

Knowledge, attitude, and practice of ergonomics among dental clinicians in a Philippine private university

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Abstract

Improved ergonomics and good working environment could enhance productivity and safety in Dentistry. In this study, clinicians of a private dental school were surveyed to determine their knowledge, attitude and practice of ergonomics, test significant difference on knowledge, attitude and practice when grouped according to profile, and test relationship between knowledge, attitude and practice. Results revealed that majority of respondents are 22-year-old female, fourth year students, living in suburban, working more than five hours per day, with physical activity outside work and experiencing mild body pains during or after clinical works. Their knowledge, attitude, and practice of ergonomics were satisfactory. They have knowledge about ergonomics, exhibit good attitudes and practice very often the ergonomic principles during clinical work. Knowledge and attitude are not affected by demographic profile. Age, sex, physical activity and experience of body pains have significant difference with regards to practice. A significant relationship exists among knowledge, attitude and practice. Students with more knowledge also have more positive attitude towards ergonomics and more likely to practice ergonomics. Findings support suggested action plan to promote ergonomics and avoid musculoskeletal problems among clinicians. Other variables influencing occupational health and safety may be investigated by future researchers in Clinical Dentistry.

Keywords: ergonomics, dental clinicians, dentistry

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1. Introduction

Understanding how the working environment affects productivity and efficiency of the rendered service is important to ensure quality dental care. Ergonomics, as the scientific study of people and their working environment, is essential in the dental practice. Dentistry is a profession that generally produces various musculoskeletal disorders due to the very limited operating space of the oral cavity, restricted operator and patient positioning and the complexity and length of the dental treatments done to the patient. Given these several challenges and restrictions, ergonomic principles must be applied in the dental clinical practice. Applying these principles helps to prevent occupational health hazards and provides more comfort both to the dentist and patient. Ergonomics in dentistry seeks to minimize physical and mental stress, avoid dental practice diseases, increase productivity, improve quality of life, and provide comfort for the professional and, as a result, for the patient. as well. Dentists have more discomfort and musculoskeletal pain than the general population. Dentists' bodies, particularly their neck, shoulders, upper limbs, and, most notably, their lower backs, are affected by the nature of their profession and the positions they adopt throughout their work (Shobhana et al., 2020).

Healthy ergonomics must be learned at any point in one's professional life; however, the sooner they are learned, the higher the benefits, integration, and application, minimizing the development of harmful habits in the case of dental ergonomic posture (Kumar et al., 2012). Comprehensive knowledge of ergonomic principles would increase awareness of conducive treatment positioning, use of ergonomic tools and provision of good working environment among dental clinicians as they progress in their clinical skills. In a study by Araújo et al. (2021), dental undergraduates had a strong understanding of ergonomic principles as well as proper posture during normal dental operations, but they did not put this information into effect in its totality, which could explain why of them reported frequent discomfort. As a result, it is advised that more attention should be given to dental students in order to ensure that dental ergonomic principles be implemented throughout their course, as well as the production of more research for better occupational health and safety. Ergonomic-related health issues among these future dentists can be greatly reduced with such approaches. In a study by Kalghatgi et al. (2014), dental practitioners tend to demonstrate a high level of awareness and behavior about ergonomics in dental practice. Their positive attitude score implies that ergonomic concepts and recommendations are more widely accepted while performing dental treatments. Dental faculty should motivate and train the students on having positive outlook in practicing the ergonomic principles by implementing and monitoring if these ergonomic principles were observed during their clinical procedures.

This research aimed to provide a better understanding of the dental clinicians' knowledge, attitude and practice of ergonomics as they do their case requirements in Clinical Dentistry. This may then be used to guide dental schools in developing an ergonomic and productive Clinical Dentistry learning experiences, promoting long term health benefits and better clinical performance.

Objectives of the research - The goal of this research is to determine the knowledge, attitude and practice of ergonomics among the dental clinicians of LPU Batangas during their online clinical dentistry cases. More specifically, it aims to achieve the following objectives: 1) Present the profile of the respondents according to age, sex, residence, academic level, work duration in a day, frequency of work duration in a day, physical activities outside work and presence of body pains, 2) Determine knowledge, attitude and practice of ergonomics among the dental clinicians, 3) Test the significant difference on the knowledge, attitude and practice of ergonomics among the dental clinicians when grouped according to profile; 4) Test the relationship between knowledge, attitude and practice of ergonomics of the participants and 5) Propose an action plan to enhance ergonomic working principles and protocols that may be incorporated into the dental curriculum.

