

ASSESSMENT OF AN ERGONOMICS INTERVENTIONAL EDUCATIONAL PROGRAM ON KNOWLEDGE, ATTITUDE, PRACTICE AND BEHAVIOR AMONG A GROUP OF EGYPTIAN DENTAL STUDENTS

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ABSTRACT

Oral and Dental Medicine is a profession where clinically, operational skill is restricted to an area covering only a few tens of millimeters (the mouth) and requires repeated, precise force application while delivering oral health. Ergonomic is the science dealing with people and their working environment, but evaluation of ergonomics' awareness is minimal among dentists.

Aim: To assess the effect of an ergonomics interventional educational program on knowledge, attitude, practice and behavior among a group of Egyptian dental students.

Subjects and Methods: In an interventional study, 40 right-handed dental students aged 20–25 years were educated and assessed on ergonomics in dentistry. The participants were requested to fill out a questionnaire about ergonomics before and after the interventional educational program.

Statistical analysis: Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, data showed non-parametric (not-normal) distribution. Mann-Whitney test was used to compare between two groups in non-related samples. Wilcoxon test was used to compare between two groups in related samples. Spearman test was used to test correlation between variables.

Results: There was a statistically significant difference between (Before) and (After) groups where ($p < 0.001$) regarding each of knowledge, attitude and practice in both females and males.

Conclusions: The ergonomic educational program was effective in the promotion of knowledge, attitude and practice of dental students in relation to working body posture.

KEYWORDS: Interventional educational program, knowledge, attitude, practice, behavior and ergonomics in dentistry.

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INTRODUCTION

Human being survival is dependent on proper intake of food and adopting healthy life styles. Occupation gives secure life and organizes behavior. Dentistry is a profession where clinically, operational skill is restricted to an area covering only a few tens of millimeters (the mouth) and requires repeated, precise force application while delivering oral health. These situations demand a fixed posture that can create occupation hazards for dentist. The term Ergonomics has been derived from Greek word 'Ergo' mean work and 'nomic' means natural. It is defined as a set of multidisciplinary knowledge applied to the organization of labor activity that makes up a job. The goal of ergonomics is to stabilize a safe, healthy and comfortable working environment, thereby preventing health problem and improving productivity. ⁽¹⁾

If ergonomic principles are applied in the field of dentistry, it will help reduce cognitive and physical stress, prevent occupational hazards, thus, it will improve productivity and comfort to the dentist and the patient. Worldwide increased awareness among population regarding the importance of maintaining proper oral health, led to an increased demand to seek dental health care. This increased work load on the dental health care providers. Moreover; inappropriate postures while treating the dental patients and injudicious working hours might lead to multiple occupational hazards among dental health care providers. ⁽²⁾

There is a wide range of musculoskeletal disorders, back pain was the most common one among dentists, followed by neck pain, high muscle tension on the trapezoids, tendinitis, carpal tunnel syndrome, nerve trapping, early arthrosis, myopia and auditive alterations. ⁽³⁾ **Pargali and Jowkar in 2010** reported that 73% of dentists complained of back and neck pain. Again, even though the practice of four- handed dentistry and the use of ergonomically well-adjusted equipment are on the

rise, literature reports have reported a rise in back, neck, shoulder, and arm pain in almost 81% of dental professionals. ⁽⁴⁾

Work-related stress, tension, and awkward postural positions can add to back and neck problems for the dentist. ⁽⁵⁾ A recent study reported that from 189 retired dentists, the common reason for retirement was musculoskeletal disorders. ⁽⁶⁾

Since several studies revealed contradicting results regarding knowledge and awareness of dental professionals about ergonomics worldwide. ⁽⁷⁾ Applying dental ergonomics can improve the quality of work making it easier, faster and safer, consequently increasing productivity and maintaining better quality of life for dental professionals, and the need increases to include ergonomics' principles in the curricula of all dental schools. ^(8,9)

AIM OF STUDY

In the Egyptian set-up there is a severe dearth of literature evaluating knowledge, attitude, practices and behavior among dental students regarding optimal postures at the time of rendering oral health services. Therefore, the current ergonomics interventional educational program was conducted with the aim to evaluate the effect of ergonomics educational intervention on knowledge, attitude, practice and behavior of dental students among a group of Egyptian dental students.

SUBJECTS AND METHODS

An ergonomics interventional educational program was carried out on a group of students of the tenth semester in Faculty of Oral and Dental Medicine, Future University in Egypt. Researchers of the current study followed the rules and regulations of Ethical Committee of Faculty of Oral and Dental Medicine, Future University in Egypt; the purpose of the study was explained to the students and a written informed consent was obtained from each volunteer.

