

Ergonomic Risk Assessment of Nigerian Teaching Personnel: Cases of a Secondary School and a Tertiary Institution in Ibadan, Nigeria

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ABSTRACT

Educators often spend a lot of time carrying out repetitive motions of the upper limbs and prolonged standing on a daily basis, exposing them to hours of ergonomic risks. This is due to awkward postures, caused by significant deviation of some major body members from the normal neutral positions. Poor ergonomics can lead to various Musculoskeletal Disorders (MSDs), which are of serious concern for workplace safety, especially in jobs that require repetitive motions. It thus became necessary to assess the stress level associated with teaching postures and the prevalent musculoskeletal discomfort in different parts of the body. In this study, ergonomic assessment of teaching personnel at an International Secondary School and University of Ibadan, Nigeria was conducted to determine the prevalent musculoskeletal discomfort in different parts of the body. The study utilised two ergonomic assessment tools- Rapid Entire Body Assessment (REBA) and Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) to gather qualitative and quantitative data about posture and motions during teaching activities. It was discovered that both university lecturers and secondary school teachers in Nigeria face significant ergonomic risks, primarily in the neck, shoulders, and lower back. Further comparison revealed that educators in the secondary school experienced higher severity of musculoskeletal discomfort and exposure to MSD risks, compared to those in the tertiary institution. The educators of the International School had an average REBA score of 4.57, while those at the University of Ibadan had a score of 3.73. These scores indicated a medium level of MSD risk for both groups, but the educators of the International School were at a higher risk. On comparing the CMDQ outcome, it was discovered that there were major differences in the regions where discomforts were reported. While secondary school revealed higher average scores in the neck, right shoulder, and left shoulder regions, and with the neck region having a mean score of 7.003; right shoulder having a mean score of 4.550; and left shoulder having a mean score of 1.600; outcome from University of Ibadan revealed higher mean scores in the lower back and left wrist regions, with the lower back region having a mean score of 7.450 and left wrist region having a mean score of 1.030. These scores indicated a mild to moderate level of discomfort for both groups, with each facing major discomfort in unique body regions. This research highlights the significance of ergonomic evaluation and the combination of quantitative and qualitative data to identify potential interventions.

Keywords: Ergonomics, Musculoskeletal disorders (MSDs), Teaching personnel, Work-related discomfort.

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I. INTRODUCTION

Nigerian teaching personnel at all levels of education are at a risk of developing health problems associated with Musculoskeletal Disorders (MSDs). MSDs are injuries that affect various parts of the body such as muscles, bones, nerves, tendons, ligaments, joints, cartilages, and spinal discs [1]. These disorders can lead to sprains, strains, tears, soreness, pain, carpal tunnel syndrome, hernias, and connective tissue injuries. MSDs have been the most consistent and major reason for non-fatal injuries or

illnesses that require days away from work, which would ultimately hinder productivity [2]. MSDs can be caused by a number of ergonomic risk factors such as repetitive motions, poor posture, prolonged standing, extended work periods, and exposure to ergonomic risks, which all contribute to mechanical strain on the joints [3]. Educators engage in tasks that involve repetitive upper limb movement and prolonged standing and may be at a risk of MSDs if they maintain bad or improper body postures and body motions for long periods of time [4]. Ergonomic risk factors are significant in the development, prevention, and management

