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An interventional ergonomics program assessment of dental students

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ABSTRACT

The objective was to evaluate the effect of ergonomic education on knowledge, attitude and practice of dental students about working body posture. In an interventional study, 50 right-handed dental students aged 20–25 years were educated and assessed on ergonomic body posture. The participants were requested to fill out a questionnaire about ergonomics, before and after the education. They also frequently paid attention to their sitting posture while treating the school children during a four-week period. Data were analyzed using chi-square, independent t-test and paired-sample t-test at a significance level of $P<0.05$. The mean (SD) score of knowledge before and after the education were estimated at 11.9±4.4 and 20.5±6.7, respectively. There was a significant difference between knowledge scores before and after the intervention (P=0.00). No significant difference was found between the baseline scores of knowledge in terms of gender, but the knowledge scores of females after the intervention were significantly higher than that of the males. Knowledge scores were not significantly different in terms of semesters. The attitude scores were calculated at 27.9±2.1, 28.8±1.8, respectively before and after the intervention and the practice scores were 17.2±2.2 and 18.2±2.2, respectively. These scores improved after education (P=0.03, P=0.00), with no significant differences in terms of gender or semester. During the observation period, ergonomic principles were respected for 78.4±10.1%, not correlated to gender or semester. It was concluded that knowledge, attitude and practice of dental students were improved by an ergonomic educational program.

KEY WORDS: ERGONOMICS, DENTAL STUDENTS, KNOWLEDGE, ATTITUDE, PRACTICE

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INTRODUCTION

In spite of industrialization, mechanization, development of feasibilities and equipment, and lowering physical work-load, work-related musculoskeletal disorders (WMSDs) are still considered to be one of the occupational health hazards (Mohammadi, et al. 2010). WMSDs include a wide range of signs and symptoms involving muscles, tendons and joints (Muslim, et al. 2012 ; Tirgar, et al. 2013).This occupational disorder is a multi-factorial phenomenon. Morphological and genetic risk factors, as well as psycho-social and biomechanical risk factors have a role in WMSDs (Muslim, et al. 2012; Mohammadi, et al. 2010). Morphological and genetic factors in terms of personal characteristics which include weight and body mass index (BMI), etc are the main predictors of WMSDs (Tirgar, et al. 2013).

Psychosocial risk factors such as heavy work-load, insufficient rest and stressful job constitute other important predictors of WMSDs (Tirgar, et al. 2013). Biomechanical risk factors which are described as unfavorable with prolonged statistical working posture, forceful and repetitive motions alongside unsuitable workplace physical conditions such as light, temperature, sound, design of equipment, etc. were found to have greatly influenced WMSDs (Muslim, et al. 2012 ; Diaz-Caballero, et al. 2010; Mohammadi, et al. 2010).

Dentistry as a very fine and precise profession is naturally stressful. Dental professionals frequently suffer from physical and psychological tensions while working. Prolonged working time, static body posture, forceful and repetitive motions, badly designed instruments or workplaces alongside inevitable psychological stress exposes them to WMSDs (Muslim, et al. 2012 ; Diaz-Caballero, et al. 2010; Mohammadi, et al. 2010; Karibasappa et al. 2014). Limited studies were conducted on dental students to evaluate MSDs despite many documented data for dental professionals (Hayes, et al. 2009). However, it has been reported that 64-93% of dentists and 70% of dental students suffer from WMSDs and moreover they are at risk of neurovascular and postural disorders (Khan and Chew et al. 2013).

In an analytical cross-sectional study conducted by de Carvalho et al 2009. the frequency of pain during or after clinical work was estimated to be 76.2% in dental students and this was significantly associated with gender (de Carvalho, et al. 2009). In addition, in an investigation conducted by Tirgar et al. on general dental practitioners working in Babol-Iran, it was demonstrated that 83.3% of dentists suffered from cervical pain, 56.7% and 41% reported to be suffering from back and shoulder pains (Tirgar, et al. 2015).

