomfort among dental professionals and students. Ergonomic training, such as the proper use of dental stools, adjusting the height of the patient's chair, and using lightweight instruments, can significantly reduce strain on the practitioner's body. Lietz et al. (2020) found that dental students who used lightweight and wide-diameter instruments experienced less discomfort in their shoulders and hands compared to those using heavier instruments. Similarly, proper illumination and the use of magnification tools, such as dental loupes, have been found to reduce the need for awkward postures during procedures, thereby decreasing the risk of musculoskeletal discomfort (De Sio et al., 2018).

Furthermore, regular stretching exercises and taking breaks between procedures can help alleviate muscle tension and prevent discomfort. A study by Babatunde et al. (2017) emphasized the importance of physical activity in preventing musculoskeletal issues, as regular exercise strengthens muscles and reduces the risk of injury. Incorporating these preventive measures into daily practice can help dental students maintain better posture, reduce discomfort, and ultimately improve their long-term health.

Challenges in Ergonomic Practice Compliance

Despite the known benefits of ergonomic practices, dental students often face challenges in adhering to these principles. Garcia et al. (2016) reported that dental students struggle to maintain ergonomic postures due to factors such as poor visibility of the operative field, lack of ergonomic training, and the pressure to meet clinical requirements. Additionally, many students are unaware of the importance of ergonomic practices and may not prioritize them during procedures, focusing instead on completing tasks quickly. This lack of awareness and practice can lead to the development of poor habits that persist into professional practice, increasing the risk of long-term musculoskeletal disorders.

Moreover, Moosa and Bhayat (2022) highlighted the lack of practical ergonomic training and supervision in some dental schools, which contributes to suboptimal ergonomic practices among students. To address these challenges, it is essential to integrate ergonomic training into the dental curriculum and provide continuous monitoring and feedback to ensure students develop healthy work habits.

METHODS

This study utilized a quantitative descriptive research design to assess the relationship between dental ergonomic practices and musculoskeletal discomfort among dental students at a private university. Quantitative methods were employed to collect objective, statistical data regarding the ergonomic habits of dental students and the frequency of their musculoskeletal discomfort. A descriptive correlational approach was chosen to investigate the association between these two variables.

Population and Sampling

The population of the study included dental students from a private university in the Philippines, consisting of pre-clinical and clinical students. A total of 145 respondents participated in the study, selected using a nonprobability convenience sampling technique. Nonprobability sampling allowed the researchers to select participants based on availability and willingness to participate. The sample size was determined using Yamane's formula with a 5% margin of error, accounting for a diverse range of dental students at different clinical levels.

The sample included students from various stages of their dental education, from pre-clinical training to residency. Out of 145 respondents, 69.7% were female and 30.3% were male, which aligns with previous research indicating a higher proportion of females in dental education. The clinical level distribution showed that most respondents were in Clinic 1 and Clinic 2, with fewer participants in more advanced clinical levels or residency.

Instrumentation

A modified questionnaire was used to gather data. The questionnaire consisted of three sections: demographic information, dental ergonomic practices, and musculoskeletal discomfort. The

demographic section included questions about the participant's sex and clinical level, while the second and third sections were designed to assess ergonomic practices and the frequency of musculoskeletal discomfort in various body areas.

The ergonomic practices section was adapted from an existing study on ergonomic factors affecting dental professionals (Aghahi, 2018) and focused on evaluating specific behaviors, such as maintaining proper posture, the placement of instruments, and the use of dental lighting. Responses were recorded on a Likert scale, where 1 indicated "never" and 5 indicated "always." The musculoskeletal discomfort section was based on the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) and measured the frequency of discomfort in areas such as the neck, shoulders, back, and wrists, using a similar Likert scale.

The reliability and validity of the questionnaire were confirmed through a pilot study involving 23 dental students. Cronbach's Alpha was used to assess internal consistency, with scores of 0.742 for the ergonomic practices section and 0.951 for the musculoskeletal discomfort section, indicating strong reliability for both measures.