2. Methods

This study employed a descriptive research design since the overall objective is to determine the knowledge, attitude, and practice of ergonomics among the dental clinicians. Individuals and conditions were described through examining them in their natural environment, to further understand the sample and variables being assessed (Siedlecki, 2020). Dental clinicians comprising of the third- and fourth-year students were chosen to participate in the study because they were the students who had most laboratory works and clinical requirements in the dental program, where ergonomics could be practiced and enhanced. Out of one hundred sixty-eight (168) dental clinicians enrolled in Clinical Dentistry of the second semester SY 2021-2022 of College of Dentistry, one hundred eighteen (118) were able to participate in the study. Using the Raosoft sample size calculator, 118 is the minimum recommended size for the survey consisting of 168 total population, with 95% confidence level and 5% margin of error. Due to restricted social interaction caused by the pandemic, respondents were asked to answer the questionnaire regarding the knowledge, attitude and practice of ergonomics using Google survey form.

A self-administered and closed-ended questionnaire was used, adopted from earlier studies that were both valid and reliable (Kritika et al., 2014; Kalghatgi et al., 2014). Cronbach alpha values for knowledge, attitude, and practice were 0.684, 0.784, and 0.810, respectively. The split half reliability values for knowledge, attitude, and practice were 0.791, 0.881, and 0.698, respectively. It consisted of 27 items with 16 questions related to Knowledge, 5 questions related to Attitude and 6 questions related to Practice of Ergonomics in addition to questions related to the profile of the respondents such age, sex, residence, academic level, work duration in a day, frequency of work duration in a day, physical activities outside work and body pains during or after clinical work. The items on knowledge and attitude were rated using a 5-point Likert scale: definitely yes, yes, neutral, no, and definitely no. The practices of ergonomics also used a 5-point Likert scale: always, very often, often, rare, and never.

The approval of the college dean was secured before the students were invited to participate in the survey. Due to the restrictions brought about by the pandemic and the limitation of physical access to the students, the data was gathered using Google form questionnaire sent through active social media accounts of the respondents. Results of the survey were tallied by the researchers through Microsoft excel. The gathered data was analyzed by using SPSS. Descriptive statistical data will be tabulated and summarized in proportions and percentage. Less than 5% significance was adopted in this study ($p < 0.05$). Aside from chi square, frequency distribution, percentage, mean, rank, T-test, ANOVA and Pearson R were used to achieve the objectives of the study.

The researchers ensured full confidentiality and privacy of the data and all the personal information gathered. To guarantee maximum collaboration, the researchers sought approval and consent from the LPU Batangas college dean and chief of clinics to conduct the study among the dental clinicians. Using the consent form, the researchers discussed to the participants the study's goals and methodology, as well as the advantages and risks of the study. Upon obtaining their consent, they were asked to answer the questionnaire. A copy of their responses was also sent to their respective email address, for their personal keeping. Those who were not willing to give their consent were excluded from the study.

3. Results and discussion

Table 1 presents the frequency of the respondent's demographic profile. Out of 118 respondents, majority (39% and 50%) were 21 and 22 years old. Majority of them (79.7%) were female, while 20.3% were males. 74.6% of the respondents were fourth year students, while 20.3% were third year students. Majority of the students were female and more women are enrolling in the university to take up health science courses, such Dentistry. This phenomenon is observed in the recent years in the said university due to the ongoing promotion of the university in terms of the many benefits such as good image, esteem, and privileges that these health science course may bring to the students as future health care practitioners. Women are becoming more

interested and studying dentistry in most schools (Kornmehl et al., 2021; Al-Hallak et al., 2018; Bernabe et al., 2006; Gietzelt, 1997) due to increasing interest in restoration of healthy smile and esthetic importance of the dental health. Women are particular in good image and esthetic, considering the nature of women to uphold good self-esteem and confidence in them and in others.

