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Evaluation of workplace ergonomics practices, body parts affected by WMSDs and associated risk factors: a case study

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Abstract

Ergonomics programs play an essential role in providing proper working conditions and a healthy working environment for workers. This article focuses on assessing the level of workplace ergonomic practices, identifying different body parts affected by risk factors, and identifying possible work activities that cause body part injuries. Questionnaires related to the level of workplace ergonomics practices were coded into SPSS. The result depicted the average response for management support on implementing workplace ergonomics, and behavioral components of workplace ergonomics turn neutral. The average response of physical components of workplace ergonomics and management's awareness of workplace ergonomics lay below neutral. Regarding the three risk factors, the body part that is most affected is the lower back, and work activities that cause WMSDs on body parts have been identified. Inferential analysis was also conducted using the SPSS 22 package. Chi-square analysis was applied to determine the association of the WMSDs with socio-demographic parameters like gender, work experience, and level of education. In this study, logistic regression analysis was carried out to find the odds ratio (OR) and measure factors that were likely to affect WMSDs at different body parts. Finally, it concluded that workplace ergonomic practices in the case of the company were not satisfactory and that further improvement of workplace ergonomics practices should be made.

1. INTRODUCTION

The textile sector significantly contributes to Ethiopia's economic development, making it a top priority in the government's industrial advancement strategy. This sector has generated numerous business opportunities and has had a substantial impact on employment. However, increasing reports of unsafe working conditions among workers in this industry have raised concerns. Consequently, assessing current workplace ergonomics in the textile sector has become crucial. Ergonomics involves identifying risk factors for work-related musculoskeletal disorders (WMSDs), including awkward body positions, repetitive movements, high force demands, temperature extremes, static stress, and vibration, adversely affecting worker health and productivity. Key risk factors prevalent in many organizations include high-intensity forces during pinch-grip or open-handed grips while handling heavy or large loads, awkward lifting and carrying postures, and the repetitive motion and pace of work.

This research focuses on "Edget Yarn and Sewing Thread S.C," a case study in the Ethiopian textile industry. The textile sector was chosen for several reasons. First, it has been observed that the case company experiences WMSDs associated with various risk factors in its work environment. Second, the Ethiopian government aims to create employment opportunities for approximately 60,000 citizens. Finally, according to the Ethiopian Textile Industry Development Institute (ETIDI), there is an inadequate focus on human safety measures to mitigate WMSDs, with existing efforts primarily aimed at enhancing human capacity through training.

Reports from a decade ago from both internal and external organizations indicated that while the textile sector contributes significantly to the national economy, insufficient attention is given to ergonomics. Evidence from Chemonics International Inc. (1996) and ETIDI shows that Ethiopian textile industries evaluate their performance based on employment numbers, production capacity, profits, or net worth. This focus has negatively affected the health and safety conditions of workers, leading to intensified workloads, increased pace, and heightened risks of MSDs, as noted by (Kumie et al., 2016). Medical records and reports from the case company's management provide documentation on the number of workers who have sustained work-related injuries, detailed in Table 1.

Table 1. Quarterly based work-related health problems

Periods (arranged in quarters)	1/3/21-30/6/21	1/7/21-30/9/21	1/10/21-31/12/21	1/1/22-30/3/22	1/4/22-30/6/22	1/7/22-31/9/22	1/10/22-31/12/22
Total workers who visited the company's clinic	224	185	182	153	110	210	180
workers faced work-related injuries and/or were referred to higher health centres	34	32	49	47	50	67	57

