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THE IMPACT OF MUSCULOSKELETAL DISORDERS AND WORKLOAD ON THE WELL-BEING AND PERFORMANCE OF TEXTILE WORKERS

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Abstract

There is minimal awareness of ergonomics in the textile industry, leading to a high prevalence of musculoskeletal disorders (MSDs) that negatively impact the physical and general well-being of spinning workers. This study investigates the effects of MSDs on worker performance in the spinning sector to address this issue by using a deductive approach, quantitative method, and survey strategy. The authors collected data from fifty employees working in different processes and shifts of the spinning section at case textile company. The authors used A 7-point Likert questionnaire to collect data. The authors analyzed the data by using SPSS after initial processing in Microsoft Excel. The analysis included demographic frequencies, descriptive statistics, reliability testing via Cronbach's alpha, and normality checks, followed by Pearson correlation analysis. Findings revealed that general and physical well-being were weakly associated with workload, suggesting that improved well-being enhances performance under higher workloads. The general well-being and physical well-being showed a weak correlation with each other and with employee performance. The study concludes that MSDs significantly impair both the performance and well-being of spinning workers, emphasizing the urgent need to promote ergonomic awareness and interventions in the textile industry.

I. INTRODUCTION

Pakistan's textile industry is highly diverse, ranging from traditional handlooms and handicrafts to large-scale organized production using advanced technologies. While the organized sector is technology-driven, much of the industry remains unorganized and dominated by private enterprises, offering employment opportunities for unskilled rural workers. The sector plays a major role in the economy, with about 2.2 million people employed in clothing, 1.8 million in textiles, and 200,000 in leather and footwear, and serves as a key global supplier to international markets [1], [2], [3], [4]. Work-related musculoskeletal disorders (WMSDs) are injuries caused by repetitive stress and overuse, recognized as a major occupational health problem since the 1980s. They affect not only employee well-being but also company finances,

healthcare systems, and society at large. Symptoms such as stiffness, swelling, and muscle tightness can lead to long-term disability and even career-ending conditions. WMSDs are among the most common workplace health issues, frequently causing absenteeism, with high prevalence reported in sectors like construction [5]. [6]. [7]. [8]. [9]. [10]. Musculoskeletal disorders (MSDs) constitute a significant global health challenge, encompassing more than 150 conditions that affect the locomotor system. They are commonly associated with pain, reduced mobility, and loss of function, which in turn contribute to mental health decline, a higher likelihood of chronic diseases, and increased mortality. The impact of MSDs are amplified by demographic and lifestyle trends, particularly the global rise in aging populations and obesity, two major risk factors. This burden is especially critical in low- and middle-income countries, where limited healthcare resources intensify the social and economic consequences of MSDs [11], [12]. Nabi et al. (2021) emphasize that enforcing even minimal International Labor Organization (ILO) occupational safety and health (OSH) standards, alongside introducing low-cost initiatives to improve workplace conditions in non-compliant factories, is essential for sustaining the rapid growth of the spinning sector [13]. Celik et al. (2018) highlight that ergonomically designed workplaces, combined with healthy lifestyle practices, are critical in preventing musculoskeletal pain among employees, including those in office-based roles [14]. Yang et al. (2023) stress that effective training and interventions for ergonomic risk reduction must address poor posture, limit prolonged sitting, and actively encourage physical activity among workers [15]. The long-term growth of the textile and clothing industry cannot be achieved at the expense of employee well-being. Both government bodies and company management must ensure safe and healthy working environments for spinning workers to secure sustainable progress [1]. The textile industry involves an extensive production chain from cotton ginning and dyeing to spinning, fabric formation, and garment manufacturing, making it a vital sector in global manufacturing. Pakistan holds a significant position, ranking fourth in cotton production and third in spinning capacity after India and China, contributing about 5% to global spinning output. The global apparel market, valued at approximately US$1.7 trillion, represents 2% of the world's GDP. In Pakistan, textile production operates through hundreds of ginning and spinning units, with the spinning process playing a central role by transforming cotton fibers into yarn, the fundamental stage in textile manufacturing [16]–[22]. The several stages of spinning are presented in Figure 1.