Table 1*Frequency Table for the Dental Clinicians' Demographic Profile*

	Frequency	Percentage
Age		
20	6	5.1
21	46	39.0
22	59	50.0
23	7	5.9
Sex		
Male	24	20.3
Female	94	79.7
Year Level		
DDM 3	29	24.6
DDM 4	88	74.6
Others	1	.8
Residence		
Urban (major/highly developed city)	42	35.6
Suburban (small city)	48	40.7
Rural (agricultural/farm)	28	23.7
Work duration per day		
Less than 5hrs/day	57	48.3
More than 5hrs/day	61	51.7
Physical Activity		
Yes	65	55.1
No	53	44.9
Body pains during or after clinical/laboratory works		
None	8	6.8
Mild pain	53	44.9
Moderate pain	49	41.5
Severe pain	8	6.8

Most of them (40.7%) lived in suburban location, more specifically in small cities. Due to the location of the university being in a suburban location, most of its students were coming from within the city or the nearby towns. Most of the students were also able to get good access of the curricular and extracurricular needs within the suburban location. High rates of housing insecurity and poor housing had a negative impact on the student's class attendance and performance, as well as their ability to complete their education (Silva et al., 2017), thereby finding a convenient and accessible location to pursue dental education is important to student success.

A greater number of them (51.7%) has work duration of more than five hours a day. The dental curriculum was designed that students are engaged in their academic works for at least 5 hours a day. This work hours includes lecture, demonstrations, laboratory works and training in the dental dispensary, which has three rounds per day, with each round providing 3 hours of clinical duty for any clinical cases. Although the quantity of time spent studying or working outside school hours had no direct effect on student performance, students with high ability who also spend more time studying are the ones who are most likely to excel in college (Nonis & Hudson, 2006).

Majority of the respondents (55.1%) were doing physical activity outside work. Physical exercise during COVID-19 pandemic lockdown has been widely promoted among people in isolation due to its health benefits (Shang et al., 2021). It not only has direct impact on the negative emotions of college students, more so it enhanced their resilience by slowing down their negative emotions and promoting their mental health (Li et al., 2021).

Most of them (44.9%) experienced mild body pains during or after clinical or laboratory works, while

41.5% rated for moderate pain, and 6.8% noted to experience severe pain. There were 6.8% who mentioned no body pains experienced. Musculoskeletal diseases are common among dental practitioners (Mulimani et al., 2019), and begins to manifest early, particularly when they are still dental students. Musculoskeletal pain is regarded as a neglected aspect of dentistry (Gangwal et al., 2019). Chronic pain is prevalent among dental practitioners in extended working hours resulting to longer static postures in the development of back pain, along with neck and wrist and hand pain (Kalappa & Shankar, 2017).

Table 2.1

Dental Clinicians' Knowledge on Ergonomics

	Mean	Rank	I
1. Do you know what is meant by ergonomics	2.88	4	Yes
2. Do you know what are the health hazards of your job without ergonomics?	2.73	9.5	Yes
3. Do you know the benefits of ergonomic application?	2.80	7	Yes
4. Do you know the popular operating posture that may cause musculoskeletal disorders?	2.57	14	Yes
5. Do you know the best posture of the dentist sitting?	3.18	2	Yes
6. Do you know the best level of the dentist shoulders and site of elbow and upper arms?	3.20	1	Yes
7. Do you know the best site for forearms and operating fingers of the dentist?	2.98	3	Yes
8. Do you know the degree of the sight-line and the light-line?	2.55	15.5	Yes
9. Do you know the points on the body, including fingertips and feet, that come in contact with patients and objects for stable control and sightings of the operating points?	2.73	9.5	Yes
10. Do you know, when designing and equipping the treatment room, what specifics should dentists be looking for?	2.86	6	Yes
11. Do you know human supports and material objects that account for body space, paths of motion of body parts, and location of instrument supports?	2.75	8	Yes
12. Do you know the orbit range around the patients' head?	2.62	13	Yes
13. Do you know the ergonomic head rest and its benefits?	2.64	12	Yes
14. Do you know the ideal distance from the floor to the position?	2.71	11	Yes
15. Do you know the moving, exercise, and stretch exercise between patient's appointments?	2.55	15.5	Yes
16. Do you know how to maintain a comfortable environment, light, and temperature in the treatment room?	2.87	5	Yes
Composite Mean	2.79	Yes	

Legend for Motivation: 0.00 – 0.49 (Definitely No), 0.50 – 1.49 (No), 1.50 – 2.49 (Neutral), 2.50 – 3.49 (Yes), 3.50-4.00 (Definitely Yes)

Table 2.1 presents the knowledge on ergonomics of the dental clinicians. The composite mean of 2.79 denotes that enumerated questions about knowledge of ergonomics are answered Yes by the dental clinicians. Ergonomics is basically discussed in several clinical and laboratory subjects in Dentistry, specifically in the treatment procedures, materials and equipment used in patient management, thereby giving students a basic knowledge on the ergonomics of the treatment, procedures and equipment used in Dentistry.