All the right-handed participants aged 20–25 years, who were attending the pediatric and conservative dentistry courses were invited for the study (n=40). Left-handed dental students and those over 25 years of age were excluded. The subjects were asked to complete a tailored self-administered questionnaire which was used as the study instrument consisting of 28 questions to evaluate their previous awareness and training, knowledge, attitude, practices and behavior in relation to ergonomics in dentistry. Subjects were asked to respond to each item according to the response format. Subjects received full explanation of how to score their responses and were made fully aware regarding responses before they started the questionnaire.

The questionnaire was comprising of demographic information, then it comprised 4 sections including; first: the history of ergonomics training (previous awareness and training), Second: 6 questions on knowledge assessed whether they knew (height of the dental stool, elbow level, range of upper arm abduction, range of bending of the head and trunk, position of the upper and lower extremities and appropriate sitting area for the right and left quadrants). Knowledge was assessed by a total of 6 questions on ergonomics that focused on principles of ergonomics in routine dental procedures such as pediatric and conservative dentistry procedures. Correctly answering between 6 and 5 questions was regarded as having good knowledge. Correctly answering between 4 and 3 questions was regarded as having fair knowledge and correctly answering between 2 and 1 questions/ question were/was regarded as having poor knowledge.

Third: another 6 questions assessed their attitude towards whether (ergonomics awareness and principles should be part of the dental curriculum, if dentists should follow the ergonomic principles in routine dental practice, whether the dental chair and instruments play any role in following ergonomics principles in routine dental practice, whether

four handed dentistry is important in dentistry, whether the dentist should alternate between sitting and standing between patient appointments and whether various dental institutions should conduct continuing dental education). Correctly answering between 6 and 5 questions was regarded as having good attitude. Correctly answering between 4 and 3 questions was regarded as having fair attitude and correctly answering between 2 and 1 questions/question were/was regarded as having poor attitude.

Fourth: ergonomic practices and behavior at the workplace were also elicited. These were a multiple choice 15 questions in which participants were allowed to choose all options that applied to them. Questions included (indirect visualization of maxillary teeth, gentle hand movements, changing positions while working, placing feet flat on the floor while working, taking intermittent breaks while working, keeping the back supported while sitting as well as working with assistance when necessary, keeping the shoulders relaxed while working, keeping the neck tilted only within safe limits, ensuring and/or advocating ergonomically considered shift duties, adjustment of workspace for better viewing and engaging in physical activity while working, how frequently the respondents obtained information related to ergonomics in dentistry either from the internet or scientific journals, using dental loupes for magnification purposes, making an effort to maintain neutral posture while working, attending any workshop/lecture on ergonomics in dental career and performed stretching exercises in between patient appointments). Application of 15-11 ergonomic practices was regarded as having good practice. Application of 10-6 ergonomic practices was regarded as having fair practice and application of 5-1 was regarded as having poor practice.

Then an interacting lecture was given on Ergonomics in Dentistry by trained lecturers of Pediatric and conservative Dentistry. The same questionnaire was completed again by the

participants after 2 weeks. After that scoring the knowledge, attitude, practices and behavior was done and data before and after intervention were statistically analyzed.

RESULTS

The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, data showed non-parametric (not-normal) distribution. Mann-Whitney test was used to compare between two groups in non-related samples. Wilcoxon test was used to compare between two groups in related samples. Spearman test was used to test correlation between variables. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows. Out of the 40 dental students participating in the study, 16 were females and 24 were males. Prior to the study, 16 of the dental students reported that they were a little bit familiar with the ergonomics and 24 were not familiar with it at all.

Effect of educational intervention on both females and males as shown in table 1 and figure 1

(A) Females

Regarding Knowledge: There was a statistically significant difference between (Before) and (After) groups where ($p < 0.001$). Before educational intervention; 8 (50%) showed poor results, 8 (50%) showed fair results and 0 (0%) showed good results. While After educational intervention; 0 (0%) showed poor results, 2 (12.5%) showed fair results and 14 (87.5%) showed good results.

Regarding attitude: There was also a statistically significant difference between (Before) and (After) groups where ($p = 0.002$). Before educational intervention; 0 (0%) showed poor results, 10 (62.5%) showed fair results and 6 (37.5%) showed

good results. While After educational intervention; 0 (0%) showed poor results, 0 (0%) showed fair results and 16 (100%) showed good results.