Ergonomics focuses on WMSDs and its causative factors such as individual and environmental risks, creating fatigue and damage to the muscular and skeletal structures that represent some approaches to relieve the occupational health problems (Mohammadi, et al. 2010). Thus, it seems that the ergonomic educational interventions and provision of appropriate occupational environments and equipment based on the ergonomics principles may be effective in reducing WMSDs (Mohammadi, et al. 2010).

Shirzaei and colleagues reported that 80.8% of dental students were not aware of ergonomic posture during dental procedures. They believed that dental students with knowledge of ergonomic principals would be able to maintain their health (Shirzaei, et al. 2015). Lewis et al. 2001, demonstrated that the frequency and severity of WMSDs might decrease in the video display terminal users by training the ergonomic principles (Lewis, et al. 2001). On the other hand, Karibasappa et al. (2014) have reported that although knowledge and attitude of qualified dentists towards ergonomic body posture were sufficient and proper, respectively, they did not result in favorable behavior. They indicated that awareness had not motivated the dental practitioners adequately to adopt ergonomic principles (Karibasappa, et al. 2014). In addition, Garcia et al. 2015, found no correlation between knowledge and practice of dental student in term of ergonomic working posture (Garcia et al, 2015).

The aim of this study was to evaluate the effect of ergonomics educational intervention on knowledge, attitude and practice of dental students of Babol University of Medical Sciences in relation to working body posture.

MATERIAL AND METHODS

An interventional trial by ergonomic training program was carried out on dental students (8th and 10th semesters) of Babol University of Medical Sciences, Babol, Iran, in winter, 2014 with a four-week observational period. The study protocol was approved by the Ethics Committee of Babol University of Medical Sciences and a written information regarding consent was obtained from each volunteer. Also, this trial was registered in Iranian Registry of Clinical Trials website (IRCT2015041721519N3).

All the right-handed participants aged 20–25 years, who were attending the pediatric dentistry course, were invited for the study (n=50). Left-handed dental students and those over 25 years of age were excluded. Prior to training in ergonomics, the subjects were asked to complete a tailored questionnaire consisting of 22 questions, with five response options based on the results of previous studies, reviewed and gathered by (Muslim, et al. 2012) in order to evaluate the knowledge, attitude and practice of participants in relation to ergonomics in dentistry.

The questionnaire had five sections comprising demographic information (age, gender and semester), two questions on the history of ergonomics training (previous awareness and training), eight questions on knowledge about height of the dental stool, elbow level, ideal range of upper arm abduction, bending of the neck and trunk, positions of the upper and lower extremities and appropriate sitting area for the right and left quadrants, six questions on attitude (importance of awareness about ergonomic principles, performance of educational programs, use of ergonomic equipment, four-handed dentistry, sitting position vs. standing, body posture of the dentist relative to the patient) and six questions on practice (static posture, ergonomic exercise, back support, bending of the trunk, indirect visualization of maxillary teeth and receiving instruments without tensions). The options related to questions involving attitude and practice were designed according to Likert scale. The face validity of the questioner had already been confirmed by three Dental Faculty members of Babol University of Medical Sciences and the reliability had been assessed by test-retest method (the Cronbach's alpha internal consistency coefficient = 0.926).

Then, lectures were given on Ergonomics in Dentistry by a trained pedodontist and the ergonomic sitting posture during the restorative procedures (based on Muslim's study) was shown and impacted in volunteers (Muslim, et al. 2012). The ergonomic sitting posture considered for education and evaluation in this study can be seen in Table 1.