Among the queries listed, the question on the best level of the dentist shoulders and site of elbow and upper arms got the highest rank with the weighted mean of 3.20 which were interpreted as Yes. It is followed by knowing the best posture of the dentist sitting (3.18) and knowing the best site for forearms and operating fingers of the dentist (2.98). As good ergonomic guideline, the clinician's seated position must encourage a relaxed shoulder position with an evenly balanced weight placement. In terms of arm and forearm position, arms are ideally placed parallel to the long axis of the body with the forearm parallel to the floor but may be raised or lowered, taking care that an angle greater than 60 degrees must not be adopted. Neutral hand positions are also encouraged to be assumed with the alignment of the wrist in concordance with that of the forearm. Operator position relative to the patient position must also be changed to achieve the most acceptable ergonomic posture for each procedure performed by the clinician (Munjal, 2021). Knowing the best posture of the dentist sitting is the second highest due to the acknowledgement of the students of the necessary and helpful posture of being able to sit while treating the patient. Sitting provides a more relaxed position for the clinicians. According to studies by Chaikumarn (2005) and Kawaldeep et al. (2018), variation in operator's positions is advisable for better posture and facilitation of treatment procedures. Dental clinicians understanding the different possible work positions is important to achieve the best result of treatment. Some dental procedures might necessitate movements between sitting, standing and being at the side of the patient.

Knowing the best site for forearms and operating fingers of the dentist involved knowledge of good manual dexterity and techniques in handling different instruments and equipment in Dentistry. Because the students were taught of the different armamentarium of every specialty in Dentistry, they were able to know how to handle these instruments and operate on patients based on the learned principles and importance of these tools. Kawaldeep et al. (2018) emphasize the value of acquiring the needed tools and instrument design that lessens forceful exertion. Dental clinicians seeking awareness in how to choose the proper equipment to perform dental procedures may be guided by the ergonomic principles considered in the manufacture of these dental tools.

Meanwhile, even though interpreted as known, among the values listed, the questions ‘Do you know the degree of the sight-line and the light-line?’ and ‘Do you know the moving, exercise, and stretch exercise between patient’s appointments?’ both got the lowest rank with weighted mean of 2.55 which was interpreted as Yes. These two items were least known due to the clinician’s varied preference on how to have good visualization of the operating field. Ideal posture of a dentist during a procedure does not only encompass one part of the body, but multiple parts in conjunction with the position of the patient being treated for maximum visualization of the operating field. The head of the dentist must be positioned forward with the interpupillary line between 15 to 20 degrees horizontally, and the torso must be upright to align with the proper curvature of the spine and may be aided by a backrest to enhance lumbar support. (FDI, 2021). Due to the bulk of the work and continuous flow of patients and steps in the treatment process, clinicians were not able to acknowledge that doing exercise and stretch break is necessary in the clinical work. Frequent breaks with chairside directional stretching and postural strengthening techniques are being recommended to prevent musculoskeletal diseases related to poor dental ergonomics (Valachi & Valachi, 2003; Abdolalizadeh & Jahanimoghadam, 2015; Jackson, 2021).

Next least item is the student agreeing that they know the popular operating posture that may cause musculoskeletal disorders (2.57). This is least known because the students may be indifferent to the physical strains they are experiencing while they are in their clinical training. Musculoskeletal conditions are widespread among dental professionals (Mulimani et al., 2019). They frequently start to show symptoms when they are still dental students. Ergonomics knowledge and use might reduce the possibility of musculoskeletal diseases during dental work. Hence, all educational institutions and continuing dental health programs should include ergonomic education for dental health-care workers in their curricula, conveying ergonomic principles both conceptually and practically (Kumar et al., 2020).