Source: Company's clinical report

In ergonomic studies, careful consideration of risk factors is crucial for the successful operation of a company (Amira et al., 2017). Ergonomics and Occupational Health and Safety (OHS) primarily aim to preserve the workforce's capabilities while identifying, assessing, and preventing hazards in the workplace (Shaikh et al., 2018; Subash and Das, 2019). Therefore, industry management is required to focus on refining ergonomics and OHS, as doing so can enhance productivity (Bano, 2019). In industrialized nations, Upper Limb Work-related Musculoskeletal Disorders (UL-WMSDs) are the predominant type of occupational disease (Van Eerd et al., 2016). WMSDs represent a significant occupational health issue today (Shah et al., 2020) and are linked to ergonomic risk factors contributing to the development of musculoskeletal disorders (Njaka et al., 2021). Adverse climatic conditions in textile companies can exacerbate mechanical loads, increasing the risk of MSDs (Kebede and Tafese, 2014; Berberoğlu and Tokuç, 2013; Hossain et al., 2018). Moreover, research by (Hoque et al., 2022) suggests that a strong arrangement between suppliers, work environments, and buyers is necessary for employees to work safely and efficiently. The economic burden of MSDs impacts individuals, organizations, and society. In developed countries, musculoskeletal complaints are a dominant cause of short-term sickness absence (Abraha et al., 2018). In developing nations, the GDP losses from work-related injuries and occupational diseases due to poor working conditions are often unaccounted for (Biadgo et al., 2021; Piedrahita, 2006). Ergonomic injuries result in significant financial, material, and time losses for many manufacturing firms (Davis et al., 2014). In today's competitive national and international markets, adequate safety and health programs can help control overhead costs (Sultan-Taïeb et al., 2017). Consequently, implementing workplace environment improvement programs is vital for providing a safe, healthy, and comfortable work setting. The manufacturing sector requires modifications in the physical design of equipment or processes under evaluation (Kaya, 2015). This study indicates that the ergonomic design of loads, tasks, equipment, workstations, work environments, and overall facilities is the most effective approach to reduce fatigue and enhance productivity (Tang, 2021). Analyzing ergonomic risk factors aids in formulating strategies that can improve working conditions, consequently reducing MSDs and enhancing company performance (Dominguez-Alfaro et al., 2021; Singh Rana et al., 2021). When the workplace environment is swiftly arranged to meet the required standards, production can proceed when ensuring workers' safety (Hazana Abdullah et al., 2018).

After thoroughly reviewing previous studies on ergonomics and OHS in the textile sector, a research title in this area has been proposed. The literature review indicates that most studies on ergonomics focus on MSDs, the costs associated with pain burdens, and risk factors, often addressing these topics in isolation.

Research assessing workplace ergonomics practices in the manufacturing sector is limited, particularly in developing countries like Ethiopia. In Ethiopia, awareness and implementation of workplace ergonomics remain in their infancy, with most existing studies primarily concentrating on the valuation of MSDs, which inadequately highlight areas that need improvement. Therefore, it is crucial to consider all employee groups through a diversified sample distribution to examine the current level of workplace ergonomics practices.

This research aims to evaluate the awareness and implementation of workplace ergonomics, assess body parts affected by WMSDs, and identify risk factors and work activities that contribute to these issues. This comprehensive study has significant implications for the factory, as it can inform the redesign of the working environment to ensure a safe and ergonomic workspace, ultimately enhancing competitiveness. Additionally, the study provides recommendations to address the issues faced by Edget Yarn and Sewing Thread Share Company, which is a primary focus of this research.

2. METHODOLOGY

2.1 Research method and data collection

A case study was conducted at the Edget Yarn and Sewing Thread Company in Addis Ababa, Ethiopia. The research employed observational methods to gain a deeper understanding and knowledge of the current situation and to collect data on employees' activities on the shop floor and the overall working environment. For comprehensive information regarding the number of injured workers, data were collected from the medical records maintained by the company's clinic. Furthermore, the literature was reviewed to analyze relevant concepts and gain background information about the research area. A questionnaire was also designed to collect information from the company's employees.

The questionnaire consisted of three sections, incorporating both closed-ended and open-ended questions. Part one focused on gathering socio-demographic information, such as gender, age, educational level, and work experience. Part two aimed to assess workplace ergonomics practices, composed of the physical components, behavioral components, management awareness of workplace ergonomics, and the level of management's support to implement ergonomic practices. Questions in this section were structured using a 5-point Likert scale, where 1 represented "Strongly Disagree," 2 "Disagree Somewhat," 3 "No Opinion (Neutral)," 4 "Agree Somewhat," and 5 "Strongly Agree." Part three was designed to identify body parts affected by WMSDs, the risk factors involved, and the work activities at the company that might cause these disorders. Questions in parts two and three were adapted from the ergonomics checkpoints developed by the International Labor Organization (ILO) in cooperation with the International Ergonomics Association (IEA) (ILO, 2010), and these checkpoints were modified to suit the local context of the case company.

2.2 Sample size determination

The number of respondents was determined after the appropriate sample size calculation formula was used, and the following assumptions were made. A simple or systematic random sampling method was used to determine the sample size, n, using Equation 1.

$$n = \frac{Z^2NP(1-P)}{d^2(N-1)+Z^2P(1-P)} \quad (1)$$

Where;

n= sample size (number of respondents)

N=population size

Z= the level of confidence of 95%=1.96.

P=expected proportion/population proportion estimator=0.96.

d =amount of tolerable deviation/expected variation/precision=5%

Finally, the sample size (n=51) was obtained by the addition of a 10% nonresponse rate. Meanwhile, the distribution of samples to each work position is done proportionally, as shown in Table 2.