The same questionnaire was completed again by the participants after four weeks. During the observation period, sitting posture of participants was frequently checked by two calibrated and skillful dentists (Kappa=0.791) by filling out a checklist with 10 items illustrated in Table 1, three times within one month for each volunteer when they used dental hand pieces on cooperative school children. The observational assessment was performed for each participant at the beginning of the dental procedure. The participants were not informed when they were checked out.After collecting data, scoring the knowledge, attitude and practice was done before and after intervention based on the following method: In the knowledge section, the scores of 'true', 'false' and 'no idea' answers were '4', '0' and '1', respectively. Each question on attitude and practice was scored from '1' to '5', adding up to '30' based on the degree of agreement with the ergonomic principles in thought and behavior. In the period of observation, one score was given to each favorable position, adding up to 10 for work on maxillary teeth and nine for mandibular teeth. The mean percentage of scores of practice was based on the observational study and recorded for each volunteer and the mean percentage of scores of each item on the checklist was estimated too.Statistical analyses were carried out with SPSS 18, using the chi-squared test, independent t-test and paired-sample t-test. Statistical significance was defined at P=0.05.

RESULTS

Out of the 50 dental students participating in the study, 26 were females and 24 were males; 13 males and nine females were in the 8th semester and 11 males and 17 females were in 10th semester. Chi-squared test revealed no significant differences between different genders or semesters (P=0.134). Prior to the study, one of the dental students reported that he was familiar with the ergonomics comprehensively; 34 subjects were familiar

Table 1: Ergonomic principles for sitting posture[2]

Variable	Ideal range	Remarks
Height of dental stool	-	Should be adjusted at the level of dentist's knees
Elbow level	-	The mouth positioned with maximum height of 5 cm above the elbow
Upper arm abduction	<10	Should be maintained as close as possible to the trunk
Forward bending of the head	<20	Eyeball movements help dentists maintain normal position of the head
Trunk rotation	<20	Avoid bending trunk exceeding 60 degrees for more than 5% of the working hours
Trunk sideward inclination	<10	-
Back support	-	To maintain the normal arch of the skeleton
Leg-knee angle	90–120	The upper extremity is parallel and the lower extremity is perpendicular to the floor
Indirect visualization	-	For maxillary teeth by a dental mirror
Appropriate sitting area	9–11 O'clock	9 O'clock for the right side, 11 O'clock for the left side of the mouth