Table 2.2

Dental Clinicians’ Attitude on Ergonomics

	Mean	Rank	Interpretation
1. Do you think ergonomics should be a part of the dental curriculum?	3.26	4	Yes
2. Do you think dentists should follow the ergonomic principles in routine dental practice?	3.36	1.5	Yes
3. Do you think the dental chair and instruments play any role in following ergonomic principles in routine dental practice?	3.36	1.5	Yes
4. Do you think the dentist should alternate between sitting and standing between patient appointments?	2.95	5	Yes
5. Do you think various dental institutions should conduct continuing dental education?	3.33	3	Yes
Composite Mean	3.25	Yes	

Legend for Motivation: 0.00 – 0.49 (Definitely No), 0.50 – 1.49 (No), 1.50 – 2.49 (Neutral), 2.50 – 3.49 (Yes), 3.50-4.00 (Definitely Yes)

Table 2.2 presents the attitude on ergonomics of the dental clinicians. The composite mean of 3.25 denotes that enumerated questions about attitude on ergonomics are answered Yes by the dental clinicians. Among the values listed, the questions ‘Do you think dentists should follow the ergonomic principles in routine dental practice?’ and ‘Do you think the dental chair and instruments play any role in following ergonomic principles in routine dental practice?’ both got the highest rank with the weighted mean of 3.36 which were interpreted as Yes. Students agree to follow ergonomic principles in their clinical training and employ convenient and comfortable techniques in handling instruments while treating patients. This is because they were trained to use their instruments and tools properly based on its intended function and usability. Clinical instructors were keen to give feedback and provide directions on how to perform steps of dental treatment using various dental tools. In cases

when the necessary instruments and equipment is unavailable, the procedure may be postponed for another time when the tools will be made available.

Having a positive attitude towards following ergonomic principles in the dental clinic as well as using the dental chair and instruments ergonomically is a wise attribute of a dentist. Acquiring the needed tools and instrument design that reduces force exertion and maintains hand/wrist in neutral posture should be considered by a clinician in buying such instruments. Choosing larger diameter, balanced instruments with hollow handles increased the tactile sensitivity and lessen clinician fatigue. Thin instruments are difficult to grasp and increase the chance of muscle cramping. Sharp instruments and blade would also cause less fatigue to the clinician and facilitates efficacy of work. Choosing handles that are textured and with good grip design reduces possibility of slippage. Lightweight and sufficiently powered automatic handpieces is also advisable (Kawaldeep et al., 2018).

Meanwhile, even though interpreted as thought of, among the values listed, the question ‘Do you think the dentist should alternate between sitting and standing between patient appointments?’ got the lowest rank with weighted mean of 2.95 which was interpreted as Yes. This is least valued due to the freedom of the clinician to choose the convenient position for better view and access to the patient. However alternating work positions between sitting, standing and being at the side of the patient is advisable for better posture and facilitation of treatment procedures (Chaikumarn, 2005; Kawaldeep et al., 2018).

Table 2.3

Dental Clinicians’ Practice of Ergonomics

	Mean	Rank	Interpretation
1. How frequent do you work with your legs separated and your feet flat on the floor?	2.81	1	Very Often
2. How frequent do you work in the upright position and your spine resting on the back of the stool?	2.45	5	Very Often
3. How frequent do you orient the operating field to the elbow level of your working hand?	2.59	4	Very Often
4. How frequently do you made an effort to maintain neutral posture while working?	2.70	2	Very Often
5. How frequent do you orient beam of light perpendicular to the observational direction?	2.67	3	Very Often
6. How frequently do you use dental loupes for magnification purposes?	2.07	6	Often
Composite Mean	2.55		Very Often

Legend for Motivation: 0.00 – 0.49 (Never), 0.50 – 1.49 (Rarely), 1.50 – 2.49 (Often), 2.50 – 3.49 (Very Often), 3.50-4.00 (Always)

Table 2.3 presents the dental clinicians’ practice of ergonomics. The composite mean of 2.55 denotes that enumerated practices of ergonomics are very often practiced by the dental clinicians. Given the adequate knowledge and acquiring the attitudes toward ergonomics, clinicians are able to apply and put these into practice. Among the practices listed, the clinicians very often work with their legs separated and feet flat on the floor (2.81), followed by very often making an effort to maintain neutral posture while working (2.70) and very often orienting beam of light perpendicular to the observational direction (2.67).

These three practices were the highest among the practices of ergonomics in the dental clinical setup. This is because the students were trained to demonstrate the proper operatory positioning during their pre-clinical years, when they were practicing through simulated cases in the laboratory. They were adequately exposed to the simulated environment of a dental operatory office, and were given feedback and taught with techniques on how to best approach certain clinical cases. Maintaining an erect posture, adjusting the chair that enables the clinician to have feet flat on the floor and legs separated, that is with the knee in about 90-100-degree angle, would ensure balance, less stress and fatigue to the clinician while in statis sitting position. Before proceeding with the treatment, clinicians adjust the height of their chair and the patient’s chair to a comfortable level. Light is also adjusted to provide shadow-free and well illumined operative field. Light source coming from directly above or slightly behind the patient is favorable (Chaikumarn, 2005; Kawaldeep et al., 2018). Clinical instructors also ensures that clinicians observe these practices while they are treating a patient in the dental dispensary, providing them with feedback on a good workstation and ergonomic principle to be applied.