Table 2. Total sample size and sample respondents from different work divisions

Work division	Total number of workers in each position	Sample respondents from each work position
Management	6	2
Supervision	4	1
Finance, sales, and marketing personnel	12	3
Quality control	4	1
Production Operators, maintenance personnel, and other shop floor workers	164	38
Cleaning service providers	4	1
Total by formula+10% nonresponse rate	194	46+46*10%=51

2.3 Data Analysis

Once the data was collected, it was analyzed using appropriate methods and tools. The socio-demographic data were examined through inferential analysis to determine if there was an association between WMSDs and socio-demographic characteristics such as age, educational level, and work experience. Inferential analysis was performed using the SPSS 22 software, with a significance level set at $p < 0.05$ for all tests. Pearson's chi-square analysis was utilized to assess the association between the prevalence of WMSDs and socio-demographic characteristics. Additionally, logistic regression analysis was conducted to calculate the odds ratio (OR), which measures the factors likely to affect WMSDs in different body parts. The odds ratio provides a more interpretable result than the chi-square, yielding a quantified outcome (Sogunle PT and Sogunle EO, 2020). In the regression analysis, one of the variables (WMSDs affecting the shoulder, upper back, lower back, etc.) was treated as the dependent variable. In contrast, all other variables served as covariates in SPSS.

Conversely, the level of workplace ergonomics practices in the case company was analyzed using descriptive statistics, including average means and standard deviations. Completed responses were coded in SPSS Version 22, and the average means and standard deviations were presented in tabular form to discuss the level of workplace ergonomics practices. Finally, the workers' responses regarding the body parts affected by WMSDs and the associated risk factors were summarized using statistical graphs. The analysis also included a discussion of possible work activities causing WMSDs, comparing the findings of this research with recent studies in similar areas.

3. RESULTS AND DISCUSSION

3.1 Socio-demographic Information

This study utilized gender, age, educational background, and years of work experience to describe the socio-demographic characteristics of the participants. The socio-demographic characteristics of the respondents are presented in Table 3.

Table 3. Socio-demographic characteristics of the respondents

Variable	Number of respondents	Percentage
Gender		
Male	32	62.75%
Female	19	37.25%
Age		
≤20 years	2	3.92%
21-30 years	13	25.49%
31-40 years	25	49.02%
≥41 years	11	21.57%
Educational Background		
Below High School	3	5.88%
High School Graduate	6	11.76%
College/Polytechnic Diploma	28	54.9%
First Degree	10	19.6%
Postgraduate	4	7.8%
Work experience		
<1 year	8	15.68%
1-5 years	14	35.3%
6-9 years	11	27.45%
≥10 years	18	21.57%

A total of 51 workers from the case company completed and returned the survey, resulting in a response rate of 100%. Among the participants, 67.75% (n=32) were male, while the remainder were female. In terms of age distribution, 3.92% (n=2) were aged 20 years or younger, 25.49% (n=13) were between the ages of 21 and 30 years, 49.02% (n=25) fell within the age range of 31 to 40 years, and the remaining 21.57% (n=11) were aged 41 years or older. Regarding educational background, 5.88% (n=3) had education below high school, 11.67% (n=6) were high school graduates, 54.9% (n=28) held college or polytechnic diplomas, 19.6% (n=10) possessed a bachelor's degree, and 7.8% (n=4) held postgraduate degrees. In terms of work experience, 15.68% (n=8) had less than one year of experience, 35.3% (n=14) had between one and five years of experience, 27.45% (n=11) had between six and nine years of experience, and 21.57% (n=18) had ten or more years of work experience.

3.2 Evaluation of the Level of Workplace Ergonomics Practices

Descriptive statistics have been calculated using measures of central tendency, including means and standard deviations, to assess the level of workplace ergonomics practices. Table 4 presents the descriptive analysis of the physical components of workplace ergonomics based on mean and standard deviation values.

Based on the average mean results, nearly all responses were below the neutral mean of 3, resulting in an overall average of 2.74. This suggests that respondents generally expressed disagreement, although they were somewhat closer to a neutral stance regarding the physical aspects of the workplace environment. It is important to note that respondents agreed on certain points, specifically that the work area is spacious and comfortable, as indicated by an average mean of 3.35 (agree). The average standard deviation for the data was below 1 (0.95), indicating low dispersion, except for comments regarding the overall design of the working environment, the availability of appropriate safety materials, and enough lighting to ensure that workers can perform efficiently and comfortably, including localized lighting for precision or inspection tasks.