Data Collection

Data collection was conducted through an online survey using Google Forms. The link to the survey was distributed to dental students through email and social media platforms. This method was chosen due to the ongoing COVID-19 pandemic, which limited face-to-face interactions. Online distribution allowed participants to respond at their convenience and ensured the safety of both researchers and respondents.

The data collection process took two weeks, after which the responses were compiled into a Microsoft Excel spreadsheet for analysis. The researchers verified the accuracy of the data before proceeding with the analysis.

Ethical Considerations

Ethical guidelines were strictly followed to ensure the integrity of the study and the safety of participants. Informed consent was obtained from all participants before they completed the questionnaire. The informed consent form included details about the purpose of the study, the voluntary nature of participation, the potential risks and benefits, and assurances of confidentiality. Respondents were required to indicate their agreement to participate by selecting "Yes, I wish to proceed" before completing the survey.

All personal data were anonymized to protect participants' privacy, and responses were kept confidential. The study was conducted in accordance with the guidelines provided by the Ethics Review Board of the private university.

Data Analysis

The data were analyzed using descriptive and inferential statistical methods. The degree of dental ergonomic practices and the prevalence of musculoskeletal discomfort were measured using means and standard deviations. Pearson's correlation coefficient was used to determine the strength and direction of the relationship between ergonomic practices and musculoskeletal discomfort, with a p-value of less than 0.05 considered statistically significant.

Additionally, a one-way analysis of variance (ANOVA) and t-tests were conducted to assess whether there were significant differences in ergonomic practices and musculoskeletal discomfort when grouped by sex and clinical level.

RESULTS AND DISCUSSION

This section presents the findings of the study, which aimed to examine the relationship between dental ergonomic practices and musculoskeletal discomfort among dental students at a private university. The results are organized into several categories, including the degree of ergonomic practices, the prevalence of musculoskeletal discomfort, and the relationship between these two variables. Additionally, the results of the analysis are presented to determine whether there are significant differences in these factors when grouped by clinical level and sex.

1. Degree of Dental Ergonomic Practices of Dental Students

The study found that the overall degree of dental ergonomic practices among dental students was rated as "Good," with a grand mean score of 3.40 (M=3.40, SD=0.387) based on a 5-point Likert scale (see Table 1). The highest-rated item was the consistent use of dental lighting to ensure optimal visibility in the oral cavity (M=4.67, SD=0.717), which was classified as "Excellent." The use of proper lighting is critical in preventing improper posture and ensuring ergonomic compliance. This is supported by previous research, which highlights the importance of proper lighting in dental practices to reduce strain on the neck and shoulders during procedures.

Other highly rated practices included placing instruments in close proximity to reduce strain from reaching (M=4.39, SD=0.765) and shifting positions during procedures (M=4.07, SD=0.847). Both of these practices were rated as "Very Good" and are consistent with ergonomic principles designed to minimize musculoskeletal discomfort. However, certain areas, such as adjusting the dental stool for proper cliposture, received lower ratings, with a mean score of 1.88 (SD=0.939), classified as "Poor." This suggests that students may not be prioritizing posture-related adjustments as much as other ergonomic factors.

Table 1. Mean and Standard Deviation of Dental Ergonomic Practices

Item	*Mean*	*SD*	*Interpretation*
Use of dental lighting for visibility	4.67	0.717	Excellent
Placement of instruments close to the operator	4.39	0.765	Very Good
Shifting positions during procedures	4.07	0.847	Very Good
Keeping feet flat on the floor while seated	4.02	1.017	Very Good
Adjusting dental stool for upright posture	1.88	0.939	Poor

Grand Mean	3.40	0.387	Good

2. Prevalence of Musculoskeletal Discomfort

The overall prevalence of musculoskeletal discomfort among dental students was found to be "Low," with a mean score of 2.06 (M=2.06, SD=0.798) (see Table 2). The most commonly reported areas of discomfort were the lower back (M=2.85, SD=1.063), upper back (M=2.63, SD=1.08), and shoulders (M=2.61, SD=1.132). These areas are consistent with the findings of previous studies, which have shown that lower back pain is one of the most frequent complaints among dental professionals due to the prolonged static postures required during dental procedures .

