

*Field : Physiology*

*Type : Research Article*

*Received: 02.03.2016 –Accepted: 29.07.2016*

## **Evaluation of Ergonomic Postures of Physical Education and Sport Science by REBA and Its Relation to Prevalence of Musculoskeletal Disorders**

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### **Abstract**

Postural abnormalities of regions predispose individuals to chronic pain. Because of improper position of students, who are growing, the risk of adopting abnormal postures is common. In order to establish appropriate strategies to prevent these impairments, having accurate information about them is necessary. The purpose of this study was to evaluation of ergonomic postures of physical education and sport science by REBA and its relation to prevalence of musculoskeletal disorders. In the present cross-sectional study, 260 subjects of physical education and sport science were selected randomly and interviewed. To determine the prevalence of musculoskeletal disorders and assessment of postures, we used Nordic Musculoskeletal Questionnaire (NMQ) and Rapid Entire Body Assessment (REBA) respectively. Using SPSS IBM 20 software, data were analyzed by chi-square and independent sample t-test. The Rapid Entire Body Assessment results indicated that 40% of participant, equivalent to 104 subjects obtained from 4 to 7 scores (very high risk level). Also, Results of the Nordic questionnaire indicated that the highest musculoskeletal disorder report was related to low back region with 50.8 % and the least common complaints were related to elbows and feet with prevalence rates of 20 and 26%, respectively. It seems that long duration of daily seating and repetitive its and maladjustment of the seat height in proportion were effective factors leading to the high prevalence of musculoskeletal disorders among physical education and sport science students of Gazi University-Turkey which was also confirmed by posture assessment results. Timely adjustment of the seat height through designing adjustable seats and following ergonomic principles in school might be useful strategies to reduce prevalence of musculoskeletal disorders.

**Keywords:** Ergonomic, Musculoskeletal Disorders, REBA, NORDIC

## Introduction

Ergonomics is a set of scientific principles correlating to understanding of the interactions between humans and other elements of a system. Work strain and occupational damages to humans, and preventing profession-related disorders could be evaluated by ergonomic principles. Children and teenagers are spending a lot of time seated at a desk or working with a computer because of excessive learning activities at private educational institutes, group private lessons, or home learning. Generally, posture is defined as the relative disposition of the body parts in relation to the physical position, such as standing, lying down, and sitting. Correct posture involves a straight spine, which maintains the natural curve of the spine in the human body (Moon, 2007). Correct posture minimizes the strain on the human body by maintaining balance of the muscles and skeleton. This balanced musculoskeletal state protects the supporting structures in the body and prevents damage or progressive deformation in all positions, including standing, lying down, and sitting. Additionally, correct posture implies not inclining the body forward, backward, left, or right (Chen et al., 2013). Therefore, the importance of correct posture should be emphasized, and maintaining correct sitting posture is especially important because the strain on the back is greater in a sitting posture than a standing or lying down posture, although some differences may be present between postures (Lee et al., 2000). Incorrect posture has many negative effects on the spine. For example, joint imbalance limits the movement of the tendons and muscles and makes normal exercise and movement difficult. Additionally, incorrect posture can cause pain (Park MJ & Park JS, 2003). Musculoskeletal disorders (MSDs) are the most common type of work-related ill-health problem in Great Britain. MSDs are defined as inflammatory disorders of the various body parts resulted in painful (Stock, 1991). Work-related MSDs as a commonly kind of MSDs are resulted from exposure to awkward postures (Stock, 1991). Most studies reported that main generic physical risk factors involving in musculoskeletal disorders are force, posture, repetition, contact stress and temperature (Riihimäki, 2003).

Each exposure factor can be assessed if the magnitude/intensity, duration and frequency are known (Burgess-Limerick, 2003). Repetition as a generic exposure factor for producing MSDs should be considered in ergonomic risk assessment process (Burgess-Limerick, 2003). Some other generic exposure factors related to neck and upper limbs disorders include material handling, vibration, and task invariability (Burgess-Limerick, 2003). The outcome of the generic exposure factor can be determined by knowing the magnitude and duration of exposure to that risk factor (Hignett & McAtamney, 2000). This study was conducted to evaluation of ergonomic postures of physical education and sport science by the rapid entire body assessment and its relation to prevalence of musculoskeletal disorders.

## Materials and Methods

In the present cross-sectional study, 260 subjects of physical education and sport science were selected randomly and interviewed. To determine the prevalence of musculoskeletal disorders and assessment of postures, we used Nordic Musculoskeletal Questionnaire (NMQ) and Rapid Entire Body Assessment (REBA) respectively.