The recent literature on the physical components of workplace ergonomics aligns with the findings of this research. For example, a study investigating the relationship between physical workplace ergonomics and worker productivity in small and medium-sized enterprises found statistically significant positive correlations (Nigeriannenna, 2022). Research by (Barbu et al., 2020) identified that ergonomic factors—including temperature, noise levels, relative humidity, airspeed, vibration levels and directions, light intensity and brightness, radiation levels, ambient music and its volume, and color—significantly affect worker productivity. Additionally, a study by (Uthayakumar and Balakumaran, 2022) assessing ergonomic risks for workers in the apparel industry revealed increased risks of muscle pain, bodily discomfort, joint injuries leading to work-related musculoskeletal disorders (WMSDs), and other occupational health issues.

Table 4. Physical components of workplace ergonomics

Questions	n	Minimum	Maximum	Mean	Std. Deviation
The working environment has a good general design	51	1	5	2.72	1.047
The working area has support with appropriate safety materials	51	1	5	2.52	1.049
Make labels and signs easy to see, easy to read, and easy to understand. Use warning signs that workers understand easily and correctly.	51	1	5	2.80	.859
The working area is spacious and comfortable to work in (the aisles are clear of obstacles, floor surface: e.g., slippery, uneven, or damaged)	51	2	5	3.35	.849
The workplace arrangement allows for ease of communication and collaboration/mutual support at the workplace	51	1	5	2.85	.942
The Furniture is in a good state and suitable for working: Provide standing workers with chairs or stools for occasional sitting.	51	1	5	2.24	.993
The equipment (Material handling aids, machineries) is in good condition and functioning state	51	2	5	2.80	.833
The rooms have an ambient temperature and relative humidity, and tools and machines are regularly used to reduce noise.	51	1	5	2.96	.893
Provide and maintain good changing, washing, and sanitary facilities to ensure good hygiene and tidiness, as well as provide drinking facilities and hygienic eating areas to ensure good performance and well-being.	51	1	5	2.41	.909
The working environment has enough lighting for workers so that you can always work efficiently and comfortably and provide local lights for precision or inspection work.	51	1	5	2.78	1.031
Average	51	1.182	5	2.74	.95

Ultimately, this study recommends that enhancing the ergonomic aspects of the physical work environment can substantially improve employee well-being and productivity.

Table 5 illustrates the behavioral components of workplace ergonomics practices. Descriptive statistics will be employed to analyze the results, which include calculating the mean and standard deviation.

The results showed that responses ranged from a mean of 3.13 to 3.20, with an overall average mean of 3.16. The respondents were somewhat divided, as just over half expressed the view that the behavioral component of workplace ergonomics aided their work, with a mean score of 3.16, which is close to neutral. Additionally, the standard deviation of less than 1 (0.851) suggested that the data was not highly dispersed.

The results presented in Table 6 concerning the management's awareness of workplace ergonomics suggest that management does not fully prioritize ergonomic practices in the workplace.

The respondents exhibited a slightly neutral stance on whether management considers workplace ergonomics. As indicated in Table 6, the standard deviations of all responses are below 1, with an average standard deviation of 0.8. This suggests that the data values are not highly dispersed. The findings of this study regarding the impact of awareness levels on effective workplace ergonomics practices are not encouraging. However, recent research indicates that implementing such programs can increase organizational productivity. Due to insufficient awareness of ergonomics, workers often adopt awkward postures, resulting in WMSDs and injuries in various body areas (Yasotha et al., 2018). An exploratory study conducted in Nigerian industries on ergonomics awareness and its effect on employee performance (Olabode et al., 2017) highlighted the importance of orienting and training employees in ergonomics, as well as involving them in the ergonomics design process by collecting detailed anthropometric data to achieve better outcomes in the workplace.

The findings presented in Table 7 regarding management support for implementing workplace ergonomics revealed that respondents tended to have no opinion (neutral), with an average mean of 3. The data showed minimal dispersion, indicated by an average standard deviation of 0.824.

Based on the findings, respondents expressed slight agreement that the company takes steps to ensure that older workers can perform their jobs safely and efficiently and pays proper attention to the safety and health of pregnant and nursing employees. Furthermore, the company offers easy access to first-aid supplies and primary healthcare services at the workplace.

According to a study (Ramdass, 2013), empowering employees to address ergonomics concerns in the workplace significantly enhances productivity, overall performance, and competitive advantages. An article that reviewed the obstacles to successfully implementing changes to prevent musculoskeletal disorders identified a lack of management support, commitment, and engagement as the primary barriers (Yazdani and Wells, 2018). Additionally, research aimed at assessing the impact of ergonomics management on reducing the risk of WMSDs among textile export industry workers found that workers' discomfort scores significantly decreased following the effective implementation of ergonomics management (Anizar et al., 2020). Drawing parallels with the recent literature, it can be concluded that management support for implementing workplace ergonomics is essential for preventing WMSDs and related risk factors.