of MSDs, in such a way that if ergonomic principles are not applied properly, workers in general are at a greater risk of physical strain on their muscles, tendons, and ligaments [5]. Ergonomic principles are guidelines and principles that rely on scientific knowledge of human abilities and restrictions [6]. The objective of these principles is to improve the design of workspaces, equipment, tasks, and environments to promote human wellness, efficiency, and safety. Ergonomics is a field of study that involves multiple related disciplines such as engineering, psychology, occupational hygiene, and physiology. Its main focus is on the interaction between humans and technology, which serve as components of a complex system [7]. It is also the study of how people interact with their work environment, including both the physical space and the organization itself. Ergonomics can be broadly classified into 3 groups, namely; physical, cognitive, and organizational ergonomics [8]. Physical ergonomics is directly related to MSDs. It focuses on the design of physical aspects such as workstations, equipment, tools, and tasks to optimize human performance and reduce the risk of injuries and MSDs [9]. Ergonomic assessment is commonly used to identify hazards in the work environment and to suggest ways to lessen them [10]. Useful ergonomic assessment tools include: Rapid Entire Body Assessment (REBA) through observation and the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) through a questionnaire. The CMDQ is a self-reporting tool for assessing discomfort in office and sedentary workers. It provides valuable information about the type and severity of musculoskeletal discomfort experienced by workers [11]. It also helps in identifying affected body areas and monitor changes over time, guiding ergonomic interventions. The REBA is an ergonomics-based workplace risk assessment tool that evaluates different body parts, including upper limbs (arm, forearm and wrist), lower extremities, trunk, and neck. It is a useful method for identifying forced postures that are often adopted by workers, and can then be used to develop improvement measures if necessary [12]. Both methods provided valuable insights for improving work environments, reducing risks, and enhancing worker safety and comfort. Ergonomic standards are designed to make people feel safe and comfortable in their work environments [13]. Teaching is both a science and an art that involves creating a positive learning environment, using various techniques, and adapting to individual student needs. Teaching is an important way of helping students develop their qualifications, socialize, and become responsible subjects in their own lives [14]. Lecturing is still a popular teaching method, mainly due to its practicality and convenience for conveying information to large groups of learners using limited educational resources [15]. It challenges students' thinking, fosters engagement, and encourages deeper understanding. Despite the benefits of teaching and lecturing, ergonomic risks exist for teaching personnel. Prolonged exposure to risk factors can lead to MSDs, emphasizing the need to improve working conditions. An ergonomic risk assessment is necessary to identify conditions that contribute to these disorders [16]. Previous studies have focused on the ergonomic risks and challenges faced by teaching personnel, suggesting interventions such

as fitness exercises, ergonomic interventions, and stress management to reduce the prevalence of musculoskeletal disorders, stress, and burnout. However, a more comprehensive assessment is required to understand the effects on educators' health and well-being [17]. Maintaining a good teaching posture is crucial for creating a confident and engaging teaching environment. Poor teaching posture can increase the risk of back pain and other musculoskeletal disorders, as well as impact mental well-being [18]. Deviation from the neutral posture, which refers to a posture not aligned with the body's natural position, can increase stress on muscles and joints, leading to pain and discomfort. Factors such as prolonged sitting or standing, poor ergonomics, and technology use contribute to deviation from neutral posture. Maintaining neutral posture through good ergonomics, breaks, and exercises can help reduce the risk of pain, discomfort, and injury [19]. Educators who spend long hours teaching and sitting are at an increased risk of MSDs due to deviation from neutral posture [20]. Ergonomic assessments are crucial for identifying work-related stress and injury risks [10]. There are two main approaches to ergonomic assessments, which are the quantitative and the qualitative methods [21]. Quantitative methods involve the use of physical measurements, computer simulations, and mathematical models to quantify the impact of work tasks on posture, muscle activity, and biomechanical stress. These methods employ tools such as inclinometers, pressure mats, and goniometers to measure joint angles and muscle activity [22]. Qualitative methods, on the other hand, rely on observation, self-assessment tools, and subjective assessments to understand worker comfort and perceived risk [23]. While less precise than quantitative methods, qualitative approaches offer valuable insights into workers' subjective experiences and help identify areas of concern or discomfort that may not be captured by quantitative measures. Tools such as checklists or questionnaires, allow workers to identify areas of discomfort or risk in their work environment through their own assessments [23]. This study was aimed at performing ergonomic risk assessment on teaching personnel in Nigeria, using University of Ibadan and an International Secondary School in Ibadan, Nigeria as cases. Therefore, the objectives of this research were: 1) Evaluating the activities and work postures of educators in both institutions during their lessons, 2) Comparing the effects of work posture and the severity of musculoskeletal discomfort experienced by these educators, and 3) Providing recommendations based on the analysis of results. This study's outcomes will serve as a basis for taking necessary actions and providing standards for the Nigerian educational system, in order to minimise stress and negative impacts on the musculoskeletal systems of teaching personnel.