Figure 1: The process flow of spinning Source: [Author]

The spinning process begins with bale opening, where compressed cotton is loosened, cleaned, and blended to improve fibre homogeneity and minimize inconsistencies in the yarn. Next, carding disentangles and aligns fibres into a uniform web, which is condensed into a sliver. To produce finer yarns, combing removes short fibres, impurities, and neps, ensuring long fibres remain parallel. After combing, drawing combines and elongates slivers, reducing thickness and improving fibre alignment. The roving process further refines the sliver, adding

a slight twist before it is wound onto bobbins for spinning. In spinning, fibres are twisted and drawn to form continuous yarn, a crucial step for fabric weaving. The winding operation then transfers yarn into larger, manageable packages for efficient use in subsequent fabric manufacturing. Twisting adds strength and cohesion to yarns, while controlled steaming in an autoclave sets the twist permanently. Finally, yarns may undergo top dyeing, followed by recombing and filling to ensure uniform colour blending before weaving [18], [20], [23]–[28]. These yarn manufacturing processes and related machines are shown in Figure 2.



Figure 2: Yarn Manufacturing Processes Source: [[29], [27] & [30]]

This study investigates musculoskeletal disorders (MSDs) among spinning workers, focusing on their causes and impacts on well-being, workload, and overall performance. MSDs, which affect the body's movement-supporting structures, are common in textile spinning due to repetitive tasks, awkward postures, and heavy workloads involved in activities such as cotton picking and thread loading. These factors contribute to pain, stiffness, and reduced mobility, ultimately diminishing workers' physical and general well-being. The research further analyzes how MSDs and workload influence worker performance while highlighting the economic and operational burdens they impose on textile companies. It emphasizes the need for ergonomic practices and workplace safety measures to safeguard worker health, enhance performance, and ensure the textile industry's long-term efficiency and competitiveness. The research objectives of the study include 1) identifying the factors causing the MSDs in the workers of the spinning factory 2) to analyze the impact of MSDs, workers` workload and well-being on the performance of spinning workers and 3) to put forward suggestions for the spinning workers, considering the results of the research.

II. LITERATURE REVIEW

Musculoskeletal health refers to the proper functioning of the body's locomotor system, including muscles, joints, bones, and connective tissues. Musculoskeletal disorders (MSDs) encompass around 150 conditions that cause functional limitations and can affect individuals throughout life. These disorders contribute significantly to illness, disability, and healthcare burdens. In industrial settings, such as synthetic thread production in Lithuania, workers commonly experience MSDs due to prolonged strained postures affecting the back, arms, legs, and neck [31]–[33]. Productivity improvement and sustained performance growth have become critical priorities for modern textile industries. However, work-related musculoskeletal disorders remain a major barrier to workforce efficiency in the textile sector [34]–[38]. Lawson et al. (2010) investigated manual work using human factors approaches and behavioral analysis,

emphasizing how workload distribution and ergonomics influence musculoskeletal disorders, employee well-being, and overall task performance [39]. Shaikh et al. (2012a) examined the role of takt time in mixed-model and single-model assembly lines, demonstrating that the adjustment of pacing influences workload intensity. The study highlighted that inadequate workload balance can aggravate musculoskeletal disorders, whereas optimized pacing enhances well-being and supports sustainable performance [40]. Musculoskeletal disorders (MSDs) encompass a wide range of conditions affecting muscles, bones, tendons, ligaments, and joints. Common types include arthritis, osteoporosis, ankylosing spondylitis, annular tears, and disc herniations. Nerve compression syndromes such as carpal, cubital, and radial tunnel syndromes are also prevalent. Other notable conditions include tendinitis or tendonitis, rotator cuff injuries, epicondylitis (tennis elbow), trigger finger, and ligament sprain. Additionally, disorders like tension neck syndrome, thoracic outlet compression, digital neuritis, De Quervain's syndrome, mechanical back syndrome, fibromyalgia, bone fractures, dislocations, and scoliosis significantly impact physical function and overall well-being [41]. Daudpoto et al. (2021) analyzed the fatigue failure of SUP-9 spring steel, noting that material fatigue parallels human fatigue in industrial contexts. Their findings indirectly emphasized the importance of workload management and preventive strategies to reduce musculoskeletal disorders, thereby supporting worker well-being and maintaining consistent performance [42]. The common symptoms of musculoskeletal disorders include recurrent or dull pain, stiffness, redness, and swelling or edema. Individuals may also experience muscle weakness, which can affect mobility and overall physical performance [41].

