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*Original Article*

# Effectiveness of specific muscle group stretching in reducing regional musculoskeletal disorders among textile workers

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## ABSTRACT

**Introduction:** Regional musculoskeletal disorders (MSDs) are prevalent in the textile industry, primarily due to repetitive or static work postures. This study aimed to assess whether specific muscle group stretching exercises could reduce MSDs complaints among workers in the textile industry.

**Methods:** A quasi-experimental design with a pretest–posttest approach without a control group, which limits causal inference, was employed. Thirty textile workers participated in a structured stretching program twice daily for 8 weeks. Complaints of MSDs were assessed using the Nordic Body Map (NBM) questionnaire at baseline, Week 4, and Week 8. The data were analyzed using Repeated Measure ANCOVA to control for age, gender, length of employment, and BMI, with effect sizes calculated using Cohen's d.

**Results:** Significant reductions in MSDs complaints were observed across seven body regions ($p<0.05$). The largest improvement was in the upper neck region (mean score reduction = 0.83; Cohen's d = 1.116), indicating a very large effect size. Covariates (age, gender, length of employment, and BMI) did not significantly influence outcomes ($p > 0.05$).

**Conclusion:** While targeted stretching of specific muscle groups appeared to reduce regional MSDs among textile workers, the absence of a control group limits the ability to draw definitive causal conclusions. Future studies should employ randomized controlled trials with larger sample sizes to confirm these preliminary findings.

**Keywords:** Musculoskeletal Pain, Nordic Body Map, Quasi-Experimental Study, Textile Workers, Workplace Stretching

## Introduction

The issue of musculoskeletal disorders (MSDs) has persistently been an occupational health issue in various industries around the world, with a specific participation of labor-intensive industries like the textile industry.[1] The causes of these disorders include repetitive motion, awkward postures, and extended static work, resulting in physical discomfort and significant productivity loss. Most of the tasks in the textile industry require prolonged sitting postures, repetitive upper limb actions, and pain in the neck, shoulders, lower back, and lower limbs.[2,3]

The Textile industry is the largest labor-intensive industry in Indonesia, employing millions of workers. Still, the country does not have much information about the prevalence of MSDs in this sector. There are a few interventions that have been noted to avert the risk of MSDs, which include ergonomic workstation design, postural modification, and stretch-exercise programs in the workplace.[4,5] It has been observed that such programs positively affect the posture, improve flexibility, and lower pain complaints of industrial workers.[6] Research in the Indonesian industrial setting, like the case of the aluminum plant, indicated that an intervention in worksite stretching had reduced MSDs pain scores in 19 compared to 13, indicating the possible sustainability of the method in the textile industry.[7]

However, there has been little to no research on the effects of ergonomic interventions, especially stretching exercises, on the clustering of the textile industry in Indonesia. It is in this gap that context-specific programs will address the ergonomic needs of those workers. Consequently, the study aims to determine the effectiveness of selected muscle group stretching exercises in reducing regional MSD complaints among a sample of textile workers based on an evidence-based ergonomic intervention.

It has also been established globally that workplace stretching regimens actually contribute significantly toward the reduction of MSDs complaints and improvement in musculoskeletal function over time.[8] Nonetheless, even though Indonesia has a high number of textile workers and ergonomic hazards like repetitive and static work are well-documented, there have not been systematic reviews of these types of interventions in the industry. This study fills that gap through a combination of an ergonomically tailored stretching program that specifically focuses on the various parts of the body that are most often affected in the case of a textile worker, including the knees, thighs, calves, lower back, upper back, and overall body discomfort. A quasi-experimental design was used to measure MSD complaints three times (week 0, week 4, and week 8) to determine the effectiveness of the program in a real-world occupational context.

Most previous studies of ergonomic interventions were conducted in office working conditions or industries other than textiles. Workplace stretching exercise interventions within the textile industry in Indonesia remain relatively understudied, with no studies being conducted to quantify the specific impacts on textile workers in Surakarta. Textile factory workers have definite job characteristics like repetitive movements and static working posture, particularly in the weaving unit, which raises the risk for MSDs. This study aims to address the gap in the literature on the effectiveness of workplace stretching exercises in reducing complaints of MSDs among textile plant workers with standing workstations.