Table 5. Behavioral components of workplace ergonomics

Questions	n	Minimum	Maximum	Mean	Std. Deviation
There is the ability to focus on my work appropriately without distractions	51	1	5	3.20	.778
Your current environment is a source of motivation for your job satisfaction: the work environment is safe, secure, and quiet enough	51	1	5	3.15	.942
Inform and reward workers about the results of their work and the workplace is interconnected with the work process to enhance confidentiality	51	1	5	3.13	.833
Average	51	1	5	3.16	.851

Table 6. Management's level of awareness of workplace ergonomics

Questions	n	Minimum	Maximum	Mean	Std. Deviation
Workplace ergonomics practiced in your facility	51	2	4	2.78	.758
In your honest opinion, does the management consider your workplace ergonomics?	51	1	5	2.85	.842
Average	51	1.5	4.5	2.81	.8

Table 7. Management support on implementation of workplace ergonomics

Questions	n	Minimum	Maximum	Mean	Std. Deviation
Encourage full participation by women and men in finding and implementing work improvements.	51	1	5	2.83	.797
Take measures so that older workers can perform work safely and efficiently and give due attention to the safety and health of pregnant and nursing women.	51	1	5	3.26	.855
Provide easy access to first-aid equipment and primary healthcare facilities at the workplace.	51	1	4	3.13	.778
Average	51	1	4.5	3	.824

3.3 Body parts affected by the work-related musculoskeletal disorder risk factors

After analyzing socio-demographic information, descriptive statistics were calculated to explore workplace ergonomics practices. A graphical method was employed to illustrate the different body parts impacted by WMSD risk factors. Figure 1 presents the body parts influenced by awkward body positions, excessive forces, repetitive motions, and work pace.

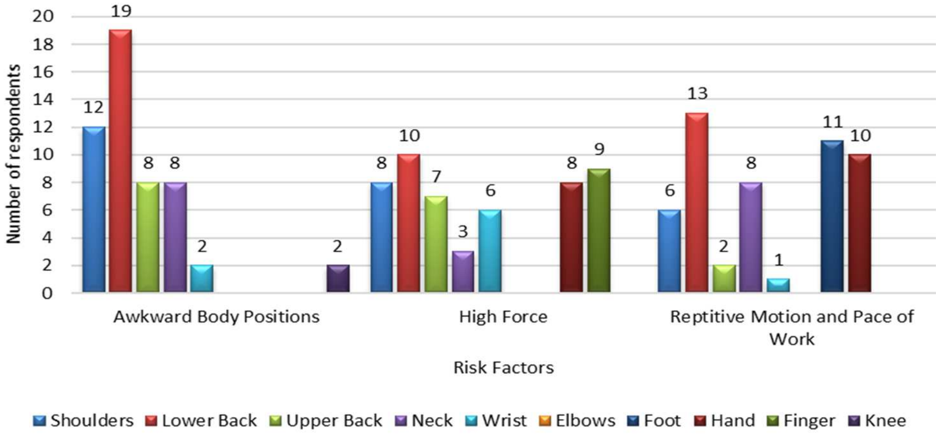

Figure 1. Body parts affected by WMSDS risk factors

Considering awkward body positions as a risk factor, 37.25% (n=19) of respondents identified the lower back as the most affected area. Shoulders followed this at 23.53% (n=12), upper back at 15.68% (n=8), neck at 15.68% (n=8), wrists at 3.92% (n=2), and knees at 3.92% (n=2). Due to high force risk factors, 19.6% (n=10) of respondents reported that the lower back is the most affected body part, followed by fingers at 17.65% (n=9), shoulders at 15.68% (n=8), hands at 15.68% (n=8), upper back at 13.72% (n=7), wrists at 11.76% (n=6), and neck at 5.88% (n=3). Repetitive motion and work pace are also significant risk factors. Because of this risk factor, the lower back was identified as the most affected body part, accounting for 25.49% (n=13), followed by feet at 21.57% (n=11), hands at 19.6% (n=10), neck at 15.68% (n=8), shoulders at 11.76% (n=6), upper back at 3.92% (n=2), and wrists at 1.96% (n=1). Overall, regarding the three risk factors, the lower back emerged as the most affected body part, followed by shoulders due to awkward body positions, feet/legs due to repetitive motion and work pace, arms/hands due to repetitive motion and work pace, fingers due to high force exertion, and neck and upper back.

