



(RESEARCH ARTICLE)



## Association of ergonomics and musculoskeletal disorders among school teachers

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### Abstract

**Objective:** To find the association between ergonomics and musculoskeletal disorders (MSD) among school teachers.

**Methods:** 40 subjects were selected for the study, to assess the prevalence of Musculoskeletal Disorders (MSD) with the standardized Nordic musculoskeletal questionnaire (NMQ) and evaluate for ergonomics in class and while working on computers/smart phones, and awareness of the same was noted with the help of checklists and Rapid Entire Body Assessment (REBA) and Rapid Upper limb Assessment (RULA) tools.

**Results:** REBA scores revealed that majorly, teachers were at medium risk levels of getting MSDs, with 72.72% of primary teachers, and 75.86% of secondary teachers for tasks performed, whereas RULA scores concluded that 48.27% of secondary teachers and 45.45% of primary teachers were in the medium risk level of getting MSDs.

**Conclusions:** The research revealed an association between ergonomics and the prevalence of MSDs in school teachers, and demonstrated the sites involved in the MSDs.

**Keywords:** MSDs; Ergonomics; NMQ; RULA; REBA; School Teachers

### 1. Introduction

Every occupation is related to some hazards, the occupational characteristics of some workers may render them especially susceptible to work-related musculoskeletal pain [1]. Teachers represent a risky occupational group that is usually affected by musculoskeletal disorders [2]. Musculoskeletal disorders most commonly take place in a non-ergonomic environment [3]. Generally, school teachers have a great prevalence of MSD rates which is between 40% to 95% concerning other occupational groups [4].

The Online teaching trend came into fashion with the corona virus pandemic and calling for more tech-savvy attitudes and regular use of devices like smart phones and computers resulting in sedentary postures and body alignments leading to MSD symptoms in individuals, both the teachers and students interacted online for educational purposes, as partial opening of schools, and blended mode of teaching proved to be useful. Research has shown that using online platforms for learning interaction was achieved by whole-class combined video-/audio-based lessons which were one of the most frequently used ways, irrespective of the learning stage, and the arrangement done by teachers of combined text-based discussions depended on the learning level [5, 6].

As the cases decreased, the complete opening of schools was declared with a complete offline mode of teaching. The abrupt changes faced by teachers with the way of teaching resulted in newer challenges, be it in class or while doing schoolwork on computers and smart phones continued poor postures and ergonomics dominated in several ways. In the process of digitalization of the educational system and the increasing priority of the use of distance learning

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technologies, the use of various digital gadgets, especially smart phones, is increasing [7]. As schools operated on 'physical mode/ offline mode' newer challenges were faced by the teachers such as modifying the teaching techniques, tackling students with continuing the use of smart phones and computers for various purposes like feeding data, completing Excel sheets, checking assignments or quizzes given online, etc. Work conducted on these devices allows this population to carry out several tasks which can be sharing academic information with students and other staff members and consulting online reference sources for their information needs [8].

Hence work environment of teachers is subjected to numerous factors like computer ergonomics, smart phone ergonomics, classroom ergonomics and so on which calls for evaluation of the same and minimizing the risk of MSD prevalence in this population. As in the online, blended, and offline modes of teaching, teachers experience these stressors and extended online teaching somehow sprouted the MSD symptoms due to repetitive stresses, prolonged acquired postures, etc. Various studies have shown that teachers are one of the occupational groups subjected to work-related musculoskeletal disorder (WRMSD) and are generally unaware of the factors leading to these hazards such as poor posture, poor ergonomics, and other factors like that [9]. Therefore, this study aims to find the association between ergonomics and musculoskeletal disorders (MSD) among school teachers.

## 2. Material and Methods

This was a cross-sectional study with a sample size of 40 selected by the method of convenience sampling.

Inclusion criteria: Primary and Secondary school teachers were selected for the age group 25-60 years, both; Male and Female subjects were included, with the mode of teaching being both Online (for the past 8 months or more) or Offline, using a computer or smart phone use for academic or non-academic purposes.