This study aims to examine the effectiveness of the Specific Muscle Group Stretching Exercise program, one component of the Workplace Stretching Exercise intervention, in reducing complaints of MSDs in workers' neck, back, waist, thighs, knees, and calves at PT. Iskandar Indah Printing Textile, Surakarta, Indonesia. It was chosen as the trial site because it is one of the largest textile manufacturers in the area, where most workers are employed in repetitive static jobs, awkward working postures, and prolonged standing, which predisposes them to MSD development. Primary ergonomic evaluations, as well as company health records, suggested that complaints of MSDs were especially high in the neck, back, and lower extremities. The results of this study are expected to provide guidelines for an effective and focused specific muscle group stretching program in an effort to minimize the risk of musculoskeletal disorders in the textile industry.

## Methods

This study employed a quasi-experimental pretest-posttest design without a control group. The absence of a control group was due to company policy and ethical considerations, which required that all eligible workers receive the intervention to prevent potential health disadvantages. The study aimed to evaluate the effectiveness of specific muscle group stretching exercise in reducing localized musculoskeletal symptoms among textile workers over an eight-week period. The study was conducted at PT Iskandar Indah Printing Textile, Surakarta, Indonesia, a workplace with high ergonomic risk, over an eight-week period encompassing preparation, intervention, and post-intervention data collection.

The duration of intervention was eight weeks and was realized through specific muscle group stretching exercises applied twice a day (after two hours of morning work and in the afternoon). The movements were repeated thrice during each session, and the selected muscle groups were those that were vulnerable to musculoskeletal disorders related to performing repetitive and static work, such as the neck, shoulders, upper back, lower back, and lower limbs. Before the intervention, participants were subjected to the organized simulation and training to adhere to proper and safe performance. A standardized, written protocol was used by trained instructors to guide all the sessions throughout in an attempt to ensure the consistency of the program.

The required sample size for this single-group intervention study was determined using the following formula:

$$n = \frac{(Z_{1-\alpha/2} + Z_{1-\beta})^2 x\, \sigma^2}{d^2}$$

where: $\alpha$ = 0.05, resulting in $Z_{1-\alpha/2}$ = 1.96; β = 0.20, resulting in $Z_{1-\beta}$ = 0.84; σ = 5 (Standard Deviation); d = 2.56 (Effect Size). Based on this calculation, the minimum required number of participants was 30.

The Specific Muscle Group Stretching Exercise is based on static stretching protocols and targets key tension-prone areas commonly affected by prolonged standing postures in textile workers. As illustrated in Figure 1, the program includes structured movements for the neck, shoulders, back, waist, and legs, which are the most commonly reported regions for musculoskeletal discomfort in this population. The movements are meant not only to increase flexibility but also to reduce the stiffness of the muscles, boost circulation, and prevent strain at a specified point in repetitive activities. Figure 1 can anchor the actual application of the intervention in the workplace and support its consistent implementation in the routine workplace-based stretching.