II. METHODOLOGY

A. Study Setting

This study was conducted on Nigerian educators located in Ibadan, Oyo State, Nigeria. Their instructional sessions in classrooms or lecture halls were thoroughly observed. The study focused on lecturers from University of Ibadan and

teachers from an International Secondary School in Ibadan.

B. Study Design

This study is an observational descriptive study that used ergonomic assessment methods such as Rapid Entire Body Analysis (REBA) and The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) to assess the teaching posture of Nigerian educators.

C. Study Population

This study involved educators from the University of Ibadan and an International Secondary School in Ibadan, Nigeria.

D. Inclusion Criteria

In this study, the inclusion criteria included:

1. Educators working at the University of Ibadan and an International Secondary School.
2. Educators who were willing to participate in the study and provided informed consent.

E. Exclusion Criteria

The exclusion criteria included:

1. Educators who had a pre-existing medical condition that affected their work posture or ergonomic conditions (such as a spinal cord injury or chronic joint pain).
2. Educators who were not willing to participate in the study or provide consent.

F. Study Sample

Thirty voluntary participants each were randomly selected amongst the lecturers of the University of Ibadan and the teachers of an International Secondary School, making a total of sixty participants.

G. Data Collection

Educators' experiences of work-related MSDs were examined by using a combination of interviewer-administered questionnaires and observational assessments. The participants' posture during work was observed using a video recording to determine any deviations from their neutral position.

Questionnaires were distributed and recorded, which were divided into three sections: Personal Information, Work-Related Information, and The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ).

H. Data Collection Procedure

The data collection process was conducted as follows:

Step 1: The participants were asked a series of questions to gather information about their demographics and work-related details. They were also required to complete the CMDQ, which involved rating the level of discomfort experienced in different parts of their body.

Step 2: The participants' postures were observed using a video camera to capture still photographs. These photographs were then analyzed, and the participants' postures were scored using the REBA assessment worksheet, as depicted in Fig. 1.

Step 3: The score for musculoskeletal discomfort was computed based on the CMDQ scoring guidelines, which enabled the determination and quantification of discomfort

levels. To calculate the CMDQ Score for each body region, the Frequency score, Discomfort Score, and Interference Score were multiplied together for each candidate.

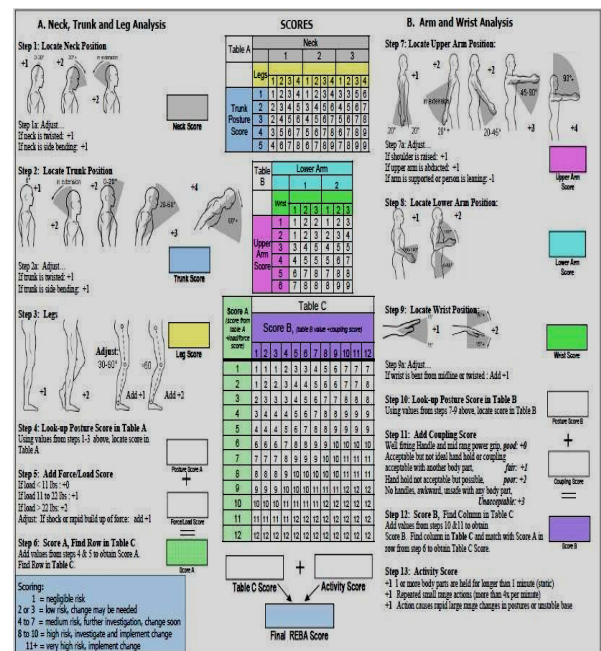


Fig. 1. REBA Worksheet Source: [24]

To get the CMDQ score for each candidate's different body region, the following steps were followed;

Step I: Calculate Frequency Score

Score: 0, for Never; 1.5, for 1 to 2 times per week; 3.5, for 3 to 4 times per week; 5, for Everyday; 10, for Several times every day.