The spinning industry in countries such as China, India, Bangladesh, Pakistan, Iran, and Turkey is highly prone to musculoskeletal disorders (MSDs) due to reliance on traditional methods, outdated technology, and repetitive static postures. These factors hinder the adoption of modern ergonomic practices, while tasks involving varied heights and loads further increase physical strain [43], [44]. Naz, Kwatra, and Ojba (2015) found that handloom weavers experience a high prevalence of musculoskeletal disorders due to poor working postures and unfavorable work conditions. The study emphasized the need to improve the work environment and manage risk factors such as long working hours, inadequate rest, posture, and the type of handloom used. According to Gamperiene and Stigum (1999), the risk factors of physical load can be better understood by observing the postures adopted by individuals and frequent changes of such postures through a detailed study. Ikhar and Deshpande (2017) used the Dutch Musculoskeletal Questionnaire (DMQ) to conduct a small-scale cottage textile industry survey and Work-related musculoskeletal disorders (WMSDs) of forty workers, were evaluated. Total Productive Maintenance (TPM) and Overall Equipment Effectiveness (OEE) are becoming popular in textile industries to enhance productivity and sustainability. These approaches can be integrated with ergonomic measures to strengthen both productivity and employee health [20], [45]–[52]. RULA and REBA assessments showed that spinning operators face high musculoskeletal strain from poor posture and heavy workloads. Inadequate workstation design causes overreaching, twisting, and bending, leading to shoulder, neck, and lower back pain, and a high risk of MSDs [53]. Andersen and Gaardboe (1993) found that long-term sewing work strongly correlates with MSDs like cervical and rotator cuff syndromes. Experience, rather than age, was the main factor increasing musculoskeletal strain among 107 female operators [54]. Yaqoob et al. studied rotating shift work in a pharmaceutical industry at Jamshoro. Their research showed that irregular workload schedules negatively affect employee well-being, increase the likelihood of musculoskeletal disorders, and ultimately hinder consistent performance [55].Shaikh et al. (2012b) explored the effects of physical and cognitive demands on the quality of performance under varying pacing levels. Their findings showed that imbalanced workload increases risks of musculoskeletal disorders, negatively affecting both worker well-being and performance outcomes [56]. Shahbazi et al. (2020) reported a 74% annual rate of WMSDs among spinning

workers, mainly in the knees, lower back, and shoulders. Repetitive motion and high physical demand were key causes of MSDs in the textile sector. Siddiqui et al. (2021) observed more MSD symptoms among handloom weavers than power loom workers, particularly in the shoulders and back. The study suggested ergonomic improvements and preventive measures to enhance health and productivity [57]. Angeline and Bobby (2018) found that over two-thirds of textile workers experienced neck and shoulder pain, especially young women and adolescents. Extended working hours (over 48 per week) were linked to physical pain and depression, highlighting the need for workload management and worker protection [58]. Recent research highlighted that combining Industry 4.0 technologies with Lean practices drives sustainable manufacturing through data-driven optimization and waste reduction which help to prevent work-related musculoskeletal disorders [59]–[66].