### *Nordic Musculoskeletal Questionnaire (NMQ)*

There are several musculoskeletal questionnaires that can be used for achieving to the data and information about musculoskeletal disorders and their symptoms. Questionnaire-aided data gathering is inexpensive, quick and easy (12). Nordic musculoskeletal

questionnaire (NMQ) is most currently used questionnaire for this purpose that has been proposed by Kuorinka and his colleagues in 1987 (12,15). It can also be used for determining incidence, prevalence, or occurrence rates and epidemiology of body regions musculoskeletal disorders resulted from un-ergonomic work situations and conditions and awkward postures. NMQ was used for detecting MSDs prevalence and symptoms. NMQ comprises questions about problems on the whole body and body part specific questions (wrist, upper and lower arms, neck, trunk, and legs). A body “map” was also used to make it easier for workers to pinpoint to their problems in each body area. The reliability and validity of the standardized NMQ has been proved frequently in different studies from 1987 up to now.

### *Rapid Entire Body Assessment (REBA)*

REBA tool proposed by Lynn Mc Atamney and Sue Hignett (1995) provides a relatively simple means of assessing the risk of entire body disorders associated with a task (McAtamney & Hignett, 2000). Thereby the tool combines posture and force assessments to provide a single score.

Some advantages of REBA are:

- REBA is a sensitive tool for musculoskeletal risks by classifying the bodies to the parts (wrist, upper arm, lower arm, neck, trunk, and legs)
- REBA is useful for manual tasks risk assessment
- REBA proposes the prioritization for corrective measures according to risk assessment and risk level

But some limitations, shortages and disadvantages of REBA are:

- REBA does not provide an integrated assessment of biomechanical risk factors;
- REBA cannot steer to the effective controls as the function of severity of various risk factors present in different tasks or jobs.

Therefore, REBA tool can be used for rapid assessment of entire bodies as evaluation of musculoskeletal loads due to posture, repetition and force. It aids in evaluating jobs or tasks that may expose workers to entire body disorders (wrist, upper and lower arms, neck, trunk, and legs). In the REBA tool, the whole body parts are classified into two groups A and B. The group A consisted of neck, legs, and trunk; and group B comprised of lower arms, upper arms, and wrist. Initially, for anybody region, the corresponding score is obtained with respect to positions, movements, and gestures of each body region from the relative table. On the one hand, by knowing the group A score obtained from table A and the FORC/LOAD score, the final group A score is calculated; and on the other the final group B score is calculated by knowing the group B score gained from table B and the COUPLING/GRIP score. Also the score C is obtained from table C and knowing the final groups A and B scores. As there is a static posture, or action repetitiveness (more than 4 times per minute), or rapid posture changings or instability, a score 1 is added to the score C as and ACTIVITY score. Finally, the REBA score is calculated by adding score C to the “ACTIVITY score”. REBA accomplishes the aforementioned goals by providing a “Grand Score” which can be compared to five Action Levels (McAtamney & Hignett, 2000; Burgess-Limerick, 2003). Many studies reported an acceptable reliability and validity of the REBA tool in various tasks or different jobs and found a good correlation between the REBA scores and NMQ results (McAtamney

& Hignett, 2000; Burgess-Limerick, 2003). The REBA data was obtained the ErgoIntelligence software. the ErgoIntelligence Upper Extremity Assessment (UEA) suite of tools incorporates a variety of tools including RULA, REBA, Strain Index, Occupational Repetitive Actions Index (OCRA) and the Cumulative Trauma Disorders Risk Index are determined based on the figure figure1.

After coding the REBA data and Questionnaire information, they were entered to SPSS software (version 20) and were analyzed by Mann-Whitney, Kruskal-Wallis, Spearman tests and Logistic Regression analyses.  $P < 0.05$  was considered as statistically significant.

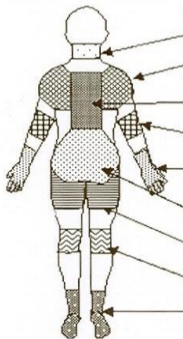


**Figure 1.** Ergo Intelligence software input field

## Results

In this study 260 physical education and sport science students of GAZI University were analyzed that their mean Stature was  $173.12 \pm 9.43$  cm, mean body weight was  $60.12 \pm 8.43$  kg and Mean age of the total students was  $21.12 \pm 2.1$  years. Table1 shows musculoskeletal problems in last 12 months, one month and last week prior to the study. As seen in Table 1, the low back, back and neck with 47.7%, 38.8% and 36.5% respectively have the most musculoskeletal problems in students during last 12 months prior. Also, Table 1, shows the low back, back and neck with 44.6%, 36.9% and 31.9% respectively have the most musculoskeletal problems in students during last 12 months prior to the study and was during last week prior the low back, back and neck with 28.8%, 23.8% and 20% respectively have the most musculoskeletal problems in students.