Step II: Calculate Discomfort Score

Score: 1, for Slightly uncomfortable; 2, for Moderately uncomfortable; 3, for Very uncomfortable.

Step III: Calculate Interference Score

Score: 1, for Not at all; 2, for Slightly Interfered; 3, for Substantially interfered.

Step IV: Multiply the Scores to get Final Score

Step V: Rank the Final Score

The final score can be interpreted as a rank of the discomfort/pain level as follows:

- 1 = No Discomfort (score of 0)
- 2 = Mild (score of 1.5 to 4.5)
- 3 = Moderate (score of 5 to 14)
- 4 = Severe (score of 15 to 45)
- 5 = Very Severe (score of 60 to 90)

I. Data Analysis

The data collected during the ergonomic assessment was analysed using IBM SPSS Statistics software and Microsoft Excel. Measurements taken, using an Image meter were inputted into the REBA worksheet and Microsoft Excel for analysis. Mean scores of REBA and CMDQ were computed to determine the average risk level of MSDs and the prevalence of body discomfort symptoms.

A comparison was made between teachers at an International Secondary School and lecturers at the University of Ibadan to assess the differences in risk levels and prevalence of discomfort symptoms.

TABLE I: WORKER'S PERSONAL AND WORK-RELATED INFORMATION (INTERNATIONAL SECONDARY SCHOOL)

Participant number	Age Range	Gender	Work Experience (Months)	Lessons per work week	Daily teaching hours (Hours)	Breaks after each teaching hour	Adequate lighting	Personally adjusted workstations	Work-related injuries	Participation in physical activities outside of work
1	21-30	Female	12 to 24	7+	5+	Yes	Yes	Yes	No	Yes
2	41-50	Male	36+	4 to 5	5+	No	Yes	Yes	No	Yes
3	21-30	Female	24 to 36	2 to 3	4 to 5	Yes	Yes	Yes	No	No
4	31-40	Male	2 to 12	7+	5+	Yes	Yes	Yes	Yes	Yes
5	31-40	Female	24 to 36	7+	4 to 5	Yes	Yes	Yes	Yes	No
6	21-30	Male	2 to 12	6 to 7	5+	No	Yes	Yes	No	Yes
7	31-40	Male	36+	7+	4 to 5	No	Yes	Yes	No	Yes
8	31-40	Female	36+	7+	5+	Yes	Yes	Yes	No	Yes
9	21-30	Female	12 to 24	7+	5+	Yes	Yes	Yes	No	No
10	21-30	Female	24 to 36	6 to 7	5+	Yes	No	Yes	No	Yes
11	31-40	Female	2 to 12	7+	5+	Yes	Yes	Yes	No	Yes
12	31-40	Male	2 to 12	4 to 5	2 to 3	Yes	Yes	Yes	No	Yes
13	41-50	Male	12 to 24	7+	1 to 2	Yes	Yes	Yes	No	Yes
14	31-40	Female	12 to 24	6 to 7	1 to 2	Yes	Yes	Yes	No	Yes
15	21-30	Female	12 to 24	7+	1 to 2	Yes	Yes	Yes	No	Yes
16	41-50	Female	36+	4 to 5	1 to 2	Yes	Yes	Yes	No	Yes
17	31-40	Female	36+	4 to 5	1 to 2	Yes	Yes	Yes	No	Yes
18	21-30	Female	12 to 24	7+	5+	Yes	Yes	Yes	No	No
19	31-40	Female	24 to 36	7+	5+	Yes	Yes	Yes	No	No
20	41-50	Female	36+	7+	2 to 3	Yes	Yes	Yes	Yes	Yes
21	21-30	Female	12 to 24	7+	2 to 3	Yes	Yes	Yes	Yes	Yes
22	21-30	Female	24 to 36	6 to 7	4 to 5	Yes	Yes	Yes	No	Yes
23	31-40	Male	36+	4 to 5	5+	No	Yes	Yes	No	Yes
24	21-30	Male	2 to 12	4 to 5	4 to 5	Yes	Yes	Yes	No	No
25	21-30	Female	24 to 36	6 to 7	4 to 5	Yes	Yes	Yes	Yes	No
26	41-50	Female	12 to 24	6 to 7	5+	No	Yes	Yes	Yes	No
27	31-40	Male	36+	6 to 7	5+	Yes	Yes	Yes	No	No
28	21-30	Male	12 to 24	7+	5+	Yes	Yes	Yes	No	Yes
29	31-40	Female	12 to 24	4 to 5	2 to 3	Yes	Yes	Yes	No	No
30	31-40	Male	12 to 24	6 to 7	4 to 5	Yes	Yes	Yes	No	No