In contrast, discomfort in the wrists, forearms, hips, and knees was less frequently reported, with scores indicating discomfort once a week or less. This suggests that, while dental students are experiencing discomfort, it tends to be concentrated in the upper and lower back, as well as the shoulders, likely due to the physical demands of their clinical training.

Table 2. Mean and Standard Deviation of Musculoskeletal Discomfort

Body Area	***Mean***	***SD***	***Frequency***	***Interpretation***
Lower back	2.85	1.063	Several times a week	Moderate
Upper back	2.63	1.08	Several times a week	Moderate
Shoulders	2.61	1.132	Several times a week	Moderate
Wrists	2.54	1.106	Several times a week	Moderate
Forearms	2.12	1.105	Once a week	Low
Hips/Buttocks	2.21	1.086	Once a week	Low
Knees	1.75	0.961	Once a week	Low
Grand Mean	2.06	0.798	Once a week	Low

3. Relationship Between Ergonomic Practices and Musculoskeletal Discomfort

The study examined the relationship between dental ergonomic practices and musculoskeletal discomfort using Pearson's correlation and Spearman's rho. The analysis revealed a significant negative correlation between the two variables, with Pearson's $r = -0.223$ ($p < 0.01$) and Spearman's rho = -0.202 ($p < 0.05$). This indicates that as the quality of ergonomic practices improves, musculoskeletal discomfort decreases (see Table 3). These findings are consistent with

the literature, which highlights that the implementation of ergonomic interventions can significantly reduce musculoskeletal discomfort in dental professionals(BAROT.

Table 3. Correlation Matrix for Ergonomic Practices and Musculoskeletal Discomfort

Variable	*Pearson's r*	*p-value*	*Spearman's rho*	*p-value*
Dental Ergonomic Practices	-0.223**	0.007	-0.202*	0.015
Musculoskeletal Discomfort	—	—	—	—

4. Differences by Clinical Level and Sex

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in dental ergonomic practices and musculoskeletal discomfort based on the students' clinical level and sex. The results indicated no significant differences in ergonomic practices across clinical levels ($F(5, 139) = 1.33$, $p = 0.255$) but suggested a near-significant difference in musculoskeletal discomfort ($F(5, 139) = 2.26$, $p = 0.052$) (see Table 4). This indicates that, although ergonomic practices remain consistent across clinical levels, students in higher clinical levels may experience slightly more discomfort due to their increased workload and clinical exposure.

In terms of sex differences, the study found that female students reported significantly higher levels of musculoskeletal discomfort than their male counterparts (Mann-Whitney $U = 1515$, $p = 0.002$), with a moderate effect size ($r = 0.318$). However, there was no significant difference in ergonomic practices between male and female students ($t = -1.74$, $p = 0.084$), suggesting that both sexes follow similar ergonomic practices despite the difference in discomfort levels (see Table 5).

Variable	*F*	*df 1*	*df2*	*p-value*
Dental Ergonomic Practices	1.33	5	139	0.255
Musculoskeletal Discomfort	2.26	5	139	0.052

Table 4. One-Way ANOVA for Clinical Level

Table 5. Group Descriptives for Ergonomic Practices and Musculoskeletal Discomfort by Sex

Group	N	Mean (Ergonomic Practices)	SD (Ergonomic Practices)	Mean (Musculoskeletal Discomfort)	SD (Musculoskeletal Discomfort)
Male	44	3.31	0.395	1.81	0.671
Female	101	3.43	0.380	2.21	0.821

CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATION

The results of this study highlight the significant relationship between ergonomic practices and musculoskeletal discomfort among dental students at a private university. The findings revealed that while students generally adhered to good ergonomic practices, specific areas such as seating posture and adjusting the dental stool were lacking, leading to discomfort in high-risk areas like the lower back, upper back, shoulders, and wrists. The negative correlation between ergonomic adherence and musculoskeletal discomfort emphasizes the importance of implementing proper ergonomic techniques to minimize discomfort during dental procedures.