Exclusion Criteria: subjects with pathological conditions, who had trauma/injury within the past 10 months, or who had consulted a physiotherapist or an ergonomist for ergonomic advice were excluded.

Informed consent was taken, with an explanation of the research topic and procedure permission for taking photos from each subject, and clearance from the Ethical committee of the institute was taken. Data collection forms were filled by the subjects including demographic (age, gender, body weight, height), occupational characteristics (occupational status- primary/secondary), time of class, the device used for schoolwork, screen time, and awareness and general knowledge of ergonomics and musculoskeletal disorders were also asked through the same.

The Standardized Nordic questionnaire was applied to assess and check the prevalence of musculoskeletal pain using questions and a body map indicating nine body sites which were neck, shoulders, upper back, elbows, low back, wrists, hips, knees, and ankles.

With close observation most sustained postures while writing on the upper part of the blackboard- Task 1, while standing in class- Task 2, and while using a smart phone or computer postural and ergonomic assessment was done by photographing the subjects and using REBA [10] and RULA [11] software respectively.

Further by providing a score to Group A consisting of Trunk, Neck, and Legs, and Group B consisting of Upper Arms, Lower Arms, and Wrists, for their respective posture during the tasks given through REBA evaluation a single score was given, representing the level of MSD risk (Table 1).

While using the desktop for classes, setting question papers, etc the most sustained posture was observed and was photographed by a mobile camera while using computers and while working on smart phones, the final score was given with the components NECK, TRUNK, ARMS, and LEG position through RULA (Table 2).

**Table 1** REBA scores with corresponding Musculoskeletal disorder risk

Reba score	Level of MSD risk
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change now

**Table 2** RULA scores with corresponding Musculoskeletal disorder risk

Reba score	Level of MSD risk
1-2	Negligible risk, no action required
3-4	Low risk, change may be needed
5-6	Medium risk, further investigation change soon
6+	Very high risk implement change now

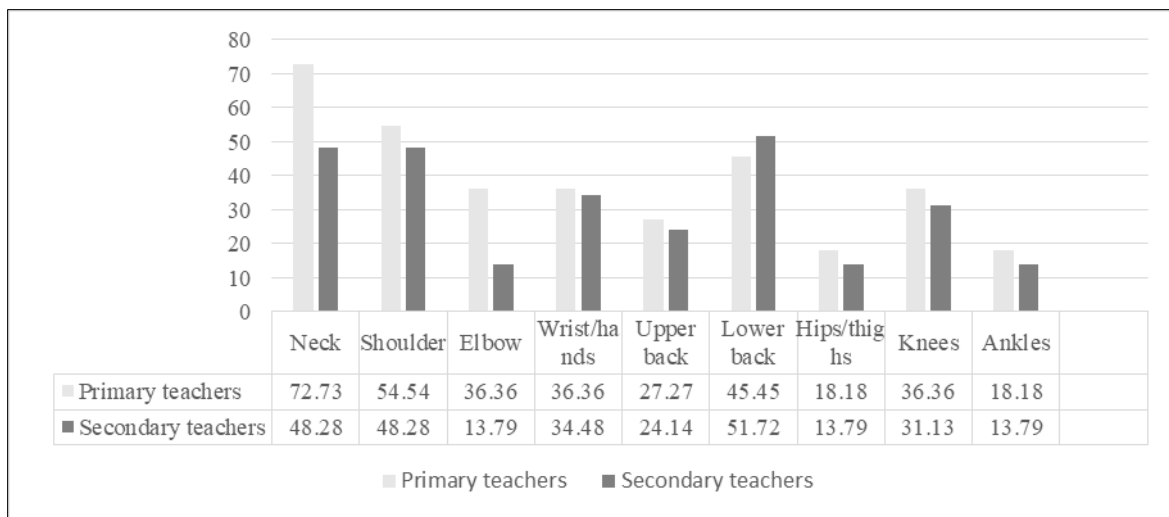
### 3. Results

Data were summarized with arithmetic mean and Standard deviation and with percentage methods, along with the use of REBA and RULA software

A total of 40 subjects participated in the study of which 11 were primary teachers (n=11) and 19 were secondary teachers (n=29) The relevant data has been presented in this section and use of Microsoft Excel for calculating percentage, mean, and standard deviation is done, supplemented with tables and graphs for a clear understanding of significant outcomes.