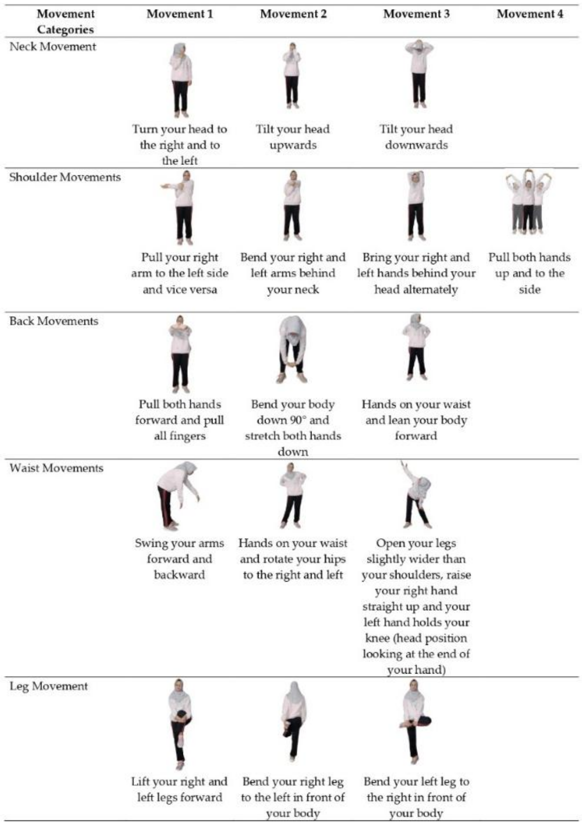



**Figure 1:** Categories and sequences of workplace-specific stretching exercises used in the intervention

Participants were recruited in line with the CONSORT guidelines. As shown in in Figure 1, a total of 104 textile workers were screened for eligibility based on predefined inclusion criteria (employed in production for ≥1 year, free from acute injury, and willing to participate) and exclusion criteria (undergoing treatment for severe MSDs, recent surgery, or pregnancy) (Figure 1). Of these, 46 participants were excluded for various reasons (e.g., not meeting the inclusion criteria, declining to participate), and 58 participants were allocated to the intervention. Just 38 people underwent the intervention, with dropout also occurring because of loss of follow-up (n=3) and termination (n=5). In total, 30 participants took part in the entire intervention and were part of the final analysis. Figure 1 is the participant flow diagram, which shows important dropout points and the reason for including the final analyzed sample. Reproducibility of the study is facilitated by the figure, which also ensures transparency in the management of the participants.

The study was approved by the Health Research Ethics Committee of RSUD Dr. Moewardi Surakarta (Number: 932/IV/HREC/2024). All participants provided written informed consent to participate in the study. Ethical standards in accordance with research guidelines were followed during the study.

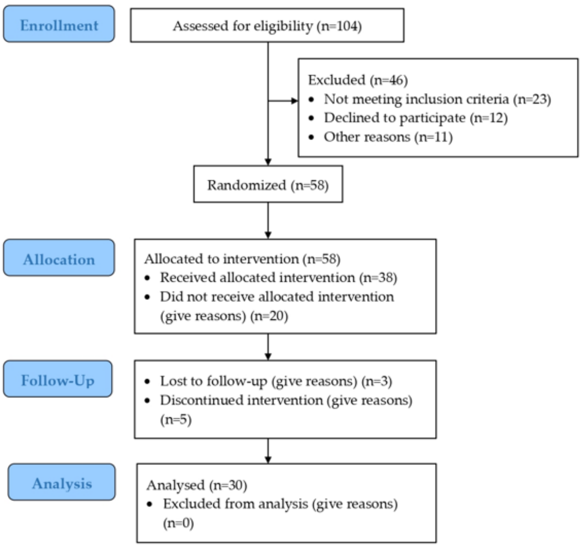



**Figure 2:** CONSORT Flow Diagram

The primary variable measurement in this study, regional musculoskeletal complaints, was conducted using the Nordic Body Map (NBM) questionnaire. The NBM questionnaire is a questionnaire that asks respondents to mark areas of pain or discomfort in the body, which has been found to be effective for identifying pain locations in workers, including the neck, shoulders, and upper back, and reflecting various levels of MSDs risk.[9] The NBM questionnaire demonstrated effectiveness because it receives extensive application throughout different industrial sectors to determine ergonomic risks.[10] The Nordic Body Map successfully assesses MSDs among blue-collar workers because its reliability and validity are confirmed through multiple assessments that show consistent results with high Cronbach's alpha scores.[11] The questionnaire presents a human body diagram as a visualization tool to direct respondents towards identifying particular pain areas. The Nordic Body Map guards 28 distinct pain points in the human body that span from the neck to shoulders and upper back and lower back and elbows to wrists/hands to hips to knees and ankles.[12]

The questionnaire contained a 4-point Likert scale ranging from 1 = no pain through 2 = slightly painful and 3 = painful to 4 = very painful, which respondents used to rate their discomfort in each noted area. The survey was distributed three times before intervention implementation and at 4 weeks and 8 weeks after intervention completion. The research collected demographic data along with risk factor data by age, gender, length of employment, and body mass index (BMI) measurements for control purposes. The researchers recorded both specific muscle group stretching exercise frequency and duration along with participant compliance data for subsequent analysis.

Musculoskeletal symptoms were compared using Repeated Measures ANCOVA before and after intervention, adjusting for age, length of employment, and BMI. Before analysis, statistical assumptions were checked: normality of residuals (Shapiro–Wilk test), sphericity (Mauchly's test), and homogeneity of variance and covariance (Levene's test and Box's M test). Effect sizes were calculated using Cohen's d. All statistical computations were performed using SPSS software, with a significance level set at $\alpha = 0.05$.

