

# Ergonomic Evaluation of Senior Undergraduate Students and Effect of Instruction Regarding Ergonomic Principles on It

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## ABSTRACT

**Background and objective:** Musculoskeletal disorders in dentists due to abnormal postures may result in economic and health problems. To prevent these problems, the working posture of dental students should be assessed and corrected in dental procedures. This study was undertaken to assess the effect of instruction regarding ergonomic principles on them by using the Rapid Entire Body Assessment (REBA) method.

**Material and methods:** The posture of 117 students was assessed by REBA before and after of the "Ergonomic principles in dentistry" course. The sample size was selected based on previous studies on this issue. REBA scores were assessed by SPSS software using Friedman-test.

**Results:** The statistical analysis of data gathered from this study showed that the ergonomic structure had a significant effect only in the group of right-handed females ( $P=0.046$ ). In other groups, no significant change was observed ( $P>0.05$ ). There was no significant change before and after instruction in REBA classifications (negligible, low risk, medium risk, high risk, very high risk) ( $P>0.05$ ). There was no relation between the types of positions and REBA score ( $P>0.05$ ).

**Conclusion:** Ergonomic instruction can significantly decrease musculoskeletal disorders in female dentists who use their right-hand to work. In the other groups, however, the absolute amount of danger became better, but this change was not statistically significant.

**Keywords:** ergonomics, musculoskeletal disorders, rapid entire body assessment method (REBA).

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## INTRODUCTION

Occupation-related musculoskeletal injuries are among the most serious occupational problems worldwide. Unfavorable occupational body position is one of the most important factors in these injuries. Other risk factors include genetic predisposition, aging, and emotional stress. Such injuries bear negative social, economic, and political complications for human societies. In 1995, direct and indirect costs of musculoskeletal injuries in the United States were reported to be 215 billion \$ (1). Assessment of work conditions using relevant evaluation methods is beneficial in the recognition of ergonomic risks due to unfavorable body positions and prediction of occupationally induced musculoskeletal disorders. In dentistry, dynamic and static activities predispose dentists to musculoskeletal disorders. Dentists are usually unaware of the ergonomic factors and their role in their musculoskeletal health (2). Finsen *et al.* evaluated the risk factors of MSDs on several Danish dentists; they revealed that 65% of all dentists suffer from neck and shoulder pain, and 59% of subjects had back pain (3). In 1999, the National Institute of Occupational Health in Denmark, Copenhagen, conducted an investigation entitled "Biomechanical aspects of neck posture during dental work" and declared that increased knowledge and awareness about neck anatomy could help subjects understand how different tissues are subjected to pressure (4). Thornton *et al.* concluded that instructing the biomechanical principles should be extended to the clinical settings as well. Also, ergonomic awareness programs should be expanded in order to cover clinical principles (5). Saremi and colleagues showed that neck and shoulder pains were the most significant complications for dentists, and reported that more than 30% of dentists were considered as high-risk individuals for these disorders (6). Nasle Seraji and co-workers also stated that pains in the neck and back are one of the most common ergonomic hazards among dentists, with a higher frequency in women than men (7). Mojabi *et al.* reported that neck pain, back pain, shoulder pain, and combined neck, back and shoulder pain was seen in 27.1%, 18.6%, 10% and 11.5% of these cases, respectively (8).

Rapid Entire Body Assessment (REBA) is a postural analysis tool and an observation-based method developed according to Rapid Upper Limb Assessment for occupations in which several injurious static and dynamic conditions exist (9). To the best of our knowledge, well-known evaluation methods are rarely used to investigate occupational disorders in dentists. Therefore, this study aimed to evaluate the effect of instruction regarding ergonomic principles on the ergonomic position of senior undergraduate students using REBA method. □

## METHOD

This study was an interventional study approved by the Research Council of Tabriz Dental School, Tabriz, Iran, with the Ethical Code of IR.TBZMED.REC.1396.1308.

A total of 117 students were randomly selected from Tabriz Dental School by using a EPI6 software. This sample size was based on the results of Yaghobee *et al.*'s study (10), with a mean pre-training and after training score of 5.8% and 11.6%, respectively, in subjects with a score of 4, and also  $\alpha=0.05$  and  $p=80\%$ .

This study only included senior undergraduate students aged 24–30 with no skeletal disorders.

Inclusion criteria were as follows: 1) students at Tabriz Dental School; 2) willingness to participate in the study and signed written consent; 3) attendance of final year 4 courses; 4) students' age range 24–30 years old.

Exclusion criteria were as follows: 1) unwillingness to participate in the study; 2) presence of skeletal problems; 3) presence of chronic neck and back problems.