#### 3.1. Prevalence of MSD among school teachers with respect to professional status

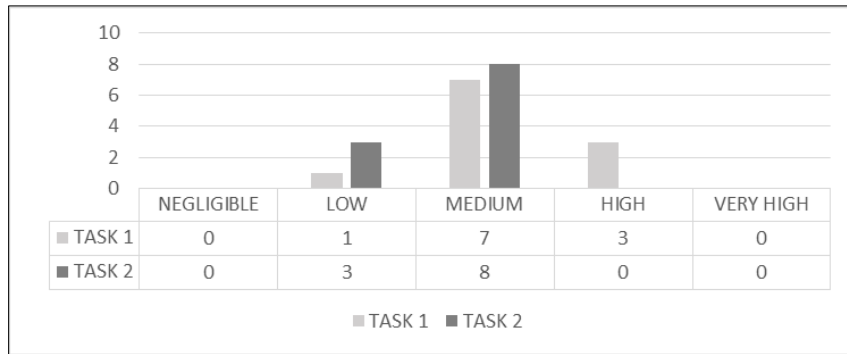
With the standardized Nordic musculoskeletal questionnaire, the MSD prevalence was noted with respondents filling the 3 sections of the questionnaire for 9 body sites, the following were the findings as tabulated in Table 3 and demonstrated in Figure 1.



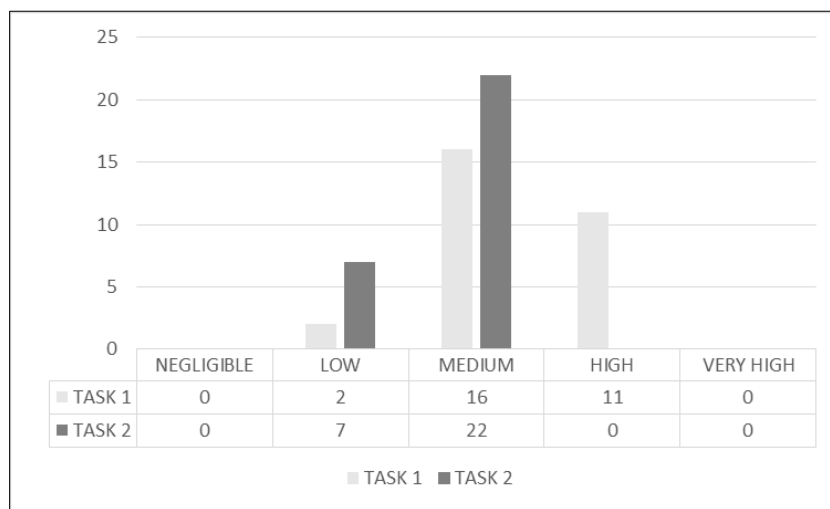
**Figure 1** Percentage of affected body site based on NMQ scoring

#### 3.2. REBA scores and corresponding MSD risk levels among school teachers

For posture in two tasks, scores were given Task- 1 writing on the upper part of the blackboard, and Task-2 prolonged standing in class scoring was done by analyzing each component, and the following findings were observed, as given in graphs (Figures 2 and 3).