This research also sheds light on gender differences in musculoskeletal discomfort, with female students reporting higher levels of discomfort compared to their male counterparts. As clinical experience increases, students in higher clinical levels appear to experience more discomfort due to the cumulative effect of longer exposure to physically demanding tasks.
Ultimately, this study underscores the need for comprehensive ergonomic education and practical applications in dental schools, as fostering good ergonomic habits early in a student's career can significantly reduce the risk of musculoskeletal disorders and improve long-term professional health outcomes.

Implication

The implications of this study are profound for dental education and practice. Ergonomics is not just a theoretical subject but a practical necessity for preventing long-term health issues. Dental schools must prioritize the incorporation of ergonomic principles into their curricula, ensuring that students are not only aware of ergonomic practices but are consistently applying them during clinical training.
The high prevalence of discomfort in specific body regions highlights the need for targeted interventions. This includes better training on adjusting dental stools and maintaining proper posture throughout clinical procedures. Clinical instructors and supervisors should regularly assess students' ergonomic practices and provide immediate feedback to help them correct bad habits before they become ingrained.

Additionally, the gender disparity in musculoskeletal discomfort suggests that ergonomic interventions should be customized to address the specific needs of female students. Female students may benefit from personalized ergonomic adjustments or additional support to alleviate

discomfort, ensuring they are not disproportionately affected by physical strain during their training.

Finally, the findings of this study point to the importance of long-term health strategies in dentistry. Without proper ergonomic training and awareness, dental professionals are at risk of developing chronic musculoskeletal disorders that can shorten their careers or reduce their productivity. Dental institutions must therefore equip future professionals with the knowledge and tools needed to preserve their health throughout their careers.

Suggestion

Based on the findings of this research, several practical suggestions can be made:

1. Comprehensive Ergonomic Training: Dental schools should incorporate hands-on ergonomic training early in the curriculum. This training should emphasize posture, instrument placement, and proper use of dental equipment to ensure students are applying ergonomic principles during clinical work. Real-time feedback from instructors can help reinforce these habits.
2. Regular Monitoring of Ergonomic Practices: Dental institutions should conduct periodic assessments of students' ergonomic practices during clinical procedures. These assessments should focus on posture, positioning, and the use of equipment, with corrective feedback provided immediately to help students adjust and avoid developing musculoskeletal discomfort.
3. Improved Ergonomic Equipment: The results suggest that dental stools and seating arrangements play a critical role in preventing discomfort. Schools should invest in adjustable stools and ergonomic chairs that support proper posture, reducing the risk of back and shoulder strain. Clinics should also ensure that equipment, including lighting and instruments, is positioned in a way that reduces physical strain on students.
4. Ergonomic Exercises and Stretching: Regular stretching and physical activity should be encouraged among dental students to alleviate muscle tension and prevent the buildup of strain. Simple exercises targeting the neck, shoulders, back, and wrists can help students remain flexible and minimize discomfort during long clinical sessions.
5. Tailored Interventions for Female Students: Given the higher levels of discomfort reported by female students, ergonomic interventions should be customized to their specific needs. This could include adjustments to equipment or posture training designed to alleviate the physical strain experienced by female students, ensuring they can perform clinical tasks with less discomfort.

Limitation

While this study offers valuable insights, there are several limitations that should be acknowledged. First, the sample size, though sufficient for statistical analysis, may not be fully representative of the entire population of dental students. Future research should aim to include students from a broader range of institutions to provide more generalizable results.

Second, the study relied on self-reported data through questionnaires, which can be subject to response bias. Students may have underreported or overreported their ergonomic practices and

discomfort levels due to a lack of self-awareness or social desirability bias. Future studies could benefit from objective measurements, such as direct observation of ergonomic practices or the use of technology to track posture during clinical procedures.

Third, this research focused on the relationship between ergonomic practices and musculoskeletal discomfort without accounting for other contributing factors, such as stress, workload, or pre-existing conditions. Further research is needed to explore how these factors interact with ergonomic practices to affect discomfort levels among dental students.

Lastly, while the study identified significant gender differences in discomfort, it did not delve into the reasons behind these differences. Future research should investigate the physiological or psychological factors that may contribute to higher levels of discomfort among female students, which could lead to more tailored ergonomic interventions.

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