Regarding practice and behavior: There was again a statistically significant difference between (Before) and (After) groups where ($p = 0.014$). Before educational intervention; 0 (0%) showed poor results, 8 (50%) showed fair results and 8 (50%) showed good results. While After educational intervention; 0 (0%) showed poor results, 2 (12.5%) showed fair results and 14 (87.5%) showed good results.

(B) Males

Regarding knowledge: There was a statistically significant difference between (Before) and (After) groups where ($p = 0.001$). Before educational intervention; 8 (33.3%) showed poor results, 12 (50%) showed fair results and 4 (16.7%) showed good results. While After educational intervention; 2 (8.3%) showed poor results, 4 (16.7%) showed fair results and 18 (75%) showed good results.

Regarding attitude: There was also a statistically significant difference between (Before) and (After) groups where ($p = 0.014$). Before educational intervention; 0 (0%) showed poor results, 6 (25%) showed fair results and 18 (75%) showed good results. While After educational intervention; 0 (0%) showed poor results, 0 (0%) showed fair results and 24 (100%) showed good results.

Regarding practice and behavior: There was again a statistically significant difference between (Before) and (After) groups where ($p = 0.010$). Before educational intervention; 6 (25%) showed poor results, 10 (41.7%) showed fair results and 8 (33.3%) showed good results. While After educational intervention; 0 (0%) showed poor results, 8 (33.3%) showed fair results and 16 (66.7%) showed good results.

TABLE (1) The frequencies values of different variables

Variables			Educational intervention			
			n	%	p-value	
Knowledge	Females	Before	Poor	8	50%	<0.001*
			Fair	8	50%	
			Good	0	0%	
		After	Poor	0	0%	
			Fair	2	12.5%	
			Good	14	87.5%	
	Males	Before	Poor	8	33.3%	0.001*
			Fair	12	50%	
			Good	4	16.7%	
		After	Poor	2	8.3%	
			Fair	4	16.7%	
			Good	18	75%	
Attitude	Females	Before	Poor	0	0%	0.002*
			Fair	10	62.5%	
			Good	6	37.5%	
		After	Poor	0	0%	
			Fair	0	0%	
			Good	16	100%	
	Males	Before	Poor	0	0%	0.014*
			Fair	6	25%	
			Good	18	75%	
		After	Poor	0	0%	
			Fair	0	0%	
			Good	24	100%	

Variables				Educational intervention		
				n	%	p-value
Practice & behavior	Females	Before	Poor	0	0%	0.014*
			Fair	8	50%	
			Good	8	50%	
		After	Poor	0	0%	
			Fair	2	12.5%	
			Good	14	87.5%	
	Males	Before	Poor	6	25%	0.010*
			Fair	10	41.7%	
			Good	8	33.3%	
		After	Poor	0	0%	
			Fair	8	33.3%	
			Good	16	66.7%	

*; significant (p<0.05) ns; non-significant (p>0.05)

Questionnaire results as shown in table 2 and figure 2

There was a statistically significant difference between (Before) and (After) groups in all questions except question 9 where there was no statistically significant difference between (Before) and (After) groups.