Students participated in an Ergonomic principles class, which was taught by the project manager; they received a training paper that contained accurate ergonomic positions in dentistry. Students' ergonomic status was analyzed two times: firstly, a day before participating in the ergonomics class, and secondly, two weeks after this class. Each time, their postures were analyzed using the REBA method and then compared to each other to see whether there was a significant change in students' REBA score. Students were divided into females/males, left-handed/right-handed, and their positions were 7, 9, 11, 12 for right-handed subjects and

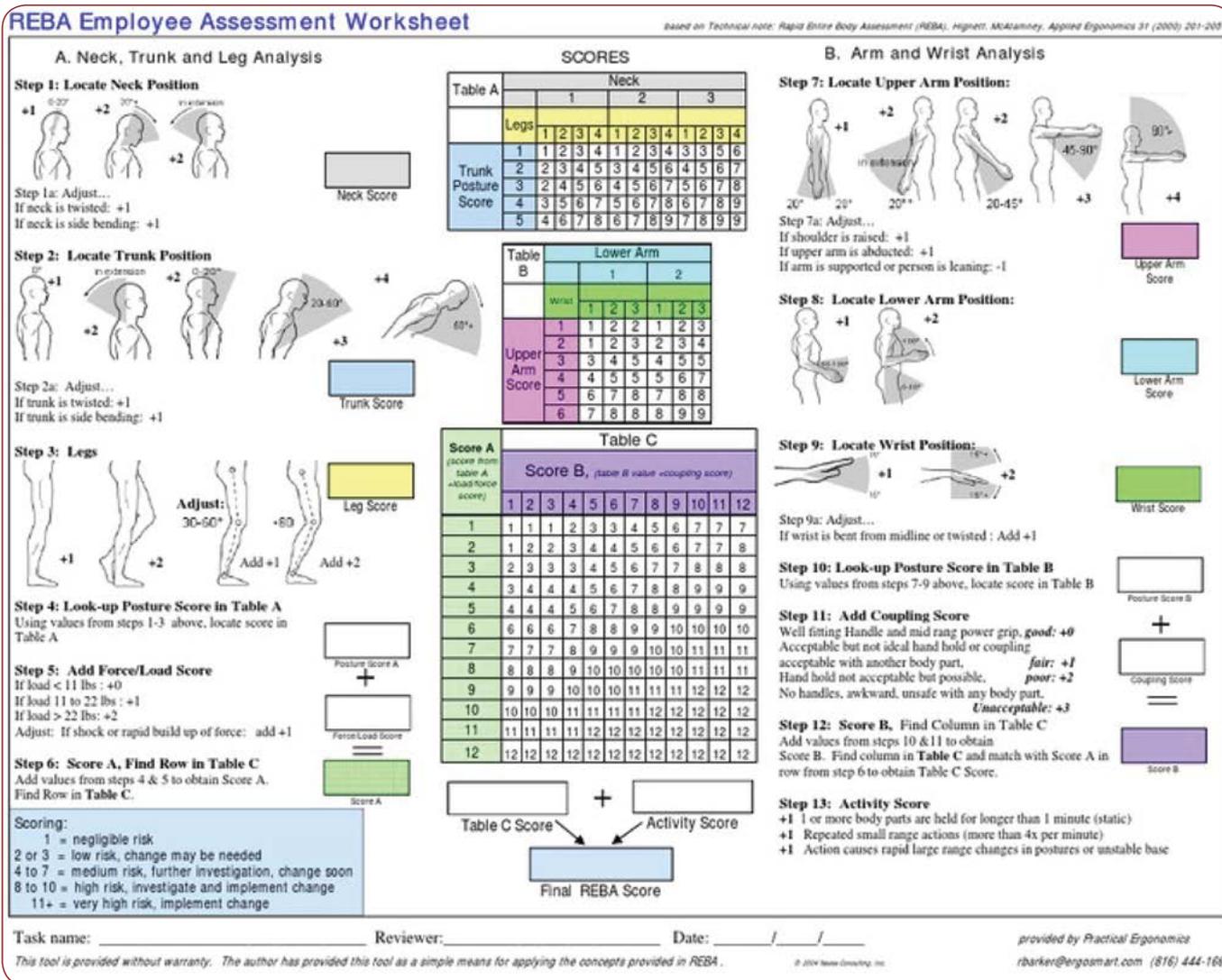


FIGURE 1. REBA work sheet

5, 3, 1, 12 for left-handed ones in the restorative dentistry department. For analyzing the data gathered from this study, we used SPSS17 and Friedman tests. P<0.05 was significant in this study.