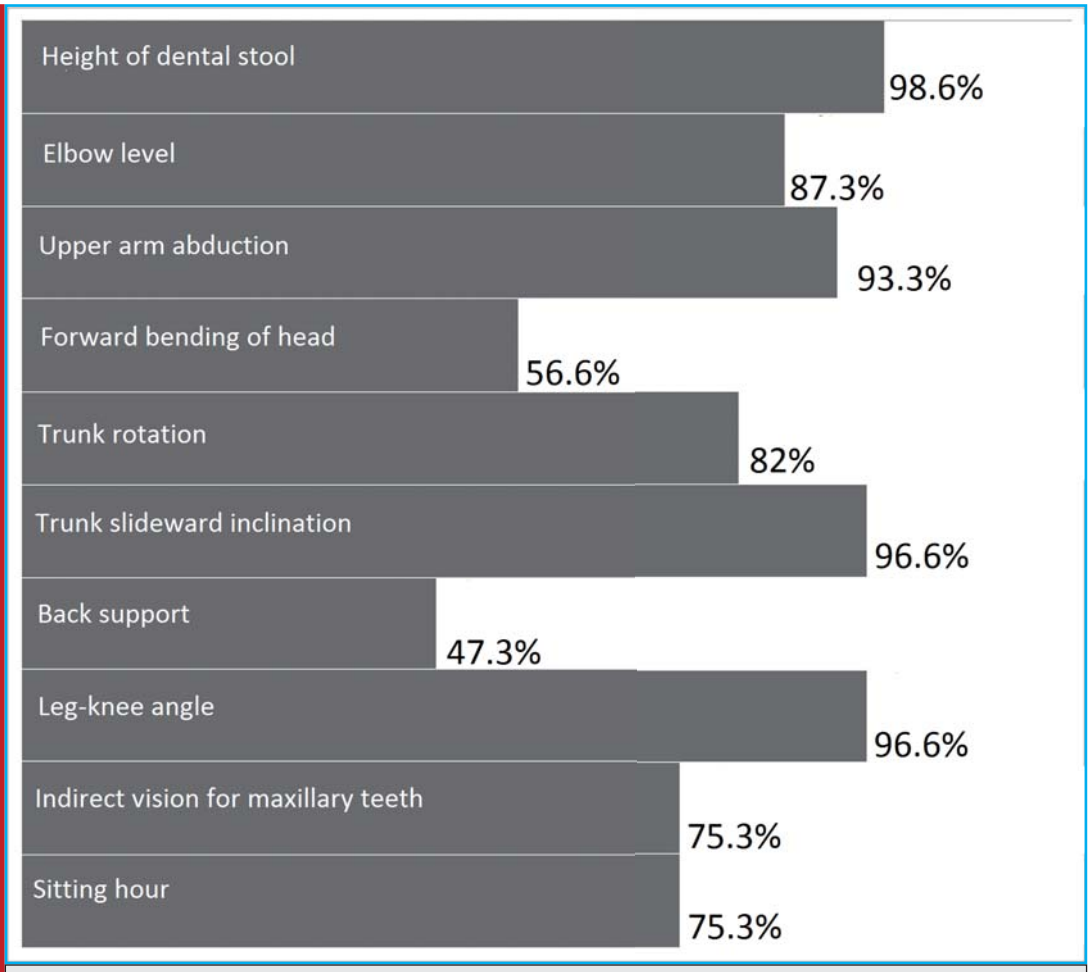

FIGURE 1. Showing Frequency percent of ergonomic positions during the observational period.

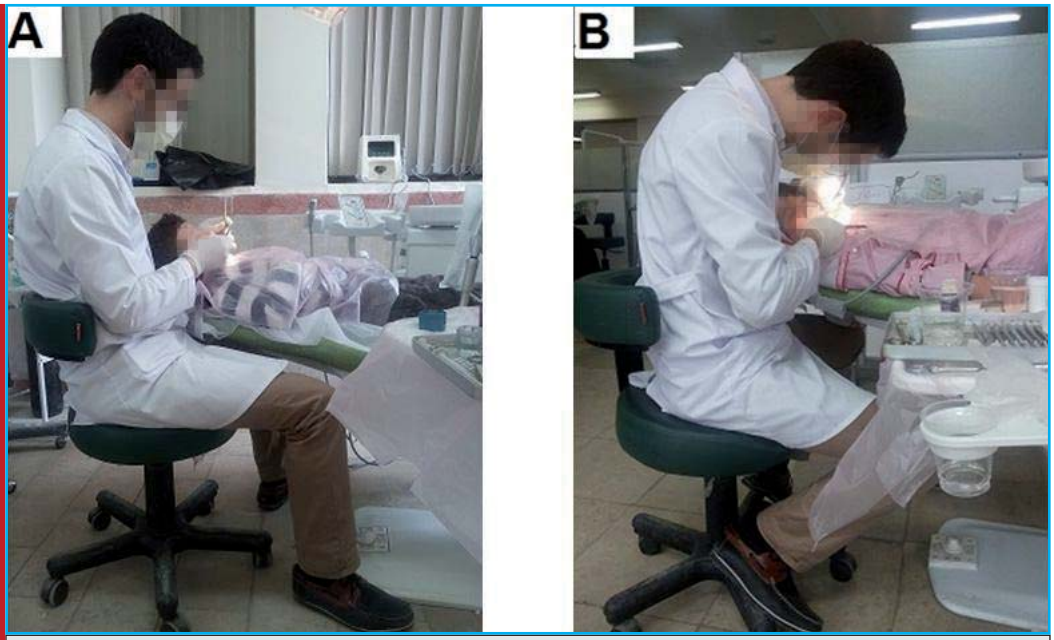

FIGURE 2. Showing the correct and incorrect sitting postures (A: Correct, B: Incorrect).