## Results

The research included 30 textile workers as subjects. Their average age was 48.2 ± 8.1 years, with a range of 39 to 62 years, and their average length of employment was 22.6 ± 5.9 years, with a range from 12 to 32 years. The average body mass index (BMI) was 22.6 ± 5.9 kg/m², with a range of

18.1 to 32.8 kg/m². In terms of gender distribution, the participants consisted of 43.3% males (n = 13) and 56.7% females (n = 17). The demographic breakdown of the participants is presented in Table 1.

**Table 1:** Demographic Profile of Study Participants (N=30)

| Variable | N | Range (Min - Max) | Mean ± SD | Frequency | % |
|---|---|---|---|---|---|
| Age (years) | 30 | 39 - 62 | 48.2 ± 8.1 | - | - |
| Length of employment (years) | 30 | 12 - 32 | 22.6 ± 5.9 | - | - |
| BMI (kg/m²) | 30 | 18.1 - 32.8 | 24.6 ± 4.4 | - | - |
| Gender | | | | | |
| Male | - | - | - | 13 | 43.3 |
| Female | - | - | - | 17 | 56.7 |
| **Total** | 30 | - | - | 30 | 100.0 |

In the normality test of standardized residuals using the Shapiro-Wilk method, the results were Pre ($p = 0.291$), Post1 ($p = 0.072$), and Post2 ($p = 0.061$). Since the p-values are greater than 0.05, the data distribution is categorized as normal. A test of sphericity performed by Mauchly was smaller than the 0.05; it means that the assumption of sphericity was not met, while the Greenhouse-Geisser correction, 0.659, was still within the recommended range. The Test of Equality of Covariance Matrices by Box ($p = 0.667$) and the Test of Pre ($p = 0.912$), Post1 ($p = 0.598$), and Post2 ($p = 0.438$) all indicated p = 0.667, 0.912, 0.612, and 0.438, respectively, as larger than 0.05; this indicates that the assumptions of identical covariances and variance were valid. Thus, assumptions on further analyses were fulfilled.

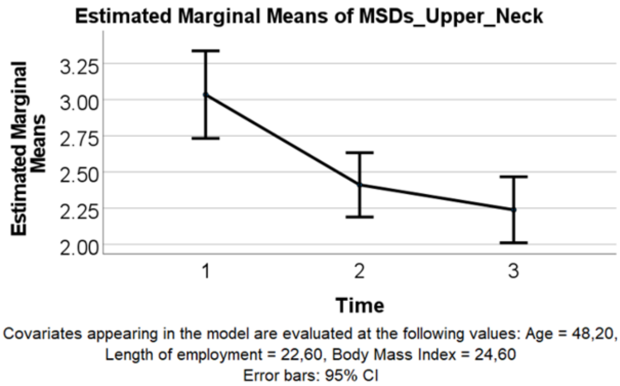
Specific muscle group stretching exercise intervention was measured for efficacy by comparing musculoskeletal complaint scores before the intervention (Pre), at 4 weeks (Post1), and at 8 weeks (Post2). The results demonstrated statistically significant reduction in complaints across all body regions measured. Estimated effect sizes based on Cohen's d ranged from moderate to large; the greatest improvement occurred in the upper neck ($d = 0.991$), while the smallest was in the left calf ($d = 0.702$). For example, the upper neck complaint score decreased from 3.00 ± 0.79 at pre-intervention to 2.23 ± 0.57 at week 8 (average difference = 0.77, 95% CI: 0.48 to 1.06, $p = 0.001$, $d = 0.991$), indicating a large effect size. Similar trends were observed across other body regions, with effect sizes ranging from medium to large. The results are presented in Table 2.