To compare these findings with recent scientific literature, it is evident that the results are largely comparable. The nature of work and awkward postures in manufacturing industries are quite similar; however, the severity of injuries to specific body parts may vary across different industries. A study assessing WMSDs among women workers in ginning mills in Dharwad Taluka (Hebbal and Renuka, 2019) revealed that manual handling—such as lifting, holding, putting down, pushing, pulling, and carrying loads—was the leading cause of injury in the textiles sector, with legs and lower backs being the most affected areas. Additionally, a systematic review and meta-analysis conducted to assess the prevalence and incidence of WMSDs in 21st-century European secondary industries indicated that the most common WMSDs affected the back (overall), shoulders/neck, neck, shoulders, lower back, and wrists (Govaerts et al., 2021). This review noted that the food industry was frequently associated with a high prevalence of WMSDs. Another study focused on analyzing WMSD risks in various work sections of the cotton garment industry, such as sewing, packing, and ironing (Das et al., 2023), found that lower back pain, knee pain, wrist pain, shoulder pain, and neck pain were the most commonly reported issues.

3.4 Inferential analysis between WMSDs and socio-demographic characteristics

This section includes an inferential analysis examining the potential association between WMSDs and the socio-demographic characteristics evaluated, specifically age, educational level, and work experience. Additionally, Table 8 displays the prevalence of WMSDs across different age categories.

In this study, workers (participants) were categorized into four age groups: Category 1 includes individuals under 20 years old, Category 2 consists of those aged 21 to 30, Category 3 includes workers aged 31 to 40, and Category 4 comprises those over 40. The prevalence of WMSDs was significantly associated with various age categories for multiple body parts, including the shoulder (p=0.018), lower back (p=0.043), upper back (p=0.020), neck (p=0.001), wrist (p=0.003), foot (p=0.023), hand (p=0.015), finger (p=0.004), and knee (p=0.038). Specifically, the likelihood of WMSDs affecting workers' shoulders in Category 2 was 1.458 times higher than that of participants in Category 1. Likewise, workers in Category 3 and Category 4 had 2.217- and 1.152 times higher incidences of shoulder WMSDs than those in Category 1. Additionally, the risk of shoulder WMSDs for workers in Category 3 was 1.152 times higher compared to Category 2, while workers in Category 4 experienced 1.555 times higher incidences than those in Category 2. Furthermore, the prevalence of shoulder WMSDs for Category 4 workers was 1.230 times greater than that of Category 3 workers. Overall, this suggests that as workers' ages increase, the incidence of WMSDs in various body parts also tends to rise.

Table 9 presents an analysis of WMSD symptoms across various body parts categorized by different levels of work experience.

This study divided employees' work experience into four categories: Category 1 includes 0 to 1 year of experience; Category 2 includes 1 to 5 years; Category 3 comprises 6 to 9 years; and Category 4 consists of more than 9 years. The occurrence of work-related musculoskeletal disorders (WMSDs) in various body areas—such as the shoulders (p=0.024), lower back (p=0.023), upper back (p=0.002), wrists (p=0.014), elbows (p=0.019), feet (p=0.028), hands (p=0.017), fingers (p=0.045), and knees (p=0.017)—showed significant associations with different levels of work experience. Specifically, the likelihood of WMSDs at the shoulders of workers in Category 2, Category 3, and Category 4 was 1.445 (odds ratio), 2.699, and 1.994 times higher, respectively, compared to those in Category 1. Additionally, the risk of WMSDs at the shoulders of workers in Category 3 and Category 4 was 1.445 and 3.312 times higher than that for workers in Category 2, respectively. Furthermore, the likelihood of WMSDs at the shoulders of workers in Category 4 was 2.457 times greater than that for workers in Category 3. These odds ratios indicate that as work experience increases, the risk of developing WMSDs in various body areas also rises.

The level of education is another socio-demographic characteristic evaluated in this study. Table 10 presents the analysis of the prevalence of WMSD in various body parts across different education level categories.

Overall, as indicated in Table 10, the prevalence of WMSDs was not significantly associated with the educational level of the workers.