**Table 1.** Frequency reported musculoskeletal symptoms during last 12 months, one month and last week prior to the study

 Body regions	N (%)	Last 12 months N (%)	Last one month N (%)	Last week N (%)
	Neck	103 (39.6)	95 (36.5)	83 (31.9)
Shoulder	65(25)	48(18.5)	35(13.5)	26(10)
Back	112(43.1)	101(38.8)	96(36.9)	62(23.8)
Elbow	23(8.8)	16(6.2)	9(3.5)	5(1.9)
Wrist	66(25.4)	46(17.7)	35(13.5)	14(5.4)
Low back	134(51.5)	124(47.7)	116(44.6)	75(28.8)
Hip	95(36.5)	78(30)	63(24.2)	37(14.2)
Knee	87(33.5)	66(25.4)	52(20)	38(14.6)
Ankle	89(34.2)	81(31.2)	65(25)	49(18.8)

Results observed from the REBA method (Table 2) indicated that 0% of student postures were in the 4<sup>th</sup> level (Very high risk), 6.5% were in 3<sup>rd</sup> level (High risk), 40% were in the 2<sup>nd</sup> level (Medium risk) and 21.5% of student postures were in the 1<sup>st</sup> level (Low risk) of final score categories by REBA method. The result shows no significant relationship between musculoskeletal problems reported in different parts of body and BMI ( $p$ -value>0.001). As well as relationship between students stature and low back pain, between stature and knee pain, between age and low back pain, ankle pain, knee pain and elbow were significant ( $p$ -value<0.001). Based on the obtained results, the relationship between different phase of body region: neck pain, hip pain, shoulder pain, elbow pain, and wrist pain and REBA was significant but the relationship between Low back and REBA ( $p$ -value=0.132) and back pain ( $p$ -value=0.452) was not significant ( $P$ -value<0.05). Table 2 shows the result of REBA assessment and prioritization of risk level. Based on this result, 40% of students have potential of leading to musculoskeletal disorders.

**Table 2.** Result of REBA assessment and prioritization of risk level

Level	Final REBA score	Corrective measure necessity and timing	frequency	Percent
0	1	Unnecessary	83.0	31.9
1	2-3	Might be necessary	56.0	21.5
2	4-7	Necessary	104.0	40.0
3	8-10	Necessary (as soon as possible)	17.0	6.5
4	11-15	Necessary (urgent)	-	-

### Discussion and Conclusion

Musculoskeletal disorders are extremely common worldwide and affect people of all ages, gender and socio-demographic background in society (Woolf, Vos & March, 2010). The purpose of this study was to evaluation of ergonomic postures of physical education and sport science by REBA and its relation to prevalence of musculoskeletal disorders. The Nordic Musculoskeletal Questionnaire showed that symptoms from the musculoskeletal system were common among the physical education and sport science student's studies. In our study, the prevalence of musculoskeletal complaints was significantly higher among women and the differences were statistically significant for all body region. High prevalence rates of musculoskeletal discomforts have been reported among students especially in those who use uncorrected posture for long hours. Our results showed that the highest prevalence rates of musculoskeletal complaints were related to the neck, lower back and back among men and women. About 94.6% of our participants did exercise regularly. Some previous studies have suggested that regular exercises are crucial to preventing musculoskeletal disorders (Erick & Smith, 2013). Boocock and colleagues have described exercise and ergonomic education as modifier interventions (Boocock et al., 2007). Physical exercises or activities such as walking, running, fitness and stretch exercises can help to relieve tension associated with uncorrected position in sited.

In the current study, the results of ergonomic risk assessment showed that 40% of physical education and sport science students were high risk ergonomically with a mean REBA score of 6.3 (ranging from 4 to 7). Soroush and Hassani suggested that increasing REBA scores are reflective of increasing musculoskeletal discomfort (Soroush & Hassani, 2015). In our study, nonadjustable chairs, awkward postures such as leaning forward which causes no back support, neck flexion, wrist deviation while writing with pen (wrist not in line with the shoulder), and prolonged pen use without taking rest breaks were the common observed risk factors. Based on our obtained risk ranks, about 40% of the studied students require necessary ergonomic interventions to reduce related risk factors.

The prevalence of musculoskeletal complaints is high among Physical Education and Sports Science students of Gazi University. Ergonomic interventions such as school benches redesign and ergonomics training should be considered to prevent the related health problems, especially for high risk stations, as soon as possible.

## Acknowledgements

The authors would like to thank Sajjad Valizadeh and Mohsen Mohammadi for his kind assistance during this research. This study was supported by Gazi University, Department of Physical Education and Sports Science, Ankara, Turkey.

## Conflict of Interest

The authors have not declared any conflicts of interest.

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