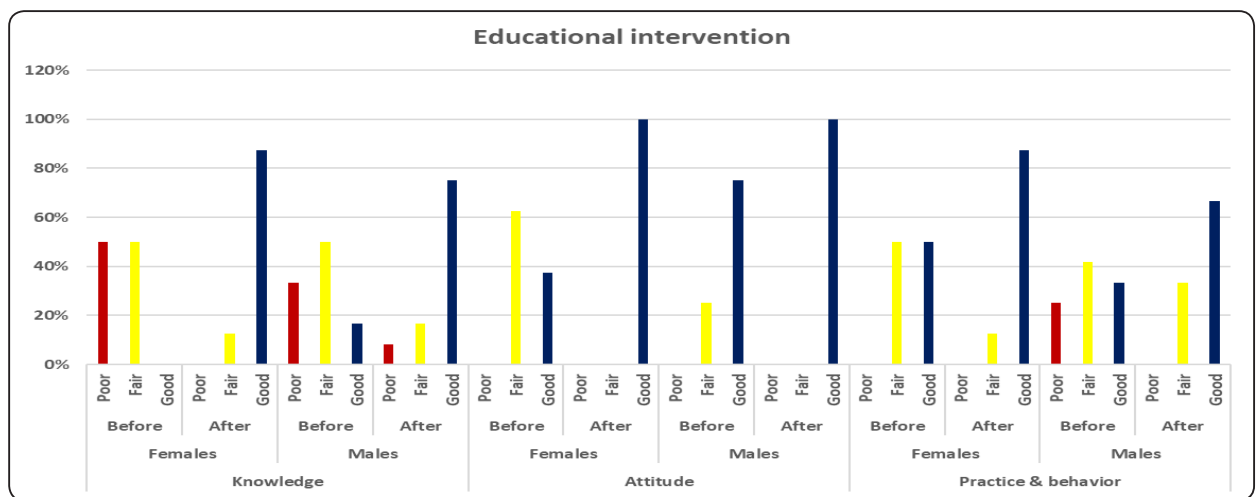


Fig. (1) Bar charts representing educational intervention

TABLE (2) The frequencies values of different variables

Variables			Educational intervention		
			n	%	p-value
Question 1 The height of the dental stool	Before	Right	24	60%	<0.001*
		Wrong	16	40%	
	After	Right	40	100%	
		Wrong	0	0%	
Question 2 The relation of patient's mouth to dentist's elbow	Before	Right	24	60%	0.002*
		Wrong	16	40%	
	After	Right	34	85%	
		Wrong	6	15%	
Question 3 The upper arm of dentist	Before	Right	14	35%	<0.001*
		Wrong	26	65%	
	After	Right	36	90%	
		Wrong	4	10%	
Question 4 The range of trunk rotation	Before	Right	4	10%	<0.001*
		Wrong	36	90%	
	After	Right	30	75%	
		Wrong	10	25%	
Question 5 The position of upper & lower extremities	Before	Right	18	45%	0.001*
		Wrong	22	55%	
	After	Right	30	75%	
		Wrong	10	25%	

Variables			Educational intervention		
			n	%	p-value
Question 6 The appropriate sitting area for the right and left quadrants	Before	Right	24	60%	0.002*
		Wrong	16	40%	
	After	Right	34	85%	
		Wrong	6	15%	
Question 7 Whether ergonomics awareness & principles should be part of the dental curriculum	Before	Right	32	80%	0.005*
		Wrong	8	20%	
	After	Right	40	100%	
		Wrong	0	0%	
Question 8 Whether the dentist should alternate between sitting and standing between patient appointments	Before	Right	32	80%	0.005*
		Wrong	8	20%	
	After	Right	40	100%	
		Wrong	0	0%	
Question 9 Using dental loupes for magnification purposes	Before	Right	18	45%	1ns
		Wrong	22	55%	
	After	Right	18	45%	
		Wrong	22	55%	
Question 10 Performing stretching exercises in between patient appointments	Before	Right	22	55%	<0.001*
		Wrong	18	45%	
	After	Right	36	90%	
		Wrong	4	10%	

*; significant (p<0.05) ns; non-significant (p>0.05)

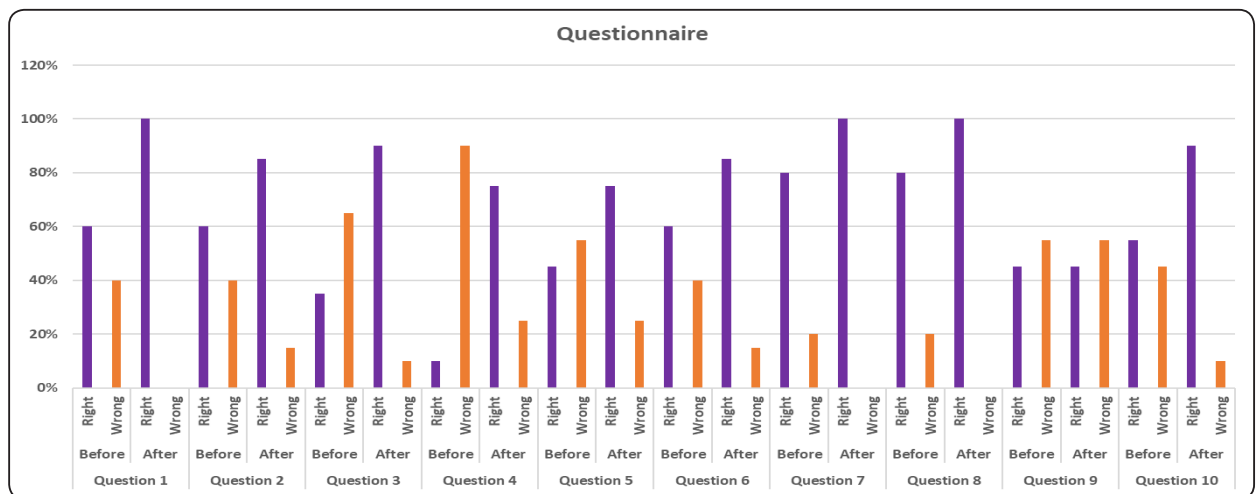


Fig. (2) Bar charts representing Questionnaire

Correlations as shown in table 3 Correlation between knowledge, attitude and behavior

A statistically significant difference was found between Knowledge and attitude where ($p=0.002$) with inter class correlation coefficient (ICC) (0.338).