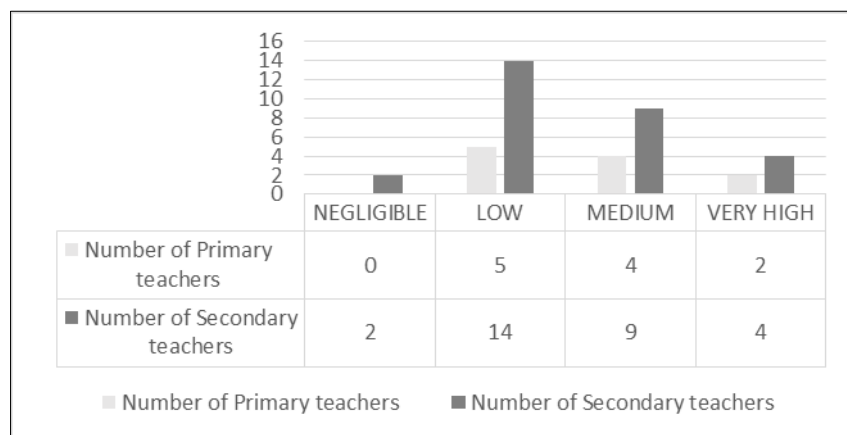
**Figure 2** REBA scores for primary teachers



**Figure 3** REBA score for secondary teachers

**3.3. RULA scores and corresponding MSD risk levels among school teachers**

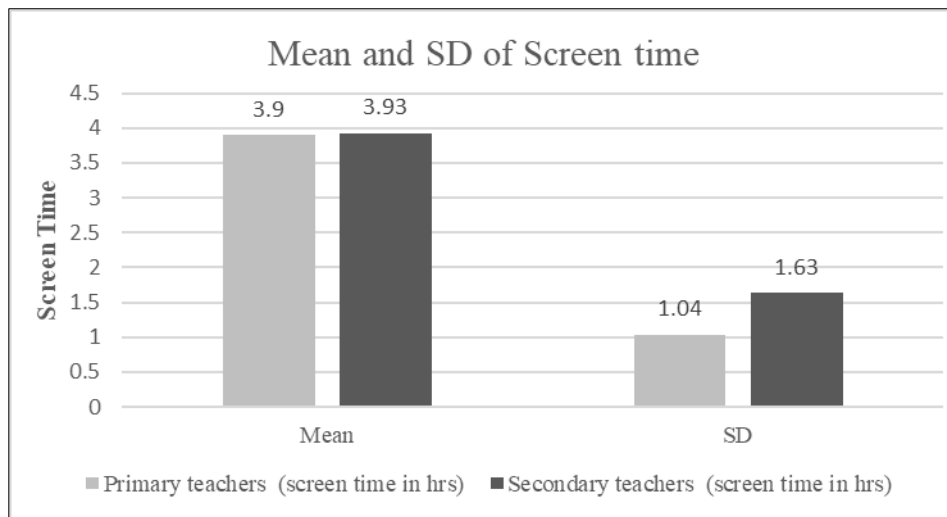
For posture and ergonomic assessment while using computers/smart phones through analyzing each component and following findings were observed in Figure 4.



**Figure 4** RULA score for teachers

### 3.4. Screen time of subjects

Screen time for school work was asked in hours, spent in front of computers or smart phone screens among 40 subjects, 21 used smart phones, and the rest 19 used computers, arithmetic mean and SD were calculated for the screen time in hours as shown in Figure 5.



**Figure 5** Mean screen time of teachers

## 4. Discussion

In the present study different ergonomic evaluation methods were used to evaluate the ergonomics and use of standardized Nordic musculoskeletal questionnaire was used for the evaluation of both groups of school teachers, all inclusion and exclusion criteria were kept in mind and participants were screened for the same. In the present study, most of the teachers had symptoms of MSD, same is seen in prior research teachers reported MSD symptoms, and a lack of awareness about correct posture while using computers[1]. Computer users like teachers have a high risk to get neck and shoulder pain due to high work strain, longer mouse and keyboard use [12].

The use of devices played a key role in both academic and non-academic purposes, Smartphone has become one of the productive ways to get desired information and teachers are extensively using these devices to effectively satisfy their academic requirements. Comparatively younger faculty members have adapted to current technological development and have improvised their way to access, using, sharing, and preserving academic information [8].