Well-being of workers can be classified in two categories, i.e. general well-being and physical well-being. Psychological well-being is a key aspect of mental health play a vital role in promoting longer, healthier, and happier lives. Employees with high psychological well-being report greater self-esteem and job satisfaction. Overall well-being reflects an individual's emotional, physical, and mental health, incorporating factors such as work-life balance and stress management. It is a critical driver of employee retention, workplace productivity, and organizational success. Moreover, promoting well-being goes beyond merely preventing occupational injuries; it involves creating a holistic environment that supports both physical and psychological health [67]–[70]. Harshitha and Senthil (2019) found that employee well-being showed no significant impact on organizational performance in the manufacturing sector [71]. Chang (2024) reported that good mental health enhances employees' focus, motivation, job satisfaction, and overall performance [72]. The Harvard Business Review emphasized that poor employee mental health reduces productivity and increases organizational costs [73]. Haddon (2018) highlighted that employee mental well-being directly influences team morale and overall workplace productivity [74]. Rufeng, Nan, and Jianqiang (2023) found that worker happiness and well-being significantly enhance manufacturing and organizational performance [75]. Mandal and Goswami (2022) revealed that psychological well-being positively affects employee work performance and productivity [68]. Cotton dust exposure in textile factories causes respiratory illnesses that reduce worker productivity and lead to economic hardship [76]. Seidu et al. (2024) reported that exposure to cotton dust, chemicals, and poor ergonomics causes respiratory and musculoskeletal issues, stress, and reduced productivity [77]. Khan (2018) identified effective techniques for waste reduction, quality improvement, and productivity enhancement. in the textile spinning sector [20]. RULA (Rapid Upper Limb Assessment) is a simple ergonomic tool used to assess upper limb disorders by analyzing posture, muscle activity, and external loads [78]. Corlett and McAtamney (1993) developed RULA to evaluate spinal and upper limb postural loads, now widely used for assessing WMSDs [79]. RULA measures muscle activity, body posture, and load exertion across two body regions to identify ergonomic risks [80]. Lean manufacturing enhances productivity and sustainable performance can be achieved by integrating ergonomic principles into production systems, ensuring a balanced focus on efficiency, worker well-being, and long-term organizational success [20], [63], [81]–[84]. Kablimiharbi and Selamat (2016) found high-risk postures in manual yarn workers and recommended ergonomic redesign and awareness [85]. Basahel (2015) linked lifting and pulling tasks to musculoskeletal pain and stress, showing strong ties between posture and MSD risk [86].

Shaikh et al. (2013) investigated the concurrent performance of physically and cognitively demanding tasks in paced assembly lines. The study concluded that excessive workload can lead to musculoskeletal disorders, while balanced task allocation improves worker well-being and assembly line performance [87]. Value Stream Mapping (VSM) approach can be utilized in textile industries to enhance productivity, minimizes work-related musculoskeletal disorders [20], [88]–[90]. Shaikh et al. (2015) conducted a doctoral study on the effects of physical and cognitive

demands under takt time conditions. The research revealed that unmanaged workload increases musculoskeletal disorders and stress levels, whereas ergonomic interventions promote well-being and improve long-term performance [91]. Integrating Lean Six Sigma with ergonomics offers a comprehensive approach to enhancing productivity and quality while reducing work-related musculoskeletal disorders [20], [92]–[94]. Lowell E. Staveland of San Jose State University and Lowell E. Staveland of San Jose State University in 1988 introduced the NASA Task Load Index (NASA-TLX) [95]. Self-reporting workload uses a predominant instrument called TLX [96]. It was developed for the healthcare and aviation sector which subjectively assesses the workload scale. The overall workload is measured by a single variable for scaling purposes[97]. Six items are there in the task load index (see Figure 3); the items include mental demand, physical demand, temporal demand, effort, performance, and the level of frustration.