Meanwhile, even though interpreted as very often, among the practices listed, the practice on using dental loupes for magnification purposes got the lowest rank with weighted mean of 2.07. Dental loupes are not readily

available for the use of the clinicians in the dental dispensary, and clinicians rely on direct view or mouth mirror view of the structures they are treating in the oral cavity. Magnification allows clinicians to maintain a farther working distance and place the patients at the right height, with shoulders relaxed and forearms parallel to the floor. Operating telescopes and loupes are commercially available in flip-up and through-the-lens configurations. Working in postures with more than 20 degrees of neck flexion has been linked to an increase in neck pain. The scopes' declination angle should allow you to retain fewer than 20 degrees of neck flexion (Kawaldeep et al., 2018).

Table 2.4 presents the summary of the dental clinicians' Knowledge, Attitude and Practice of Ergonomics. Among these three, attitude got the highest rank with composite mean of 3.25, followed by knowledge with 2.79 and lastly by practice of ergonomics with 2.55 interpreted as very often.

Table 2.4

Summary Table for the Dental Clinicians' Knowledge, Attitude and Practice of Ergonomics

	Mean	Rank	Interpretation
Knowledge	2.79	2	Yes
Attitude	3.25	1	Yes
Practice	2.55	-	Very Often

Legend for Attitude and Knowledge: :0.00 – 0.49 (Definitely No), 0.50 – 1.49 (No), 1.50 – 2.49 (Neutral), 2.50 – 3.49 (Yes), 3.50-4.00 (Definitely Yes) / Legend for Practices: :0.00 – 0.49 (Never), 0.50 – 1.49 (Rarely), 1.50 – 2.49 (Often), 2.50 – 3.49 (Very Often), 3.50-4.00 (Always)

The knowledge, attitude, and practice of ergonomics were satisfactory among the participants. The dental clinicians exhibit good attitudes towards ergonomics, as they also have the knowledge about ergonomics in dental practice. They also very often practice the ergonomic principles in their clinical work. Doing dental clinical work necessitates both mental and physical focus, and a tight work schedule causes clinicians to adopt poor working postures (Patel, 2021). This working environment is introduced to the dental students more evidently during their clinical dentistry training, where they are engaged with a variety of dental cases and procedures. During their basic dental years, students were being taught of the theoretical part of the dental curriculum. As they progressed, clinical and laboratory works are being incorporated and students became more engaged in the rigors of the dental practice and wide range of dental treatments. This result is similar to the findings of a study on Tanta University Dentistry students (El-sallamy et al., 2017), wherein only one quarter of the student population had high awareness of ergonomics, while nearly half of the students (48.9%) had fair knowledge. 84.8 percent of the participants had good views, but 95.4 percent had inadequate ergonomics practices. Principles learned must be appreciated so that they may be practiced on a regular basis. Even though there is high awareness and positive attitude towards employing ergonomic principles, there are still students who have inadequate ergonomic practice.

Dental schools, especially through the clinical instructors must ensure that ergonomics is included into daily dental practice and training of the students to be able to address the inadequate ergonomic practice in the clinic. This can be accomplished by including ergonomics in their curriculum and providing close monitoring during execution of dental treatment in the dental dispensary.

Table 3 presents the significant difference on the dental clinicians' knowledge attitude and practices of ergonomics and group according to profile. It can be seen on the table that knowledge and attitude are not affected by the demographic profile. This means that regardless of the age, sex, year level, residence, work duration, physical activity and body pains, all of the respondents have the same assessment on knowledge and attitude. The discipline of ergonomics has vast applications across different professional settings, the health and medical profession included, and therefore relevant to any worker and setting. As a science that is multidisciplinary by design, ergonomics applies to every workstation and workers aiming to provide analysis on human behavior and competencies in conjunction with engineering principles. Ergonomics seek to minimize harm and understand the cause of errors which can result to improved safety and performance (Borsci & David, 2020).

