

Effectiveness of Ergonomically Modified Workstations in Reducing Work-Related Musculoskeletal Disorders among Garment Workers: A Cross-Sectional Study

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Received: August 03, 2026; Accepted: August 12, 2026; Published: August 17, 2026

Introduction

Background

Work-related musculoskeletal disorders (WMSDs) are among the most prevalent occupational health problems worldwide, accounting for a substantial proportion of workplace injuries and disabilities. According to the World Health Organization, musculoskeletal disorders contribute to approximately 17% of all years lived with disability globally, significantly impacting workers' physical well-being and the economic performance of industries [1]. These disorders affect muscles, tendons, nerves, ligaments, and joints due to repetitive movements, forceful exertions, awkward postures, vibration exposure, and static loading during work tasks, OSHA [2].

In industrial and manufacturing sectors, repetitive and monotonous tasks, inadequate rest periods, and poorly designed workstations exacerbate the risk of developing WMSDs. Workers exposed to such conditions commonly report pain, stiffness, fatigue, and reduced range of motion in the upper limbs, lower back, neck, and shoulders. If untreated, these disorders can lead to chronic pain, absenteeism, and even permanent disability, thereby decreasing overall workforce efficiency and productivity Bernard.

In the Ready-Made Garment (RMG) industry of Bangladesh one of the most labor-intensive sectors and the second largest exporter of garments globally the prevalence of WMSDs is alarmingly high. The industry employs approximately 4 million

workers, with women comprising nearly 85% of the workforce BGMEA. Workers typically engage in long hours of sewing, ironing, or packing activities while seated on non-adjustable chairs, often with inadequate back support and poor workstation height alignment. Prolonged static posture, repetitive hand and shoulder movements, and insufficient breaks are key contributors to musculoskeletal discomfort [3,4].

A study by Rahman reported that nearly 65–70% of RMG workers experience some form of musculoskeletal pain, with the lower back, neck, and shoulders being the most commonly affected regions. Such disorders not only compromise workers' health and job satisfaction but also lead to significant productivity losses for factories through increased absenteeism and reduced work output. In many cases, these issues persist because of the absence of ergonomic principles in workstation design, limited worker awareness about proper posture, and inadequate occupational health policies International Labour Organization.

Ergonomics - the scientific discipline that optimizes the interaction between people and their work environment - provides an effective approach to prevent and manage WMSDs. Ergonomically modified workstations are designed to adapt to the worker's anthropometric dimensions, allowing for proper alignment, posture, and comfort. Such interventions may include height-adjustable chairs and tables, lumbar-supported seating, adequate legroom, proper lighting, and the use of anti-fatigue mats for standing workers [5]. Research evidence shows that

Citation: Morshedul Islam, Rockshana Habib, Md. Tanzir-Uz-Zaman, Sanjib Chandra Mandal, Protiva Sarker, et al. Effectiveness of Ergonomically Modified Workstations in Reducing Work-Related Musculoskeletal Disorders among Garment Workers: A Cross-Sectional Study. *J Ortho Physio*. 2026. 4(3): 1-3.

DOI: doi.org/10.61440/JOP.2026.v4.57

ergonomic modifications significantly reduce musculoskeletal strain, improve posture, enhance worker satisfaction, and ultimately increase productivity Hedge.

Despite the proven benefits of ergonomics, its application in the Bangladeshi RMG sector remains limited. Many factory settings still rely on outdated workstation designs that fail to consider human body mechanics. The implementation of ergonomic principles is often overlooked due to cost concerns, lack of professional expertise, and insufficient awareness among employers. Moreover, few studies in Bangladesh have systematically investigated the association between ergonomic workstation design and the prevalence of WMSDs using standardized assessment tools such as the Nordic Musculoskeletal Questionnaire (NMQ) or the Rapid Upper Limb Assessment (RULA).

Therefore, a cross-sectional analytical study is warranted to evaluate the effectiveness of ergonomically modified workstations in reducing WMSDs among garment workers. By comparing workers who operate at ergonomically modified versus conventional workstations, this study aims to identify the extent to which workstation design contributes to musculoskeletal health, comfort, and productivity. Findings from this research will provide essential evidence to inform ergonomic policy, workplace design standards, and physiotherapy-based interventions in Bangladesh's industrial sector [6].

Justification of the Study

The RMG sector is vital to Bangladesh's economy but is often characterized by poor ergonomic practices and inadequate occupational health management. High rates of WMSDs not only cause suffering among workers but also reduce factory efficiency, leading to lost productivity and increased healthcare costs.

While previous studies have documented the prevalence of musculoskeletal pain among garment workers, there is limited evidence assessing the relationship between ergonomic workstation design and the reduction of WMSD symptoms in real-world settings.

This study will fill this gap by evaluating the effectiveness of ergonomic interventions (modified workstations) on musculoskeletal health outcomes through a cross-sectional comparison between workers using modified versus conventional workstations.

Findings from this study can:

- Support the development of ergonomic guidelines for garment factories,
- Raise awareness among employers and policymakers, and
- Promote safer, more productive working environments through evidence-based recommendations.