TABLE II: WORKER'S PERSONAL AND WORK-RELATED INFORMATION (UNIVERSITY OF IBADAN)

Participant number	Age Range	Gender	Work Experience (Months)	Lessons per work week	Daily teaching hours (Hours)	Breaks after each teaching hour	Adequate lighting	Personally adjusted workstations	Work-related injuries	Participation in physical activities outside of work
1	51-60	Male	36+	2 to 3	2 to 3	Yes	No	No	Yes	Yes
2	31-40	Male	2 to 12	2 to 3	2 to 3	Yes	Yes	No	Yes	Yes
3	51-60	Male	12 to 24	4 to 5	2 to 3	Yes	No	Yes	No	Yes
4	31-40	Male	36+	4 to 5	2 to 3	Yes	Yes	Yes	No	No
5	51-60	Male	36+	4 to 5	4 to 5	Yes	No	Yes	No	Yes
6	31-40	Male	36+	2 to 3	4 to 5	Yes	No	No	No	No
7	21-30	Male	2 to 12	4 to 5	1 to 2	No	Yes	Yes	Yes	Yes
8	21-30	Male	2 to 12	4 to 5	1 to 2	Yes	Yes	Yes	Yes	No
9	41-50	Female	36+	4 to 5	1 to 2	No	Yes	Yes	No	Yes
10	41-50	Female	36+	6 to 7	2 to 3	Yes	Yes	Yes	No	Yes
11	21-30	Male	36+	4 to 5	2 to 3	Yes	Yes	Yes	Yes	Yes
12	51-60	Male	24 to 36	2 to 3	1 to 2	Yes	Yes	No	No	Yes
13	51-60	Male	36+	2 to 3	1 to 2	Yes	No	No	No	Yes
14	31-40	Male	12 to 24	2 to 3	1 to 2	Yes	Yes	Yes	No	Yes
15	41-50	Female	12 to 24	4 to 5	2 to 3	Yes	Yes	Yes	No	Yes
16	41-50	Female	36+	4 to 5	2 to 3	Yes	Yes	Yes	No	Yes
17	31-40	Male	36+	4 to 5	2 to 3	Yes	Yes	Yes	No	Yes
18	51-60	Female	36+	2 to 3	2 to 3	Yes	Yes	Yes	No	No
19	41-50	Female	36+	6 to 7	5+	Yes	Yes	Yes	No	Yes
20	41-50	Male	36+	4 to 5	4 to 5	Yes	Yes	Yes	No	Yes
21	41-50	Female	36+	4 to 5	2 to 3	Yes	Yes	Yes	No	Yes
22	41-50	Male	36+	2 to 3	5+	Yes	No	No	Yes	Yes
23	51-60	Male	36+	7+	4 to 5	Yes	No	Yes	No	Yes
24	41-50	Female	36+	4 to 5	4 to 5	Yes	No	Yes	No	Yes
25	41-50	Male	12 to 24	4 to 5	1 to 2	No	No	Yes	No	No
26	41-50	Male	36+	7+	1 to 2	Yes	Yes	Yes	No	Yes
27	41-50	Male	36+	4 to 5	4 to 5	Yes	Yes	Yes	No	Yes
28	41-50	Male	36+	4 to 5	4 to 5	Yes	Yes	Yes	No	No
29	31-40	Male	12 to 24	4 to 5	4 to 5	Yes	Yes	Yes	No	Yes
30	51-60	Male	36+	4 to 5	4 to 5	Yes	Yes	Yes	No	Yes