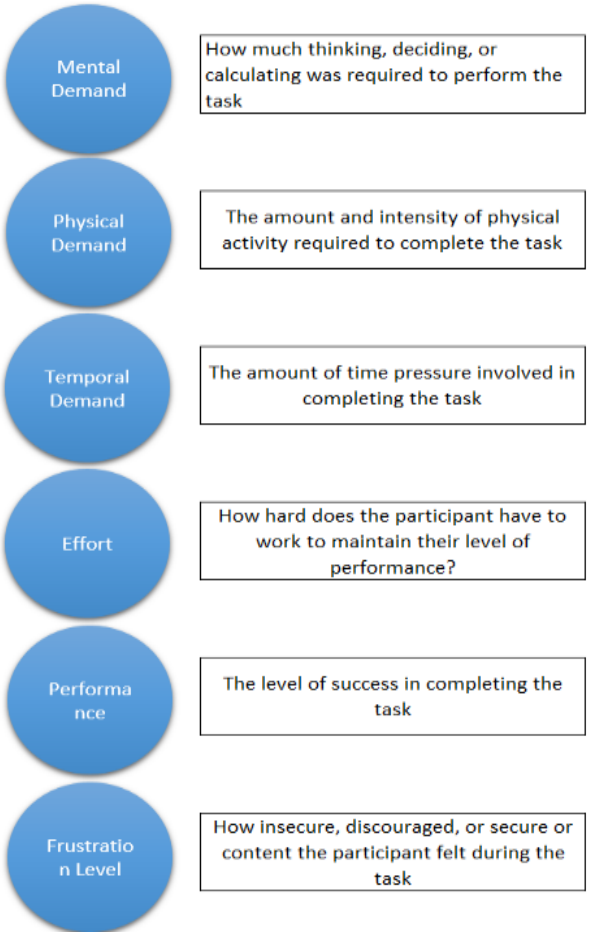


Figure 3: The description of the elements of NASA-TLXc Source: [98]

Workload is widely studied due to its strong connection with employee well-being and job performance [99]. There is no universally accepted definition of workload despite its broad use in research [100]. Excessive workload negatively affects employee job satisfaction [101]. Hernandez et al. (2024) explained that a single day of higher-than-usual workload can reduce next-day productivity, indicating short-term performance impacts. Rochman and Zuraida (2022) used NASA-TLX, the study found that high workloads lower employee job satisfaction despite other supportive workplace factors. Fan and Smith (2017) analyzed the rail industry, workload was identified as a key factor increasing fatigue and reducing employee performance [102]. Rubio-Valdehite et al. (2012) examined that the individuals with higher abilities experienced greater mental workload but achieved better performance in

complex tracking tasks [103]. Herdiana and Sary (2023)analyzed that the workload increases work stress, which in turn reduces employee performance [104]. Purwanto and Meilani (2024) concluded that motivation and a positive work environment improve employee performance, while workload showed no significant effect [105].

Several studies have examined musculoskeletal disorders (MSDs) and workload across different industries such as sewing (Andersen & Gaardboe, 1993), spinning (Shahbazi et al., 2020), small-scale textiles (Ikhar & Deshpande, 2017), textile Angeline and Bobby (2018), spinning Kablimiharbi and Selamat (2016), healthcare Tubs-Cooley et al. (2018), medical students Foo et al. (2013), aviation Surtiningtyas, Purwaningtyas, and Putriekapuja (2022) using tools like RULA, REBA, and NASA-TLX. However, the spinning industry remains underexplored regarding MSDs, workload, and worker well-being. This research addresses these gaps by focusing on three key contributions: applying RULA to analyze spinning workers' postures, assessing their workload, and evaluating their overall well-being.

III. RESEARCH METHODOLOGY

The present study adopts a deductive research approach, as it does not aim to develop new theories but rather to analyze musculoskeletal disorder (MSD) factors in the textile industry using established ergonomic knowledge. A quantitative research method is employed, as the study collects numerical data through a Likert scale and applies statistical tools such as descriptive statistics, correlation, and analysis of variance (ANOVA). To achieve its objectives, the research follows a survey strategy, collecting data directly from spinning workers to examine the impact of MSDs, workload, and well-being on worker performance. A cross-sectional time horizon is adopted, since the data was collected only once without repeated observations. Two questionnaires were adopted in the present research to analyze the impact of MSDs, physical well-being and general well-being on the performance of employees working in spinning. Moreover, the author of this research also intended to analyze the impact of mental demand, physical demand, temporal demand, effort, and level of frustration on the performance of spinning workers as can be seen in Figure 4. In addition, the influence of all the items (mental demand, physical demand, temporal demand, effort, and frustration) of workload is also analyzed in the present research as per the conceptual framework given in Figure .