**Table 2:** Mean Differences in Musculoskeletal Complaints and Effect Size (Cohen's d)

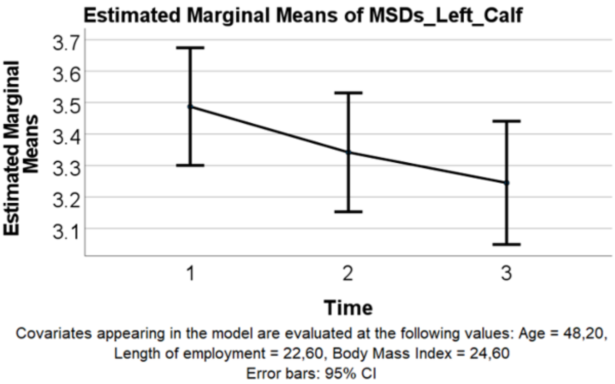
| Body Part | Pre (Mean ± SD) | Post1 (Mean ± SD) | Post2 (Mean ± SD) | Mean Difference (Pre–Post2, 95% CI) | *p-value (Pre vs. Post2) | Cohen's d (Effect Size Pre vs. Post2) | **Effect Size Interpretation |
|---|---|---|---|---|---|---|---|
| Upper Neck | 3.00 ± 0.79 | 2.40 ± 0.56 | 2.23 ± 0.57 | 0.77 (0.48 to 1.06) | 0.001 | 0.991 | Large |
| Lower Neck | 2.77 ± 0.73 | 2.23 ± 0.57 | 2.20 ± 0.55 | 0.57 (0.33 to 0.80) | 0.001 | 0.905 | Large |
| Left Shoulder | 3.07 ± 0.83 | 2.73 ± 0.52 | 2.47 ± 0.51 | 0.60 (0.31 to 0.89) | 0.001 | 0.779 | Medium |
| Right Shoulder | 2.90 ± 0.80 | 2.67 ± 0.55 | 2.47 ± 0.51 | 0.43 (0.18 to 0.69) | 0.002 | 0.683 | Medium |
| Upper Back | 2.23 ± 0.63 | 1.83 ± 0.38 | 1.73 ± 0.64 | 0.50 (0.25 to 0.75) | 0.001 | 0.733 | Medium |
| Lower Back | 3.50 ± 0.51 | 3.33 ± 0.48 | 3.00 ± 0.58 | 0.50 (0.27 to 0.74) | 0.001 | 0.794 | Medium |
| Left Thigh | 3.37 ± 0.49 | 3.23 ± 0.43 | 2.93 ± 0.36 | 0.43 (0.18 to 0.69) | 0.002 | 0.638 | Medium |
| Right Thigh | 3.57 ± 0.50 | 3.30 ± 0.47 | 3.10 ± 0.48 | 0.45 (0.23 to 0.70) | 0.002 | 0.735 | Medium |
| Left Knee | 3.70 ± 0.47 | 3.30 ± 0.54 | 3.30 ± 0.53 | 0.40 (0.19 to 0.61) | 0.001 | 0.710 | Medium |
| Right Knee | 3.50 ± 0.51 | 3.37 ± 0.49 | 3.20 ± 0.48 | 0.30 (0.10 to 0.50) | 0.005 | 0.535 | Medium |
| Left Calf | 3.50 ± 0.51 | 3.33 ± 0.48 | 3.23 ± 0.50 | 0.27 (0.07 to 0.46) | 0.009 | 0.512 | Medium |
| Right Calf | 3.63 ± 0.49 | 3.40 ± 0.49 | 3.13 ± 0.57 | 0.50 (0.25 to 0.76) | 0.001 | 0.733 | Medium |

**Notes:***$p < 0.05$ was considered statistically significant. **Cohen's d interpretation: 0.20 – 0.49 = Small; 0.50 – 0.79 = Medium; ≥ 0.80 = Large.

Figure 3 shows the trend of estimated marginal means of MSDs complaints in the two areas of the body where they occurred (upper neck and left calf) at three points: at pre-intervention, during the mid-intervention period (Week 4), and during the post-intervention period (Week 8). The upper neck region (Figure 3a) had the highest effect size value of Cohen's d = 0.991 (large). The mean complaint scores also reduced significantly, as the scores obtained at post-intervention (2.23 ± 0.57) were lower than the ones obtained at the pre-intervention (3.00 ± 0.79). This difference can be explained by the fact that the level of complaints in the upper neck was higher among the participants, which led to increased sensitivity of the region in the upper neck to specific stretching. Instead, in the left calf region (Figure 3b), the effect size was lower (Cohen's d = 0.512, medium). The decrease in the number of complaints was not as significant (Pre = 3.50 ± 0.51; Post2 = 3.23 ± 0.50), which may be attributed to lower strain in the pre-existing condition or biomechanical inactivity of the calf associated with the textile-related tasks. These pattern-based statistics confirm that an intervention effect can be different, depending on the anatomical area, the severity at the pre-intervention, and the functional demands of a particular group of muscles.