Operational Definitions

Ergonomics: The scientific discipline concerned with understanding interactions between humans and other elements of a system, applying theory, principles, and design to optimize human well-being and performance.

Work-Related Musculoskeletal Disorders (WMSDs):

Conditions affecting muscles, tendons, nerves, or joints due to repetitive motions, forceful exertions, awkward postures, or static loading during work tasks.

Ergonomically Modified Workstation: A workstation redesigned to fit worker needs by adjusting table and chair height, providing lumbar support, footrests, adequate lighting, and reducing repetitive strain.

Effectiveness: The degree to which ergonomic modification is associated with lower prevalence and severity of musculoskeletal symptoms among workers.

Aim of the Study

To evaluate the effectiveness of ergonomically modified workstations in reducing work-related musculoskeletal disorders among garment workers.

Objectives of the Study

General Objective:

To determine the relationship between ergonomic workstation modifications and the prevalence of WMSDs among garment workers in Bangladesh.

Specific Objectives:

- To assess the prevalence and distribution of WMSDs among garment workers.
- To compare musculoskeletal symptoms between workers using modified and conventional workstations.
- To identify ergonomic risk factors associated with WMSDs.
- To explore the association between workstation ergonomics and self-reported productivity.
- To recommend ergonomic interventions to prevent WMSDs in the RMG sector

Methodology

Study Design

A cross-sectional analytical study will be conducted to compare the prevalence of WMSDs among workers using ergonomically modified and non-modified workstations.

Study Site

The study will be carried out in selected Ready-Made Garment (RMG) factories in Dhaka and Gazipur, Bangladesh.

Study Population

Workers employed in sewing, finishing, and quality control sections of garment factories

Sampling Technique

Factories will be selected through purposive sampling, and within each factory, workers will be chosen using simple random sampling.

Sample Size

A total of 200 participants (100 from ergonomically modified workstations and 100 from conventional workstations) will be included, calculated using prevalence estimates of WMSDs (60%) with a 95% confidence interval and 5% margin of error.

Inclusion Criteria

- Garment workers aged 18–45 years.

- Employed for at least one year in their current workstation.
- Willing to participate and provide informed consent.

Exclusion Criteria

- Workers with previous traumatic injuries, congenital deformities, or systemic musculoskeletal diseases.
- Pregnant workers.
- Workers absent during data collection.

Measurement Tools

Standardized Nordic Musculoskeletal Questionnaire (NMQ): to assess prevalence and location of musculoskeletal symptoms.

Rapid Upper Limb Assessment (RULA): to evaluate ergonomic risks associated with posture.

Workstation Ergonomic Checklist: to classify modified vs. conventional workstations.

Visual Analog Scale (VAS): to measure pain intensity.

Productivity Record Sheet: to assess perceived performance efficiency.

Data Collection Procedure

Data will be collected using structured questionnaires and observational ergonomic assessments. Trained physiotherapy researchers will:

Conduct face-to-face interviews with workers using the NMQ and VAS.

Observe and score work posture using RULA.

Document workstation features to determine ergonomic classification.

Data Analysis

Data will be analyzed using SPSS version 25.

Descriptive statistics (mean, SD, frequency, percentage) for demographics and symptom prevalence.

Chi-square test to compare prevalence of WMSDs between groups.

Independent t-test or Mann–Whitney U test for comparing pain scores.

Multivariate logistic regression to identify predictors of WMSDs (e.g., posture, working hours, workstation type).

A p-value < 0.05 will be considered statistically significant.

Level of Significance

To determine the significance of the study, the p-value was determined. The p values represent the probability of experimental study results. Probability refers to the reliability of the findings. A p value is referred to as an experiment's degree

of significance, and a p value of 0.05 was deemed significant for health service research. If the p value is equal to or less than the significance threshold, the results are deemed significant DePoy & Gitlin.

Rigor

This study was conducted in systematic way. All the steps of research were followed by the researcher sequentially. During data collection the researcher avoided influencing the whole process by own perspectives, values, and biases. The researcher never influenced the participants by his own perceptions during data collection. A trustful relationship with participants was always maintained and the documents were kept confidential. Biasness had been avoided during data analysis and data was analyzed by the scientific way of SPSS.

Ethical Consideration

The whole process of this research project was done by following the Bangladesh Medical Research Council (BMRC) guidelines and World Health Organization (WHO) Research guidelines. The proposal of the dissertation including methodology was presented to the Institutional Review Board (IRB) (Appendix-A). Again, before starting data collection, researcher obtained permission (Appendix- B) from the head of physiotherapy department to collect data at musculoskeletal department of CRP, Savar. The researcher strictly maintained the confidentiality regarding participant's condition and treatments. The researcher obtained consent from each participant to take part in this study. A signed informed consent form (Appendix- C) was received from each participant. The participants they decline answering any question during the study and were free to withdraw their consent and terminate participation at any time. The researcher was eligible to do the study after knowing the academic and clinical rules of doing the study about what should be done and what should not. All rights of the participants were reserved and researcher was accountable to the participant to answer any type of study related question.

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