III. RESULTS AND DISCUSSION

A. Demographic and work-related data (School)

The demographic and work-related data obtained from the International School is presented in Table I, where each participant's responses to the questionnaire are displayed.

B. Demographic and work-related data (University of Ibadan)

The demographic and work-related data obtained from the University of Ibadan is presented in Table II, where each participant's responses to the questionnaire are displayed.

C. Analysis of Selected Educators in University of Ibadan

The analysis of educators in the University of Ibadan indicated that most of the participants were males between the ages of 41 and 50, with over three years of experience and teaching 4-5 lessons per week. Most educators felt the lighting was appropriate and adjusted their workstations accordingly. Few participants reported work-related injuries, and many engaged in physical activities outside of work.

Based on their REBA scores, most participants fell into the medium MSD risk category, indicating the need for further investigation into posture. It also showed that many participants were at risk for neck and spinal injuries, with half exceeding safe limits in leg movement and the majority failing to maintain safe limits in upper arm and forearm motion.

Many participants also exceeded safe limits in their wrists. The CMDQ scores showed the highest levels of discomfort in the neck and lower back regions. Based on the REBA, the 43.3% of participants were at low risk for MSDs, while the 56.7% were at moderate risk for MSDs. The average REBA score for educators was 3.73, indicating an average level of MSD risk. This study highlighted the moderate level of MSD risk among educators at the University of Ibadan, emphasizing the need to address postural issues and discomfort to improve the educators' well-being.

D. Comparison of CMDQ Average Scores

Fig. 2 displays the graphical representation of the average scores of the CMDQ comparison. The graph depicts 18 body regions studied in the CMDQ, with each region being assigned a number from 1 to 18. The numbers represent the following regions respectively: Neck, Right Shoulder, Left Shoulder, Upper Back, Right Upper Arm, Left Upper Arm, Lower Back, Right Forearm, Left Forearm, Right Wrist, Left Wrist, Hip/Buttocks, Right Thigh, Left Thigh, Right Knee, Left Knee, Right Lower Leg, and Left Lower Leg.

E. Comparison of REBA Average Scores

As depicted in Fig. 3, the average REBA score for educators at the International Secondary School is 4.57 and 3.73 for educators at the University of Ibadan. These scores indicate a medium level of MSD risk for both groups, but the educators at the International Secondary School are at a higher risk.

G. Discussion of Results

Examining the data gathered from Nigerian educators offered beneficial insights into their work conditions. The teaching profession is mostly comprised of females, which indicates that societal expectations play a role in gender imbalance. There are significant variations in work experience and teaching load, highlighting the need for standardised requirements.

Although many educators take breaks and engage in physical activity, a considerable number neglect these activities, increasing the likelihood of musculoskeletal disorders. The work environment and workstation layout are generally acceptable, but there is room for improvement. The analysis of MSDs indicates moderate to severe discomfort in the neck, shoulders, and lower back.

The case studies show differences in specific areas of discomfort. The analysis of posture reveals risks in neck, trunk, and limb movements. Both studies emphasize the need for interventions to promote good posture and prevent MSDs. These studies provide valuable insights into the ergonomic risk assessment of Nigerian teaching staff and highlight the significance of maintaining good posture.