Table 8. Association of WMSDs at different body parts with age categories

Body parts	P* value	OR (@95% confidence interval)					
		1-2#	**1-3#**	**1-4#**	**2-3#**	**2-4#**	**3-4#**
Shoulders	0.018**	1.458 (0.353-3.787)	2.217 (1.006-4.455)	1.152 (0.278-1.776)	1.152 (0.458-2.145)	1.555 (0.664-2.441)	1.230 (0.444-2.154)
Lower back	0.043**	1.754 (0.743-3.497)	2.247 (1.246-5.645)	1.045 (0.258-1.456)	1.242 (0.778-2.144)	1.545 (0.856-2.101)	1.150 (0.914-2.224)
Upper back	0.020**	1.524 (0.953-3.997)	2.447 (1.156-4.648)	2.002 (0.798-1.574)	4.252 (0.578-2.154)	4.525 (0.446-2.101)	4.450 (0.644-2.724)
Neck	0.001**	1.816 (0.924-3.454)	1.442 (0.543-3.567)	2.596 (1.017-6.644)	1.789 (1.047-3.014)	3.182 (1.472-5.453)	1.485 (1.442-3.451)
Wrist	0.003**	1.805 (1.430-1.962)	1.368 (0.904-3.525)	2.032 (1.162-6.396)	4.848 (1.455-3.171)	3.789 (1.458-5.464)	1.486 (0.994-2.984)
Elbows	0.666†	-	-	-	-	-	-
Feet	0.023**	1.747 (0.864-8.784)	3.044 (0.651-14.22)	5.411 (1.174-8.745)	1.876 (1.053-3.418)	2.264 (1.438-7.871)	1.658 0.976-3.437)
Hand	0.015**	1.118 (0.212-1.265)	4.215 (1.341-2.358)	2.495 (1.596-4.271)	1.780 (1.112-2.265)	3.148 (1.644-5.852)	1.483 (1.112-3.458)
Finger	0.004**	1.366 (1.141-2.954)	1.703 (1.486-1.790)	2.881 (1.123-2.933)	2.033 (1.198-3.767)	2.1594 (1.455-4.481)	2.115 (1.640-2.954)
Knee	0.038**	1.274 (0.856-3.704)	1.876 (1.053-3.418)	1.486 (0.994-2.984)	2.447 (1.037-4.263)	1.752 (1.326-2.758)	1.112 (0.798-2.259)

***χ2 analysis of the prevalence of WMSDs between age categories. ** Statistically significant with $p < 0.05$, † Not significant. # 1- Age category less than 20 years, 2- Age category between 21 &30 years, 3- Age category between 31 & 40 years, and 4 – Age category above 40 years.*

Table 9. Association of WMSDs at different body parts with work experience categories

Body parts	P* value	OR (@95% confidence interval)					
		1-2#	**1-3#**	**1-4#**	**2-3#**	**2-4#**	**3-4#**
Shoulders	0.024**	1.445 (1.054-0.891)	2.699 (1.005-1.456)	1.994 (0.941-6.432)	1.445 (0.885-2.651)	3.312 (0.951-11.59)	2.457 (0.975-10.54)
Lower back	0.023**	1.114 (0.684-2.909)	2.145 (1.572-9.432)	3.008 (0.788-13.068)	2.459 (1.118-6.664)	2.785 (0.560-9.245)	4.843 (0.186-3.729)
Upper back	0.002**	1.214 (1.084-2.209)	3.520 (1.272-9.432)	2.208 (1.788-13.068)	2.529 (1.118-6.664)	2.375 (0.560-9.245)	2.583 (0.186-3.729)
Neck	0.014**	1. 229 (1.007-2.256)	1.462 (1.326-2.210)	1.413 (0.252-5.283)	1.150 (0.517-3.351)	2.255 (1.275-10.872)	2.145 (1.454-7.457)
Wrist	0.019**	1.203 (1.103-2.836)	1.104 (0.525-2.324)	1.183 (0.360-3.884)	2.194 (0.999-4.871)	2.350 (0.697-7.927)	1.071 (0.283-4.059)
Elbows	0.019**	1.276 (0.966-2.123)	1.152 (0.576-2.657)	1.230 (0.477-3.154)	2.006 (1.104-2.977)	2.141 (0.976-8.754)	1.755 (0.589-2.105)
Feet	0.028**	1.154 (1.284-2.909)	3.450 (1.572-9.432)	3.118 (0.158-13.068)	2.129 (1.418-6.664)	2.075 (0.450-9.245)	1.583 (0.976-3.437)
Hand	0.017**	1.746 (0.326-3.713)	2.119 (1.440-5.170)	1.449 (0.115-4.380)	1.967 (0.433-5.278)	2.622 (0.678-10.77)	1.453 (1.112-3.458)
Finger	0.045**	0.528 (0.462-1.147)	1.745 (0.454-3.829)	2.456 (0.454-5.032)	2.154 (1.140-4.455)	3.453 (0.964-12.86)	1.345 (1.640-2.954)
Knee	0.017**	1.409 (0.476-4.375)	1.452 (0.228-3.949)	1.484 (0.499-6.868)	2.149 (1.140-5.459)	2.446 (0.456-8.456)	1.451 (0.798-4.049)

$\chi 2$ analysis of the prevalence of WMSD symptoms at different body parts with different work experience categories. ** Statistically significant with $p < 0.05$, † Not significant. # 1- work experience less than 1 year, 2- between 1 and 5 years, 3- between 6 and 9 years, 4- more than 9 years

Table 10. Association of WMSDs at different body parts with level of education categories

Body parts	P* value	comment (@95% confidence interval)	Body parts	P* value	Comment (@95% confidence interval)
Shoulders	0.245	†	Elbows	0.079	†
Lower back	0.345	†	Feet	0.129	†
Upper back	0.458	†	Hand	0.154	†
Neck	0.254	†	Finger	0.148	†
Wrist	0.410	†	Knee	0.127	†

$\chi 2$ analysis of the prevalence of WMSD at different body parts with different levels of education categories, † Not significant.