No statistically significant difference was found between Knowledge, practices and behavior where ($p=0.187$) with inter class correlation coefficient (ICC) (0.149).

A statistically significant difference was found between attitude, practices and behavior where ($p=0.004$) with inter class correlation coefficient (ICC) (0.318).

TABLE (3) Table showing relationship between knowledge, attitude and behavior:

			Correlations		
			Knowledge	Attitude	Behavior
Spearman	Knowledge	Correlation Coefficient	1.000	.338**	.149
		Sig. (2-tailed)	-	.002	.187
	Attitude	Correlation Coefficient	.338**	1.000	.318**
		Sig. (2-tailed)	.002	-	.004
	Behavior	Correlation Coefficient	.149	.318**	1.000
		Sig. (2-tailed)	.187	.004	-

** . Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

Musculoskeletal pain is a major problem among dental personnel that affects efficiency and job satisfaction; the prime reason for this may be attributed to inappropriate workplace ergonomics. Ergonomics has been always neglected, from both knowledge and practice point of view during clinical work. In addition ergonomics is not a part

of the syllabus proposed for both undergraduates and postgraduates. Thus it is important that health personnel including dentists should know what these principles are about and how they can be achieved. ⁽¹⁰⁾

In Egypt the data about ergonomics is scarce; so, on this premise the current ergonomics interventional educational program was conducted with the aim to evaluate the effect of ergonomics educational intervention on knowledge, attitude, practice and behavior among a group of Egyptian dental students. According to the syllabus for BDS proposed by the Dental Council of Egypt, undergraduates are exposed to clinical working conditions for the very first time during the 3rd year of courses, during which every student undergoes training in various subjects on a rotating basis for a fixed amount of time. This is the time during which ergonomics, as a part of the regular curriculum, should be taught, so that its importance in practice is emphasized and various guidelines are followed. For this reason, undergraduates were included as study participants.

In the present study the dental undergraduate students highly responded to the questionnaire, this high response rate may be due to handling the questionnaire to the students in person and not by mail, this comes in agreement with **Desai et al; 2012.** ⁽¹¹⁾

At base line of the current study less than half (16 students) of the studied sample thought that they adopt ergonomics principles during their routine work since they stated that they received little information about health hazards (general) in their curriculum, at the beginning of their clinical years, on contradiction more than half (24 students) reported no previous knowledge about ergonomics, this is in accordance with **Diaz- Caballero et al; 2010,** who reported that this may be due to not integrating ergonomics in syllabus of dental schools and the knowledge is disseminated by informal means. ⁽¹²⁾

Regarding the educational program in the present study, education on ergonomics was shown to be

effective in the promotion of knowledge, attitude, practice and behavior of dental students, since psychosocial and biomechanical factors related to occupational health problems can be controlled by education. In agreement with the present study, **Mohammadi et al. 2010** ⁽¹³⁾, reported that increasing the knowledge of workers in relation to occupational health is the basic factor for promoting the positive attitude and practice.

Stetler et al. ⁽¹⁴⁾ have emphasized that the multi-interventional methods, including the elimination of risk factors along with the educational programs, might be effective in solving the problem of musculoskeletal disorders.

Considering the positive effect of education in this study, dental professionals should be aware of the importance of ergonomics in dentistry and should be encouraged to apply it while providing dental care. Since it was previously emphasized that regular exercises and breaks during working hours decreased the frequency and severity of various musculoskeletal disorders ⁽¹⁵⁾

Regarding knowledge of females, the results of the current study showed that the ergonomics knowledge for the “good scores” increased from 0% before program to 87.5% after program, also knowledge of males for the “good scores” increased from 16.7% to 75% which were similar to results found in a study conducted by **Garbin et al; 2011** ⁽¹⁶⁾ in which the knowledge of ergonomics was satisfactory among 55.1% of dental students.