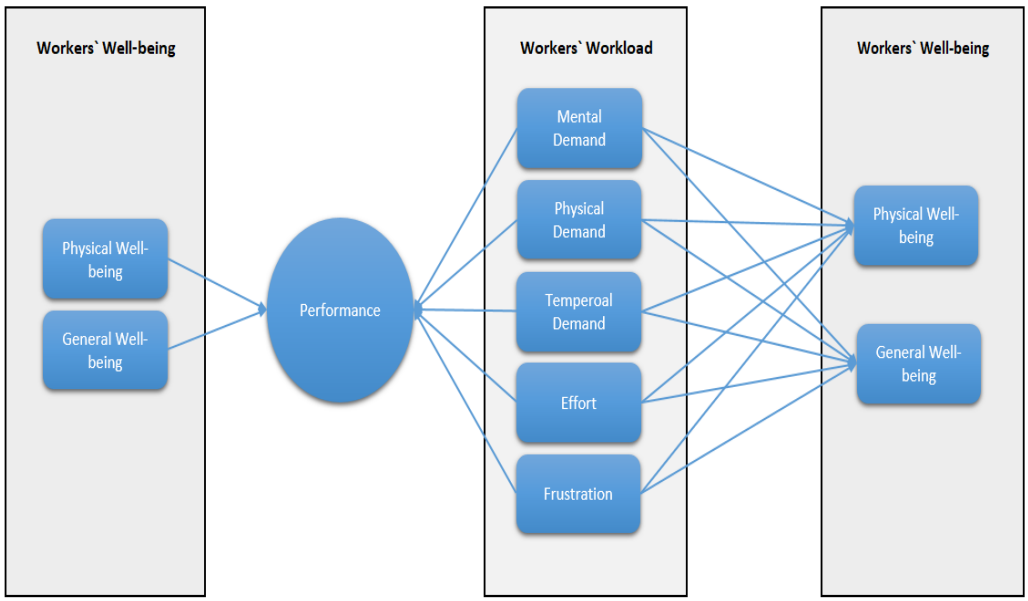


Figure 4: The diagram of the conceptual framework Source: [Author]

The primary research instrument is a questionnaire, which included two components: physical well-being measures and the NASA Task Load Index. Responses were recorded using a Likert scale, allowing participants' perceptions and workload experiences to be quantified. A random sampling technique was used to select participants from the spinning department of the textile company. Out of 150 employees, a sample of 50 workers (33%) was randomly chosen, including laborers, supervisors, and feeders. Data was collected through printed questionnaires administered to the participants. Collected responses were first entered into Microsoft Excel and later analyzed using SPSS. The analysis began with frequency distributions of demographic characteristics, followed by descriptive statistics. The reliability of the data was assessed using Cronbach's alpha, while data normality was tested to ensure the assumptions for parametric analysis were met. Finally, Pearson correlation and ANOVA were applied to examine relationships and differences among variables. The study strictly followed ethical considerations. Informed consent was obtained from all participants, and their privacy and rights were safeguarded. No sensitive or harmful questions were included, and care was taken to avoid psychological or physical discomfort. Furthermore, academic integrity was maintained by citing all used sources appropriately and excluding unused references.

IV. RESULTS & DISCUSSION

This section includes the results obtained from the data analysis and they are interpreted and discussed. The case company is a leading textile enterprise and part of a well-known business group in Pakistan. The group operates multiple textile units across the country, along with diversified ventures in other sectors. The selected spinning unit is located in the province of Sindh and is primarily engaged in the production and sale of yarn. The company holds ISO-9002 certification and has successfully passed the corporate social responsibility audit conducted by SGS Pakistan. In addition to standalone spinning mills, the group also manages vertically integrated textile units in other regions of Pakistan, covering various subsectors of the industry.