Table 3

Differences on the dental clinicians' knowledge, attitude and practice of ergonomics

	Knowledge			Attitude			Practices		
	t/F	p-value	I	t/F	p-value	I	t/F	p-value	I
Age	1.704	.170	NS	1.267	.289	NS	4.235	.007	S
Sex	.856	.394	NS	-.384	.702	NS	2.551	.012	S
Year Level	1.601	.112	NS	.690	.492	NS	1.110	.269	NS
Residence	.761	.469	NS	.523	.594	NS	1.069	.347	NS
Work Duration	-.580	.563	NS	-.090	.928	NS	-1.566	.120	NS
Physical Activity	1.026	.307	NS	.272	.786	NS	2.411	.017	S
Body Pains	2.152	.098	NS	.057	.982	NS	3.380	.021	S

Legend: Difference is significant at 0.05 alpha level, NS (Not Significant), S (Significant)

However, with regard to practices, it can be seen that age, sex, physical activity and body pains have significant difference. Post hoc revealed that in age, the difference exists when age 22 and 23 is compared. In terms of Sex, Male practice it more often (2.83) as compared to females (2.48). According to Laberge et al. (2020), more women reported working under pressure to finish their job on time, while for men, there is greater ease in performing tasks at work during intense participation in the work. Ergonomics should be applied to all age and genders as there is need in acquiring new health equity and inclusive practices into workplace policies.

In terms of physical activities, those who have physical activities outside work scored higher (2.66) than those without (2.40). For students receiving distance education during the COVID-19 pandemic, specific training programs including posture and ergonomics may increase ergonomics awareness in terms of alleviating musculoskeletal pain while boosting their physical activity level and contributing to their attitude of exercise behavior decision-making balance (Tigli et al., 2020). Exercise done outside clinical works is beneficial to the clinicians because it reduces the risk of developing work-related musculoskeletal disorders, more so they can impact their quality of life and career length (Lavé et al., 2020).

In terms of body pains, the difference only exists when those who have none is compared with those with severe body pains. Physically-demanding work expected from health care professionals can result to ergonomic-related injuries (Depauw & Eeckhoven, 2021). Upper and lower body discomfort, pronounced fatigue from poor hand posture, glenohumeral strain, and neck pain, among others, are experienced as a result of poor ergonomic considerations. Fatigue— specifically hand fatigue— is considered as one of the most frequently experienced ergonomic-related injuries in healthcare. Muscles responsible for hand movements are vulnerable to fatigue and strain and can result to pain and injury.

Musculoskeletal diseases caused by poor work ergonomics are common among surgeons, and they may force them to change their practices (Catanzarite et al., 2018; Cardenas-Trowers et al., 2018). These diseases are also common among dental practitioners (Mulimani et al., 2019), and often begins to manifest early, particularly when they are still dental students. The understanding and practice of ergonomics during dental work can help minimize the risk of developing musculoskeletal disorders. There is satisfactory dentistry students' ergonomics knowledge, attitude, and practice during ordinary dental operations. Thus, ergonomic education for dental health-care employees should be a component of the curriculum at all educational institutions and continuing dental health programs, imparting ergonomic principles both conceptually and practically (Kumar et al., 2020).

Presented in Table 4 is the significant relationship among knowledge, attitude and practice of ergonomics among dental clinicians. If a student has more knowledge about ergonomics, there is also a more positive attitude towards ergonomics and more likely that he would practice such ergonomics principles. Dentistry is basically an outcome-based program, as students are being trained to have a good theoretical foundation and knowledge of Dentistry as a medical science. The goal of acquiring solid theoretical foundation is to apply this body of knowledge to treatment and interventions addressing dental concerns of the patients, while keeping positive attitude towards dental care, the patient and developing oneself as one progresses in the dental profession.

Table 4

Relationship of the Dental Clinicians' Knowledge, Attitude and Practice of Ergonomics

	Knowledge			Attitude			Practices		
	r _{xy}	p-value	I	r _{xy}	p-value	I	r _{xy}	p-value	I
Knowledge	1	-	-	.464**	.000	S	.581**	.000	S
Attitude	.464**	.000	S	1	-	-	.277**	.002	S
Practices	.581**	.000	S	.277**	.002	S	1	-	-

Legend: Relationship is significant at 0.05 alpha level, NS (Not Significant), S (Significant)

In a study by Kumar (2020), dental students' knowledge, attitude, and practice related to ergonomics were satisfactorily increased after the students were provided with ergonomic guidelines in their clinical work. Therefore, there is a need to increase in awareness about dental ergonomic principles while they were still studying, and further as they continue their dental health programs and career. This is evidence that with adequate provision of guidelines and teaching of the principles of ergonomics, good working environment and ergonomic practice may also be improved and maintained in the dental clinic. Proper monitoring of the implementation of these guidelines may be put in place, so that students will be habitual abiding with the ergonomic principles in their patient treatment.