Table 2: Mean (SD) values of knowledge, attitude and practice before and after the education in terms of gender.

	Time	Gender	Mean	SD	P-value
Knowledge	T1	F	11.19	5.24	0.234
		M	12.70	3.35	
	T2	F	22.69	6.80	*0.019
		M	18.25	6.10	
Attitude	T1	F	28.19	2.40	0.400
		M	27.66	1.92	
	T2	F	28.84	2.16	0.860
		M	28.75	1.59	
Practice	T1	F	17.07	2.49	0.516
		M	17.50	2.02	
	T2	F	18.38	2.53	0.731
		M	18.16	1.83	
Practice based on check list		F	79.32%	10.53%	0.529
		M	77.34%	9.89%	

*significant: P<0.05 based on the independent t-test, F: female, M: male, T1: before the intervention, T2: after the intervention

with it a little bit and 15 were not familiar with it at all. Only nine subjects have previously been treated in ergonomics in dentistry. The mean (SD) values of knowledge before and after the education were estimated at 11.9±4.4 and 20.5±6.7, respectively. Paired-sample t-test revealed a significant difference between the knowledge scores before and after the intervention (P=0.00).

No significant differences were found between the baseline scores of knowledge in terms of gender, but the knowledge scores of females after the intervention were significantly higher than those of the males (Table 2). In addition, the semester had no effect on knowledge scores (Table 3). Mean scores of attitude before and after the education were calculated to be 27.9±2.1 and 28.8±1.8, respectively. The attitude of dental students significantly improved after education (P=0.03 based on the independent t-test); however, there was no significant difference between the scores of attitude before and after education in terms of the gender or semester (Tables 2 and 3).Analysis of data collected from the questionnaires by the independent t-test revealed that following the intervention, practice scores were significantly higher than those at the baseline (17.2±2.2 vs.18.2±2.2, P=0.00). However, there were no significant differences between the practice scores before and after education in terms of the gender or semester (Tables 2 and 3).

Working and sitting postures of dental students were totally evaluated 150 times. Mean ± SD score percentage of practice of participants based on the observational study was estimated at 78.4±10.1. Figure 1 illustrates the percentage frequencies of each item of ergonomic body posture observed by the students throughout the period of observation. Checking out the working posture of participants revealed no significant differences in terms of the gender or semester (Tables 2 and 3). The correct and incorrect sitting positions are shown in Figure A and B respectively.

DISCUSSION

In the present study, education on ergonomics was shown to be effective in the promotion of knowledge, attitude and practice of dental students regardless of gender or semester. It has been demonstrated that psychosocial and biomechanical factors related to occupational health problems can be controlled by education. In agreement with the present study, Mohammadi et al. (2010), reported that increasing the knowledge of workers in relation to occupational health is the basic factor for promoting the positive attitude and practice (Mohammadi, et al. 2010). Stetler et al. have emphasized

Table 3: Mean (SD) values of knowledge, attitude and practice before and after the education in terms of gender

	Time	Semester	Mean	SD	P-value
Knowledge	T1	8th	12.68	4.87	0.289
		10th	11.32	4.10	
	T2	8th	19.72	6.67	0.448
		10th	21.21	6.93	
Attitude	T1	8th	27.36	2.21	0.098
		10th	28.39	2.07	
	T2	8th	28.72	1.83	0.813
		10th	28.85	1.97	
Practice	T1	8th	17.36	2.46	0.820
		10th	17.21	2.14	
	T2	8th	18.36	2.27	0.815
		10th	18.21	2.18	
Practice based on check list		8th	79.19%	11.55%	0.712
		10th	78.01%	9.43%	

*significant: P<0.05, T1: before the intervention, T2: after the intervention

that the multi-interventional methods, including the elimination of risk factors along with the educational programs, might be effective in solving the problem of MSDs (Stetler, et al. 2003).