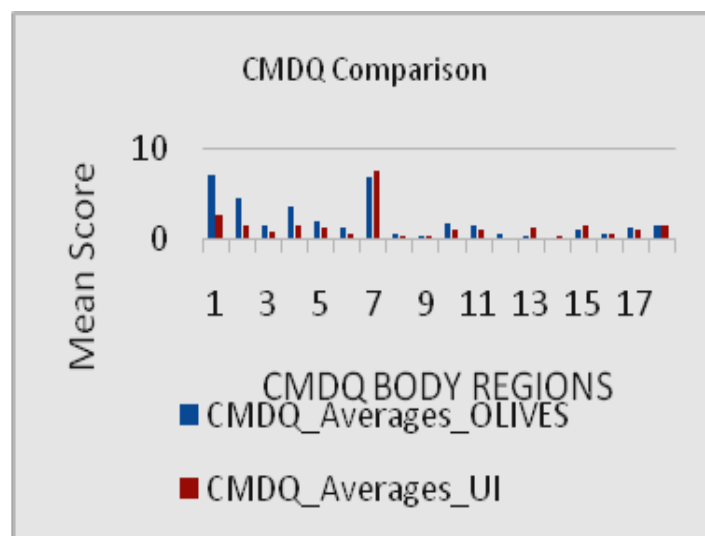


Fig. 2. Comparison of CMDQ Average Scores

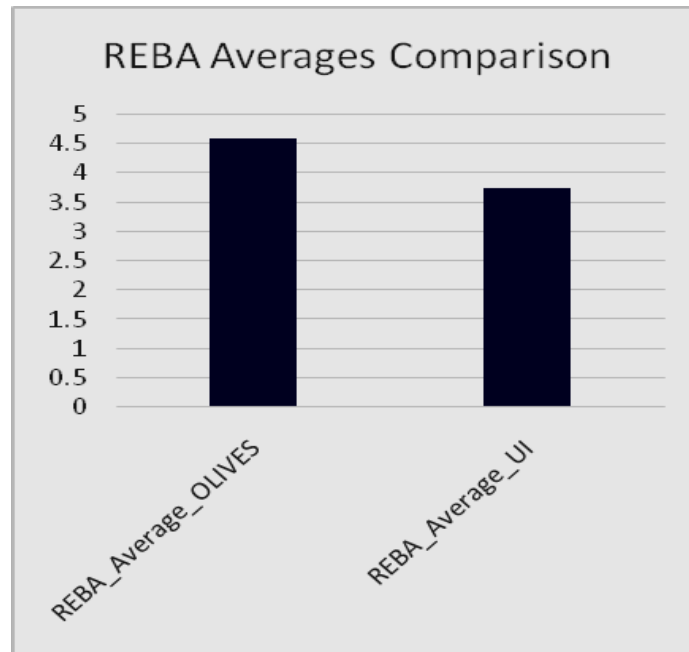


Fig. 3. Comparison of REBA Average Scores

IV. CONCLUSION

This study focused on the ergonomic risks faced by teaching personnel in Nigeria, specifically at and International Secondary School and the University of Ibadan. The research utilized the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) and Rapid Entire Body Assessment (REBA) to assess musculoskeletal discomfort and identify ergonomic risks. Findings revealed that both university lecturers and secondary school teachers face significant ergonomic risks, particularly in the neck, shoulders, and lower back. Factors such as laptop use, prolonged standing, and lecturing contributed to discomfort and fatigue. This study highlights the importance of ergonomic assessment and the need for interventions to mitigate risks. Recommendations include regular assessments, ergonomic awareness and education, provision of ergonomic furniture and equipment, and workload reduction. Implementing these measures can create a safer and healthier work environment for Nigerian teaching personnel. Ongoing research is crucial to further improve ergonomic conditions in education.

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We sincerely express our gratitude to the management and educators of the International Secondary School visited, and University of Ibadan lecturers for their participation and insights, which have shed light on ergonomic risks faced by teaching personnel in Nigeria, hoping that our findings will enhance workplace safety and health for educators in Nigeria.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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