Table 5

Plan of Action to Enhance Ergonomics in Clinical Dentistry

KRA/ Objectives	Strategies	Expected Outcome	Persons Responsible
Knowledge			
To increase awareness on proper illumination of the operatory field	Provide orientation of ergonomic principles in the dental dispensary	Better awareness of the ergonomic guidelines in the clinic	Chief of Clinic, Clinical instructors, clinicians
To increase awareness of chairside stretching exercises	Post an infographic of chairside stretching exercise in the dental dispensary	Good reminder for clinicians to perform the exercise	Staff, clinicians
To increase awareness of the proper operating posture	Conduct orientation about operating postures during pre-clinical lab classes	Better understanding of proper operating posture needed in dental procedures	Faculty members, students
Attitude			
To enhance interest towards continuing dental education supporting ergonomic principles applied in Dentistry	Collaborate with professional organizations to facilitate learning opportunities on ergonomics and occupational safety	Wider exposure of students to ergonomics and occupational safety training	Dean, Faculty members, students, other health professions organizations
To appreciate alternate postures during treatment	Provide feedback to clinicians before, during and after clinical procedures	Appreciation of ergonomic techniques relevant to procedures done	Clinical instructors, clinicians
To appreciate ergonomic principles incorporated in the dental curriculum	Provide demonstration of operating postures during pre-clinical laboratory classes	Application of ergonomic principles as early as pre-clinical years	Faculty members, students,
Practice			
To promote and familiarize use of magnification devices such as dental loupes, intraoral camera and mirrors	Acquisition and training faculty and students in using ergonomic equipment in the dental practice	Innovation supportive of ergonomic dental practice	Dentistry Dean, Faculty members, students
To perform clinical work using proper operating postures	Include operator ergonomics in the grading rubric of clinical cases	Satisfactory practice and monitoring of operator ergonomics	Clinical instructors, clinicians
To ensure ergonomic workstation and operating field	Include ergonomic workstation and operating field in the grading rubric of clinical cases	Satisfactory practice and monitoring of ergonomic workstation	Clinical instructors, clinicians

4. Conclusion and recommendation

Conclusion - Majority of the respondents are 22 year-olds, female, fourth year students, living in suburban location, with more than five hours per day work duration, doing physical activity outside work and are experiencing mild body pains during or after clinical works. The knowledge, attitude, and practice of ergonomics were satisfactory among the participants. The dental clinicians have the knowledge about ergonomics and exhibit good attitudes towards ergonomics. They also very often practice the ergonomic principles in their clinical work. Ergonomic knowledge and attitude are not affected by the demographic profile. However, with regard to practices, it can be seen that age, sex, physical activity and experience of body pains have significant difference. There is a significant relationship among knowledge, attitude and practice of ergonomics among dental clinicians. If a student has more knowledge about ergonomics, there is also a more positive attitude towards ergonomics and more likely that he would practice such ergonomics principles. The researchers were able to propose an action plan to enhance ergonomics in Clinical Dentistry based on the result of the study.

Recommendation - Lyceum of the Philippines University Batangas may enhance ergonomics in the Clinical Dentistry by providing guidelines and infographics in the dental dispensary. They may also be a thorough review of the dental equipment and tools acquired for the use of the students in clinical training. Occupational safety training may be provided for both students and clinical instructors. College of Dentistry may conduct orientation during the pre-clinical years about ergonomic principles employed in the clinic, and ensure tools recommended for use follow good dental ergonomics and safety. This orientation may be enhanced and further enforced as clinicians begin to work in the dental dispensary. The Chief of clinic, as well as section heads of the various clinics, may include in the grading rubric of clinical cases the adequate ergonomic principles applied by the clinicians and ensuring there is ergonomic workstation and operating field during treatment. Clinical instructors may provide feedback and assessment on the basis of posture and ergonomics as they monitor clinicians doing the procedure. The proposed action plan may be submitted to the College of Dentistry for further discussion and may be reviewed for possible implementation. Future researchers may conduct similar study that may further enhance ergonomics in the dental practice. More studies may be done to monitor the progress of the clinicians after implementing ergonomic guidelines and protocols in the clinic.

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