**REBA method**

The Rapid Entire Body Assessment (REBA) method was developed by Dr. Sue Hignett and Dr. Lynn McAtamney, ergonomists from the University of Nottingham in England (Dr. McAtamney is now at Telstra, Australia). The REBA method was developed as a means to assess entire body posture for risk of WRMSDs and fill a perceived need for a practitioner’s field tool, specifically designed to be sensitive to the type of unpredictable working postures found in health care and other service industries (9). This

approach can evaluate a person’s posture in a short-term observation. In this method, different parts of the body are divided into two groups: A and B. Group A consists of postures of the trunk, neck, and legs, while group B considers the arms, forearm and hands. This information is obtained through direct observation. The viewing time for each posture is 30 minutes. Participants’ clinical evaluation was performed by the project manager and her assistant.

The analysis can be conducted before and after an intervention to demonstrate that the intervention has worked to lower the risk of injury. Figure 1 shows the work sheet for evaluation by using the REBA method (Figure 1).

Group A is related to the assessment of the trunk, neck, and legs, and the final score is determined using the calculation Table A, while group B

is associated with the assessment of shoulders, elbows, and wrists, as determined by the calculation Table B. Finally, scores from Tables A and B are calculated in Matrix C. Since the load force score in dentistry is less than 11 pounds, this score is negligible. After examining people’s postures, the final REBA score was obtained, ranging from 1 to 15 for each side of the body. Based on this score, the individual’s position was divided into five ranks (negligible, low risk, middle risk, high risk, very high risk), according to the risk level, and the need to adjust the individual’s position was determined. It should be noted that in this study, ergonomic risk value was calculated separately for the left and right sides of each person’s body, and finally, all scores were calculated. □

**RESULTS**

The outcomes of this study showed that ergonomic instruction decreased the number of risky positions in students, but this change was significant only among right-handed females (P=0.046), with no statistically significant difference in the other groups (P>0.05).

As shown in Table 1, the groups had several changes. Thus, from 117 participants, 63 were males and 54 females; 13 persons were left-handed and 104 right-handed. The majority of participants was in the range of medium risk (126 persons) (Table 1 and Figure 2).

Ergonomic instruction increased the number of participants in the negligible group (with REBA value of 1) from 11 to 15 persons. The same change was seen in the group of low risks (with REBA value of 2-3). In this group, the number of participants increased from 26 to 33 persons. The other groups (medium risk, high risk, and very high risk) showed decreases in the number of participants. The amount of change was 65 to 61 (four persons) in the medium risk group, 18 to 16 (two persons) in the high risk group, and 7 to 3 (four persons) in the very high risk group. The maximum change following the instruction was seen among right-handed females in the low-risk group: 15 persons before instruction, and 25 persons after instruction (the difference was ten persons).

The statistical analysis using SPSS17 and Friedman test evaluated the significance of change in each group. The statistical analysis of data gathered from this study showed that ergo-

nomics instruction had a significant effect only in a group of right-handed females (P=0.046). In other groups, no significant change was observed (P>0.05). There was no significant change be-

REBA Score	Before instruction				Sum of participants before instruction	After instruction				Sum of participants after instruction	Sum of participants Totally
	Left		Right			Left		Right			
	M	F	M	F		M	F	M	F		
1(Negligible)	·	·	6	5	11	·	·	9	6	15	26
2-3(Low Risk)	1	1	9	15	26	1	1	6	25	33	59
4-7(Medium risk)	5	2	24	34	65	6	4	29	22	61	126
8-10(High risk)	1	2	12	3	18	1	0	9	6	16	34
11-15(Very high risk)	1	0	4	2	7	0	0	2	1	3	10

TABLE 1. Effect of ergonomic instruction in senior students

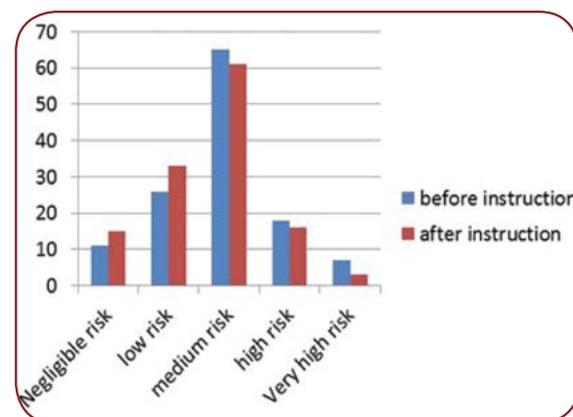


FIGURE 2. Effect of ergonomic instructions in senior students

REBA Score	Left(all positions)		Right(all positions)	
	M	F	M	F
1(Negligible)	--	--	P=0.083	P=0.999
2-3(Low Risk)	--	--	P=0.083	P=0.046
Medium 4-7(risk)	P=0.564	P=0.317	P=0.157	P=0.083
8-10(High risk)	P=0.999	P=0.317	P=0.564	P=0.157
11-15(Very high risk)	P=0.317	--	P=0.157	P=0.317

TABLE 2. P-values of the effect of ergonomic instruction in participants

fore and after instruction in REBA classifications (negligible, low risk, middle risk, high risk, very high risk) ( $P > 0.05$ ) (Table 2). The evaluation of participants' REBA value showed that most of them were in the range of medium risk, meaning that they should change their ergonomic status. Although our ergonomic instruction decreased the proportion of medium risk, high risk, and very high-risk participants to low risk and negligible risk groups, this decrease was not totally statistically significant.  $\square$

## DISCUSSION

In this study, we evaluated the postures of senior students in order to find out whether there were any differences between them in using ergonomic principles before graduation.