Considering the positive effect of education in this study (Tables 2 and 3), dental professionals should be aware of the importance of ergonomics in dentistry and should be encouraged to apply it while providing dental care. Additionally, it should be emphasized that regular exercises and breaks during working hours can decrease the frequency and severity of various MSDs (Sharma and Gholchha 2011). In the present observational study, the height of the dental stool, trunk sideward inclination, leg-knee angle and upper arm abduction were favorable in more than 90% of the cases while back support was observed in only 47.3% of the cases.

Unfortunately, forward bending of the head exceeding favorable range or lack of back support were observed in almost half of the cases (Figure 1). It seems that although the students were aware of the correct sitting posture, they frequently lost their correct posture to improve visualization while working. Based on the results of Hayes's study, back (36.3-60.1%) and neck (19.8-85%) pains were shown as the most common painful regions in Dentists (Hayes, et al. 2009). Also, Shaik et al. (2011), assessed frequency of MSDs in dental surgeons and concluded that 83.3% and 70% respectively suffered from back and neck pains sometimes and 73.3% felt stiffness in back region (Shaik, et al. 2011).

Al-Ghadir et al. (2015) have reported the lower back (60%), neck (49%) and shoulder (49%) regions as the most common regions with pain and fatigue (Alghadir, et al. 2015). Recently it has been shown that the neck and low back regions are the most common painful body areas among dental students (Ng, et al. 2016).In the present study, correct forward bending of the neck was observed in 56.6% of cases. In a study conducted by Vakili et al (2016) in Tehran, the prevalence of the forward head posture was reported in 85.5%, of the participants (Vakili, et al. 2016).

Forward bending of the neck more than 20° is considered beyond the balanced ergonomic parameters (Hoerler, et al. 2012). Researchers have found a relationship between visual acuity and balanced posture of dental professionals while working (Maillet, et al. 2008). Magnifying lenses are recommended to provide better visualization along with maintaining a proper body posture (Branson, et al. 2004). The findings of the present work showed that indirect visualization for maxillary teeth was observed in 75.3% of the cases. Reasonably, the use of oral mirrors for maxillary teeth helps dentists maintain an ergonomic posture of neck. However, almost half

of the participants exhibited forward bending of head exceeding the normal range.

Within the study limitations, lack of dexterity of dental students and natural stress and difficulties existing while treating the pediatric patients were considered as the potential factors for loss of proper body posture. Therefore, further studies on qualified dental healthcare providers are recommended. In addition, similar studies with follow-up periods for the long-term evaluation of ergonomic body posture are recommended by the authors.

CONCLUSION

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

CONFLICT OF INTEREST

The authors stated no conflict of interest.

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REFERENCES

Alghadir, A., Zafar, H.,& Iqbal, Z. A. (2015). Work-related musculoskeletal disorders among dental professionals in Saudi Arabia. Journal of physical therapy science, 27(4), 1107-1112.

Branson, B. G., Bray, K. K., Gadbury-Amyot, C., Holt, L. A., Keselyak, N. T., Mitchell, T. V., & Williams, K. B. (2004). Effect of magnification lenses on student operator posture. Journal of dental education, 68(3), 384-389.

de Carvalho, M. V. D., Soriano, E. P., de França Caldas, A., Campello, R. I. C., de Miranda, H. F., & Cavalcanti, F. I. D. (2009). Work-related musculoskeletal disorders among Brazilian dental students. Journal of dental education, 73(5), 624-630.

Diaz-Caballero, A. J., Gómez-Palencia, I. P., & Díaz-Cárdenas, S. (2010). Ergonomic factors that cause the presence of pain muscle in students of dentistry. Med Oral Patol Oral Cir Bucal, 15(6), e906.

Hayes, M. J., Cockrell, D., & Smith, D. R. (2009). A systematic review of musculoskeletal disorders among dental professionals. International journal of dental hygiene, 7(3), 159-165.