3.5 Potential work activities causing WMSDs on body parts

Part three of the questionnaire was designed to identify work activities that possibly caused WMSDs on the case company's workers' body parts. In this regard, responses from production operators, maintenance personnel and other shop floor workers, management staff, production supervisors, quality control personnel, cleaning service providers, and finance, sales, and marketing personnel are obtained and discussed in a few paragraphs. Finally, the results obtained from this research are compared with the research findings from similar firms.

Respondents from various roles, including production operators, maintenance staff, and shop floor workers, identified several key activities contributing to WMSDs on their body parts. These include the physical demands of loading and unloading heavy trucks and trolleys, difficulties maneuvering equipment, and ergonomic issues stemming from poorly designed tools and prolonged standing or sitting. Management staff cited issues related to prolonged office work and movement in the production area, while quality control personnel reported WMSDs from extended periods of standing or sitting. Supervisors emphasized the strain from prolonged standing and moving between workstations, and finance, sales, and marketing staff pointed to extended hours at computers. The cleaning staff noted injuries from bent postures and manual handling of cleaning equipment as significant contributors to their discomfort.

Respondents said that transportation aids are often heavy and difficult to operate, leading to overexertion injuries and strains, mainly due to the force needed to move and control them. Common issues include poorly maintained equipment, such as dirty wheels, and the frequent overloading of trolleys and trucks, exacerbating these problems. Additionally, respondents noted stability issues with three-wheeled trolleys and hand pallet trucks, as they struggled to find a proper balance when lifting and felt that the equipment did not adequately support the load.

Respondents have reported issues with maneuvering trolleys, particularly noting difficulties in steering and controlling box-sided models. Respondents mentioned challenges like navigating corners wide due to wheels misaligning or locking, which can be influenced by wheel type, size, and maintenance level. Additionally, some respondents found the handle height on four-wheeled trolleys uncomfortable, requiring them to stoop while pushing. Heavy loads exacerbated starting problems, especially with trolleys with small wheels or poorly maintained ones, while stopping issues were observed during cornering or on slick surfaces. Furthermore, workers in the blow room have experienced WMSDs due to prolonged standing and repetitive tasks in that environment.

The findings of this study align closely with recent literature on work-related musculoskeletal disorders (WMSDs). For example, a study by (Zinabu et al., 2024) in Bahir Dar City, Ethiopia, identified factors such as long working hours, lack of back support, repetitive movements, awkward postures, and job stress as significant contributors to WMSDs among weavers. Similarly, (Das et al., 2023) found that manual labor, awkward postures, uncomfortable movements, and prolonged standing contribute to WMSDs in the cotton garment industry. Additionally, (Haftu et al., 2023) reported that the shoulder, lower back, neck, and upper back are the most affected areas among traditional weavers in the Gamo zone, with factors like extensive sitting and job dissatisfaction playing a role. Lastly, (Jaiswal, 2021) noted that textile workers' low back and shoulder issues arise primarily from heavy workloads.

4. CONCLUSIONS

The physical and behavioral aspects of ergonomics, along with the company's management awareness and support levels regarding ergonomics, significantly influence the working environment for employees. The results from the SPSS analysis indicated that the average responses regarding management support for implementing workplace ergonomics and the behavioral components of workplace ergonomics were neutral, with an average rating of 3. This neutral average does not imply that respondents have reported no ergonomic issues. Conversely, the average responses regarding the physical components of workplace ergonomics and management's awareness of workplace ergonomics fell below the neutral mark.

Using inferential statistics such as odds ratios and chi-square tests, we examined the association between WMSDs and various socio-demographic characteristics. The findings revealed a significant association between WMSDs and the level of work experience and age, while there was no significant association with educational level. The body parts affected by risk factors for WMSDs, such as awkward body positions, repetitive motions, work pace, and high force exertion, emerged as significant concerns among the workers at the case company.

Ultimately, it can be concluded that the level of workplace ergonomic practices at Edget Yarn and Sewing Thread Share Company is unsatisfactory. There is a need for further improvement in workplace ergonomics, particularly by addressing the identified work activities that may contribute to health issues.

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