Our findings show that the senior students' ergonomic positions are not accurate, which could be explained by many reasons. One of them is insufficient instructions about ergonomic positions and musculoskeletal disorders related to it; another one is that there is no checklist for evaluating students ergonomically at the time of work in dentistry departments; and the last one is that there is no specific team in dentistry college to inspect students' musculoskeletal disorders and make them aware of their ergonomic problems by teaching them specifically in order to correct their ergonomic status and reduce their problems.

The results of our study show that the students' ergonomic status does not relate statistically to their position, gender and hand (left/right) used for work. Our instruction had more influence among right-handed students than left-handed ones, which could be explained by the lack of left-handed units in Tabriz Dental School departments. Thus, left-handed students have to adapt themselves to right-handed units, which can be the cause of ergonomic problems in left-handed students in comparison to right-handed ones. Out of many previous studies that focused on the same topic as our research, some were confirming the results obtained by us, while others did not. In 2010, Yaghobee *et al.* studied the effect of ergonomic principles' instructions on dental students in Tehran Dental School (10). In this study, the posture of 69 students was assessed by REBA before and after the "Ergonomic principles instruction in dentistry"

course. Results showed that the student's posture should be corrected. Postures of 94.2% of students had a moderate and high risk level that needed to be corrected. Although the REBA scores before and after the training course were statistically different ( $P < 0.05$ ), the training did not lead to a notable posture improvement (10). This study confirms the results of our study because, in both studies, the majority of participants were in the medium risk group and ergonomic instruction. However, it reduced the REBA score of students and did not improve their ergonomic status.

In 2011, Varmazyar *et al.* conducted a cross-sectional study on 48 dentists in Semnan. Findings from REBA showed that more than 90% of dentists' postures were above the moderate risk range and need control measures (11), while in our study, more than 60% of participants were in the medium risk range before instructions. This contradiction is because of the different populations studied by Varmazyar *et al.* In the cross-sectional study conducted by Askaripoor *et al.* (12), posture assessment of 63 participants was performed by the REBA method and results showed that 80% of dentists complained about pain in at least one part of their body and 90% of them were above the moderate risk range. Their results are not in agreement with our study because different populations were analysed by the quoted authors. Showraki *et al.* (13) investigated the effect of ergonomics training on working status in dental students of Bushehr Dental School and reported that training improved both students' working status and their REBA score, especially in female students, which is close to our findings. Jahanimoghadam *et al.* (14) evaluated the work postures of general dentists and specialists using the REBA method and concluded that work postures had moderate to high risk levels in 90% of dentists. They concluded that dentists' working postures needed improvement, and consequently, a more comprehensive ergonomic training was essential in the dentistry curriculum at universities. Their results are in agreement with those of the present study.

In another study, Movahhed *et al.* (15) concluded that dental students did not have favorable working postures and had an intermediate to high risk for developing MSDs; therefore, students should be trained by lessons of ergonomic principles, accompanied by practice and peri-

odical evaluations. Their results are in agreement with our study.

In the study of Deolia *et al.* (16), which aimed to evaluate the implementation of ergonomic principles in routine dentistry, it was shown that proper application of ergonomic principles and maintenance of a balanced posture could prevent the incidence of musculoskeletal disorders, leading to improvements in work productivity.

According to our findings, instruction performed by us influenced subjects' ergonomic status, but insufficiently, because it had only a short duration, which means that if instruction is maintained over a longer period of time, it may be more efficient. So, we propose that all departments of dentistry faculties should have an ergonomic course simultaneously to other courses. □

### CONCLUSION

Under the limitations of the present study, our instruction had an influence on participants' ergonomic status. Still, there was not a significant reduction in REBA values in senior students of

Tabriz Dental School, except for right-handed females, in which ergonomic instruction had a significant effect on their REBA scores. Thus, it is recommended that all departments of dentistry faculties offer ergonomic courses simultaneously to other courses. □

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*Authors' contributions:* HA prepared proposals, MR and AB set and entered study results and interpretation, ME prepared and interpreted the data, HA prepared a final report, MR prepared the results, AB and ME wrote the manuscript, FDT supervised the design and execution of the study and prepared a final report. FDT collected all data and contributed to the preparation of the proposal.

*Conflicts of interest:* none declared.

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