The results of knowledge questions showed significant increase in right responses of knowledge questions before and after educational program regarding height of the dental stool (increased from 60% to 100%) elbow level (increased from 60% to 85%), range of upper arm abduction (increased from 35% to 90%), range of bending of the head and trunk (increased from 10% to 75%), position of the upper and lower extremities (increased from 45% to 75%) and appropriate sitting area for the right and left quadrants (increased from 60% to 85%); these

results before the current educational program study disagree with **Barlean et al; 2012** ⁽¹⁷⁾ and **Madaan and Chaudhari; 2012** ⁽¹⁸⁾, who revealed that half of the dentists had fair knowledge, this could be attributed to lack of ergonomics principles in our curricula in Egypt.

Regarding the level of the attitude of females, the results of the current study showed that the ergonomics attitude for “good scores” increased from 37.5% before program to 100% after program, also attitude of males for the “good scores” increased from 75% to 100%; which is a good reflection of acceptability and willingness to adopt the ergonomic principles in routine dental practice by the study participants. According to the results of the current study it was found that high percentage of students believed in the importance of the concepts of ergonomics, this goes in agreement with **Mailoa & Rovani 2011** ⁽¹⁹⁾ and **El-Sallamy et al; 2017** ⁽²⁰⁾, who reported the importance of receiving information about ergonomics from internet and/or supervisors during clinical work, on the contrary these results disagree with results of a study conducted by **Madaan and Chaudhari 2012** ⁽¹⁸⁾, which showed lower scores of awareness (19%).

The scores of attitude question in the present study: including ergonomics in dental curricula, increased from 80% to 100% of which the participating dental students agreed about integrating ergonomics in dental curricula. This goes in agreement with **Vyas et al; 2014** ⁽²¹⁾ to avoid major occupational hazards problems, and **El-Sallamy et al; 2017** ⁽²⁰⁾ who stated that 69.1% thought that ergonomics should be integrated in dental curricula.

Again the results of the current study showed the increase in positive response towards standing between appointments from 80% to 100%, this goes in accordance with **Desai et al; 2012** ⁽¹¹⁾, however these results after the program disagreed with **Garbin et al; 2015** ⁽²²⁾, who revealed that about 86% of the dentists stated that they don't rest between appointments.

The practice scores; “good scores” of females in the current study were 50% before program and increased to 87.5% after program, also practice of males for the “good scores” increased from 33.3% to 66.7%; which is higher than the 38.6% found in a study conducted by **Mailoa and Rovani** ⁽²³⁾.

Regarding the practice question in the present study; most of the dentists in the study didn't use loupes, it's results nearly goes in accordance with **Desai et al; 2012** ⁽¹¹⁾ who reported that 70% didn't use loupes, this could be attributed to young age of the interns and they are just starting their clinical practice as well as extra expenses needed to use loupes.

Another practice question in the present study; half of the students before program performed stretching exercises and the other half didn't which increased after program to 90%, this may provide dentists with break from excessive workload, and strengthen their bodies in addition to providing mental relaxation. ⁽²⁴⁾

The correlation analysis revealed positive association between knowledge and attitude (0.338). However, there was a minimal positive correlation between knowledge and practices (0.149). This signifies that despite the presence of awareness and positive attitude toward ergonomics during dental procedures, there is a lack of practice.

Probably, lack of exposure of undergraduates during graduation, towards the dental ergonomics principles, poor understanding of ergonomic theory; coupled with other various factors places the dental practitioners at higher risk of work related musculoskeletal disorders. In this sense, it is wise to inculcate the ergonomics in the study curriculum for better understanding and learning. The dental profession should make an effort to create awareness about the ergonomics; also the dental students should be taught during graduation the importance of dental ergonomic principles. The acquisition of ergonomics knowledge can occur at any time however early assimilation of knowledge

and internalization of dental ergonomic principles might prevent their suffering from work related musculoskeletal disorders afterwards.

CONCLUSIONS AND RECOMMENDATIONS

The ergonomic educational program was effective in the promotion of knowledge, attitude, practice and behavior of dental students in relation to working body posture. Since knowledge, attitude, practice and behavior of dental students are not satisfactory; so there is a strong need for implementation of ergonomics in day to day students' life. There is a need to motivate and promote dentists towards the importance of ergonomics. The goal of ergonomic is to establish a safe, healthy and comfortable working environment, thereby preventing health problems and improving work efficiency so that dentists can enjoy a healthy life style and enable them to have quality of life.

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Conflict of interest:

The Authors declare that there is no conflict of interest.

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