(a)




(b)

**Figure 3:** Profile Plots of MSDs Complaints in Upper Neck and Left Calf Across Time

(a) MSDs Upper Neck (b) MSDs Left Calf

The effects of covariates like age, gender, length of employment, and BMI on the reduction of musculoskeletal symptoms were analyzed using Repeated Measures ANCOVA. The analysis showed that none of these covariates had a significant effect on the reduction in symptoms (p > 0.05), meaning that the observed improvements were largely attributable to the Specific Muscle Group Stretching Exercise intervention. The full results of this analysis are shown in in Table 3.

**Table 3:** Covariate Impact on Musculoskeletal Symptoms (Repeated Measures ANCOVA)

| Body Region | Gender | Age | Length of employment | BMI |
|---|---|---|---|---|
| Upper Neck | 0.803 | 0.908 | 0.603 | 0.843 |
| Lower Neck | 0.147 | 0.607 | 0.500 | 0.956 |
| Left Shoulder | 0.303 | 0.547 | 0.884 | 0.487 |
| Right Shoulder | 0.200 | 0.632 | 0.940 | 0.119 |
| Upper Back | 0.885 | 0.744 | 0.842 | 0.185 |
| Lower Back | 0.332 | 0.767 | 0.785 | 0.818 |
| Left Thigh | 0.106 | 0.900 | 0.532 | 0.385 |
| Right Thigh | 0.420 | 0.789 | 0.542 | 0.675 |
| Left Knee | 0.579 | 0.906 | 0.963 | 0.512 |
| Right Knee | 0.677 | 0.574 | 0.959 | 0.524 |
| Left Calf | 0.688 | 0.884 | 0.368 | 0.457 |
| Right Calf | 0.923 | 0.853 | 0.735 | 0.457 |

## Discussion

The aim of this study was to determine the effectiveness of specific muscle group stretching exercises in reducing regional musculoskeletal symptoms among textile workers. Our findings are consistent with those from diverse occupational settings internationally. For example, stretching interventions conducted among electronics factory workers in South Korea [13] and meat processing workers in Denmark [14] similarly reported significant reductions in MSDs symptoms, particularly in the neck and shoulder areas. These studies, like ours, implemented on-site, scheduled stretching routines guided by ergonomic principles. Consistent with reports from manufacturing workers in Nigeria [15] and garment workers in India [16], we also found that complaints decreased after the intervention across most body regions in question. Nevertheless, the degree of decrease in our sample was higher, especially in the upper neck, lower back, and right calf, especially in the upper neck and lower back, than that among healthcare workers in Thailand [17] and office workers in Germany [18], which was probably because of the selection of muscles in the stretching program, as well as the inclusion of muscle stretching practices in work shifts throughout the working day. The presented positive changes are consistent with biomechanical concepts interpreted as the increase in muscle-tendon unit flexibility, excessive passive tension decrease, and proprioceptive awareness enhancement, which alleviate the discomfort in areas exposed to a stationary load [19]. Unlike the creeping gains seen in sedentary worker groups, our cohort could not only gain benefit rapidly but could, therefore, realize the benefit to a greater degree to an extent that generated noticeable symptom reduction post-intervention.

The average age of the participants (49.9 + 6.9 years) shows that the targeted population has an increased baseline risk of MSDs because of lower tissue elasticity [20,21]. Age was a non-significant covariate in our analysis, as it is in nurses in Brazil,[22] which shows the potential of the intervention working equally well across the middle to late working age. The same cross-sector consistency supports the view that the targeted stretching program may have wide applicability.

The average length of employment of the respondents was 27.1 ± 5.9 years (range: 10-34 years). Long length of employment can lead to an increased risk of MSDs, particularly due to repetitive work and physical overloading [23,24]. Although long length of employment is a predictor of more complaints, from the analysis, length of employment did not affect the intervention effectiveness, which suggests the benefit of stretching in employees with long length of employment.

The respondents' mean BMI was 25.4 ± 3.8, which was overweight or preobese. Elevated BMI can increase musculoskeletal loading [25–27]. Contrary to expectations of high BMI for MSDs risk, stretching intervention was effective in reducing complaints, demonstrating its effectiveness with various physical status.