Hoerler, S. B., Branson, B. G., High, A. M., & Mitchell, T. V. (2012). Effects of Dental Magnification Lenses on Indirect Vision: A Pilot Study. American Dental Hygienists Association, 86(4), 323-330.

Karibasappa, G. N., Anandan, S., & Rajeshwari, K. (2014). Dentists' Knowledge, Attitude and Behavior towards the Dental Ergonomics. IOSR J Dent Med Sci, 13, 86-9.

Khan, S. A., & Chew, K. Y. (2013). Effect of working characteristics and taught ergonomics on the prevalence of musculoskeletal disorders amongst dental students. BMC musculoskeletal disorders, 14(1), 1.

Lewis, R. J., Fogleman, M., Deeb, J., Crandall, E., & Agopsowicz, D. (2001). Effectiveness of a VDT ergonomics training program. International Journal of Industrial Ergonomics, 27(2), 119-131.

Maillet, J. P., Millar, A. M., Burke, J. M., Maillet, M. A., Maillet, W. A., & Neish, N. R. (2008). Effect of magnification loupes on dental hygiene student posture. Journal of dental education, 72(1), 33-44.

Mohammadi, Z. I., Heydarnia, A., Niknami, S., Safari, V. A., & Varmazyar, S. (2010). The effects of an educational intervention on knowledge, attitude and ergonomic behaviors. Journal of Qazvin University of Medical Sciences,14,1(54); 33-40.

Muslim, E., Nurtjahyo, B., Darwita, R., & Widinugroho, B. (2012). Working Posture Evaluation of Clinical Student in Faculty of Dentistry University of Indonesia for the Scaling Task in Sitting Position in a Virtual Environment. Makara Journal Of Health Research, 16(1). Retrieved November 28, 2016, from http://journal.ui.ac.id/index.php/health/article/view/1300/1189.

Ng, A., Hayes, M. J., & Polster, A. (2016). Musculoskeletal Disorders and Working Posture among Dental and Oral Health Students. Healthcare, 4(1):13 Multidisciplinary Digital Publishing Institute.

Sasso Garcia PP, de Araujo Gottardello AC, Presoto CD, Bonini Campos JA. (2015). Ergonomic work posture in undergraduate dentistry students: Correlation between theory and practice. J Educ Ethics Dent, 5:47-50.

Shaik, A. R., Rao, S. B., Husain, A., & D'sa, J. (2011). Work-related musculoskeletal disorders among dental surgeons: A pilot study. Contemporary clinical dentistry, 2(4), 308.

Sharma, P., & Golchha, V. (2011). Awareness among Indian dentist regarding the role of physical activity in prevention of work related musculoskeletal disorders. Indian journal of dental research, 22(3), 381.

Shirzaei, M., Mirzaei, R., Khaje-Alizade, A., & Mohammadi, M. (2015). Evaluation of ergonomic factors and postures that cause muscle pains in dentistry students' bodies. Journal of clinical and experimental dentistry, 7(3), e414.

Stetler, C. B., Burns, M., Sander-Buscemi, K., Morsi, D., & Grunwald, E. (2003). Use of evidence for prevention of work-related musculoskeletal injuries. Orthopaedic Nursing, 22(1), 32-41.

Tirgar, A., Javanshir, K., Talebian, A., Amini, F., & Parhiz, A. (2015). Musculoskeletal disorders among a group of Iranian general dental practitioners. Journal of back and musculoskeletal rehabilitation, 28(4), 755-759.

Tirgar A. Khallaghi Sh. Taghipour M. (2013). A study on musculoskeletal disorders and personal and occupational risk factors among surgeons. IJHS, 1(1): 50-57.

Vakili, L., Halabchi, F., Mansournia, M. A., Khami, M. R., Irandoost, S., & Alizadeh, Z. (2016). Prevalence of Common Postural Disorders Among Academic Dental Staff. Asian Journal of Sports Medicine, 7(2): e29631.