Some studies have shown differences in musculoskeletal symptoms among primary and secondary school teachers one of them is the study conducted by Halmi.et.al [13] in 2015 revealed the results of Pearson  $\chi^2$  tests on the differences in health complaints expressed by both groups of school teachers showed that higher percentages of primary than secondary school teachers reported musculoskeletal pain (93.2 vs. 87.7%;  $p < .001$ ). The primary teachers complained more of neck pain (68.2 vs. 62.0%;  $p < .01$ ), shoulder pain (72.8 vs. 65.1%;  $p < .001$ ), leg pain during physical activity (54.6 vs. 41.1%;  $p < .001$ ), and headache (63.1 vs. 55.9%;  $p < .005$ ), similar findings were observed in the present study as (72.73%) of primary teachers complained neck pain, whereas only (48.28%) of secondary teachers complained of the same, shoulder pain was experienced by (54.54%) of primary teachers and (48.28%) of secondary teachers, whereas lower back pain was experienced by more secondary teachers than primary teachers percentages being (51.72%) and (45.45%) respectively. Some findings of a study from Saudi Arabia revealed that it was reported that back pain was the most affected prevalent body site (68%), shoulder pain (54.4%), and neck pain (42.1%) among secondary school female teachers [14].

Ergonomics as found in this study plays a great role in the occurrence of MSD in any profession, so does infrastructure contribute to the same as evidenced by some research, one of them suggests MSD (PR = 2.46 to 3.37) and perception of ill-suited infrastructure of schools (PR = 1.53 to 1.95) were associated to disability in all regions of the body [15].

In this study, it was found that classroom ergonomics was not well as the REBA scores for the task of writing on the upper part of the blackboard, where the MSD risk fell in medium and high categories with a REBA score of 7 or 9 being

most prevalent and this can be supported with the fact that studies showed that the job nature of school teachers included prolonged writing on the upper part of blackboard or whiteboard and twisting and turning such as from the board to the class and back again, as school teachers involved with major examination students [16].

Hence this calls for putting more awareness for the same and ergonomic evaluation for schools can be done as in the study “Ergonomic Evaluation of School Desks Concerning Bureau of Indian Standards Specifications” [17] done in 2017 in Malad, India where schools’ desks measurements and anthropometric measures were analyzed and evaluated for students of primary classes using the assessment index Evaluation of Ergonomic Quality Assessment Index (EQAI).

By findings of Da Costa [18] states that poor awareness of ergonomics occurs among teachers. This is due to school teachers’ lack of exposure and education on ergonomics. The more school teachers are aware of ergonomics, the fewer work-related injuries they will face. Hence, organizing programs or courses on ergonomic principles at school can reduce MSD and enhance work productivity [14]. Previous studies also showed that well-trained school teachers on ergonomics provide a healthy work environment and teachers were attentive regarding keeping an optimum posture during work [19]. Awareness of MSD is reported to have shown [15] a different result compared to awareness of ergonomics. Another study has reported that not more than half of school teachers (30.6%) were very aware of MSD even though school teachers are the professional group that has a high prevalence of MSD compared to other working groups of professionals [20]. Primary and secondary school teachers in this study had little awareness on MSD (only 25.0% teachers were aware) and this conforms to findings of earlier studies that demonstrated the low MSD awareness.

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## 5. Conclusion

In conclusion, there is an association between ergonomics and musculoskeletal symptoms among school teachers. Thus, to improve the current condition and enhance work efficiency, educational programs on ergonomics and prevention of Work-related Musculoskeletal Disorders should be introduced among all school teachers, irrespective of their occupational status.

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

The authors declare no conflict of interest.

### *Statement of Ethical approval*

The study was approved by the Research Review Development Committee (10/2044/SOP/DPSRU/2021/1035) of the School of Physiotherapy, Delhi Pharmaceutical Sciences and Research University. Before taking part in the study, the subjects gave their informed consent and the study’s methodology was communicated to the participants.

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