This research showed a notable reduction in MSDs symptoms in nearly all body regions. The highest reduction was found in the upper neck (Cohen's d = 1.116). The magnitude of change of upper neck symptoms (Cohen d = 0.991) compared to that reported by Buranruk & Wongwilairat (d = 0.85) in office workers may have been this way because the symptoms were relatively severe in our participants. Compared to prior research, we found greater mean effect sizes in the upper neck and lower back. This is an indication that the efficacy of stretching would be increased in a population that would deal with physically demanding tasks. These results further suggest why it is crucial to prescribe the intervention to address the particular biomechanical risks in individual occupational settings, since the interventions did not affect worker samples with low or no exposure to hazardous biomechanical postures.[28,29] The lower back and calf had effect sizes similar to those reported by King et al. among manufacturing workers, which suggested that the intervention could have a similar effect in various work-related environments [17,30].

However, unlike studies in sedentary populations such as call-center employees in the UK,[31] where only marginal improvement was observed, our intervention led to large effect sizes. This divergence might be due to differences in baseline activity levels, targeted muscle groups, and occupational demands. The rest of the body, such as the shoulders, lower back, and calf, also showed a significant reduction consistent with previous studies on the effectiveness of stretching on those areas [32].

Repeated measures ANCOVA analysis indicated that covariates such as gender, age, length of employment, and BMI had no significant effect on the reduction of MSDs complaints. This suggests that the stretching intervention was the contributing factor responsible for reducing complaints, agreeing with the previously cited studies on the effectiveness of stretching without affecting demographic aspects.[18,33–35]

Overall, this study provides strong evidence that specific muscle group stretching exercises are effective in reducing MSDs complaints among textile workers. This supports the theory that stretching enhances flexibility and posture and also reduces muscle tension.[36–38] This simple-to-implement workplace program can improve worker health and productivity and reduce MSDs-related costs.

## Limitations

The following are some of the limitations to be noted in this research. Quasi-experimental design lacking a control group lowers the internal validity and the capability to attribute the observed effects to the intervention only since the changes might also reflect the effects of other factors. Another example is those cases where there is workload fluctuation within a season (seasonal high-production requirements or overtime over an export deadline). The more intense workload during a specific period might worsen the symptoms temporarily or decrease the effectiveness of stretching exercises due to the culmination of fatigue, and the lower workload may reduce the physical strain of the task being performed with or without the intervention.

On the same note, psychosocial factors like job stresses, monotonous work, absence of supervisor support, or perceived high workload were also not captured in this study. All these factors have been known to interact with the physical load and may contribute to the development and magnitude of musculoskeletal symptoms to a substantial extent. Lack of control of these effects prevents isolation of the pure effect of stretching intervention. There is also the lack of randomization that puts a risk of selection bias, which can also affect the representativeness of the sample. Also, the possible confounding factors were not captured (psychosocial stressors, ergonomic work practices, and the workplace and environmental conditions) even though they directly influence the nature and severity of musculoskeletal disorders.[39,40] To enhance the generalizability and strengthen the causal interpretation, randomized controlled trial (RCT) designs are encouraged to be used in the future with a sizeable and a diverse sample and include measurements of psychosocial and ergonomic factors.

In summary, the present study supports the implementation of specific muscle group stretching exercises as an effective method for the prevention of MSDs complaints in textile workers. It would be necessary to design stronger and larger samples in future studies to validate the aforementioned findings and elucidate the mechanism behind the reduction of MSDs symptoms.

## Conclusion

Combined with stretching-specific muscle areas, the content of this study shows that regional musculoskeletal disorder (MSDs) complaints among textile workers can be minimized considerably through focus on special muscle groups. These are exercises that could be utilized as a cost-effective and simple health promotion program at the workplace. The interventions can be effective in enhancing the comfort of workers and productivity and minimizing the number of absent days linked to MSDs. However, the limited range of the quasi-experimental design and the lack of the control group hinder the possibility of establishing causality. Moreover, it cannot be ruled out that unmeasured reasons (i.e., psychosocial stressors and ergonomic work habits) have a potential impact. It is necessary to conduct future studies with larger and more varied populations through randomized controlled trials to see the jointly combined effects of stretching programs and ergonomic interventions and to isolate best practice strategies to prevent MSDs.

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