The frequency distribution of demographic variables is presented in the form of pie charts and descriptive statistics (minimum, maximum, mean, and standard deviation) of the variables included in the various factors are also calculated. It was also ensured that the collected data was normally distributed by using skewness and kurtosis. At the end of the chapter, Pearson correlation analysis is conducted to analyze the impact of various task loads, general well-being, and physical well-being on the performance of employees. Moreover, the effect of the workload on workers' well-being was also analyzed.

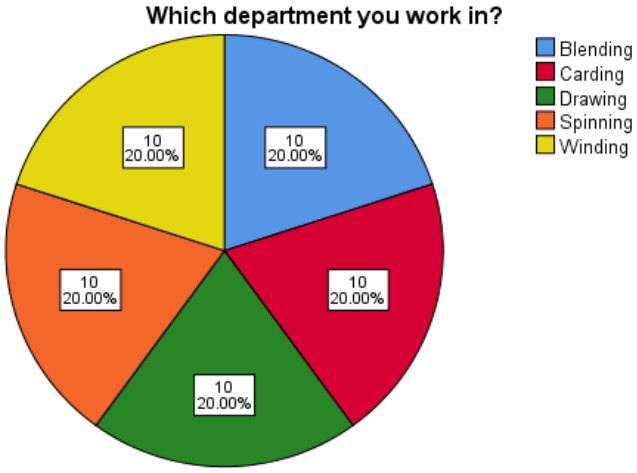


Figure 5: Department distribution of workers Source: [Author]

The employees were from three different shifts as given in Figure. Figure6 indicates that 4 (8%) participants were from each of the two shifts i.e. 4 PM to 12 PM and 12 PM to 8 PM and 42 (84%) employees/participants were from the shift of 8 AM to 4 PM.

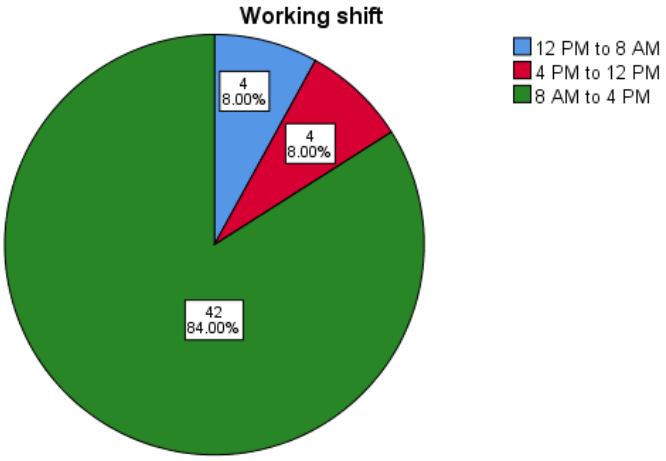


Figure 6: Working Shift of the employees Source: [Author]

The reliability of data was calculated by using Cronbach`s alpha test. It is a statistical test that was developed by Lee Cronbach in 1951, and it is used to measure the interrelatedness among the variables. The normal range of Cronbach`s alpha is 0.6 to 0.95; on obtaining the value in the mentioned range, the data is interpreted as reliable. It can be seen in Table1 that the value of Cronbach`s alpha is greater than 0.6 and less than 0.95; the values indicate that the collected data was found to be internally consistent and reliable.

Table 1. Internal Consistency of data

Factor	Cronbach`s Alpha	Remarks
Overall Reliability	0.790	Data is reliable

This heading contains the discussion of the frequency distribution of demographic variables as can be seen in Figure5. Pie chart given in Figure indicates that the data was collected from five departments (blending, carding, drawing, spinning, and winding) of the spinning section of the textile company. The percentage of workers from each of the departments was 20%. Moreover, the daily working hours of the employees at the company were 8 hours. Descriptive statistics of the various variables in the various factors was calculated. The descriptive statistics of the employees` task load, employees` physical well-being, employees 'general well-being and employees` performance are calculated. Table 2. presents the result of descriptive statistics of the employees` task load. In the same way descriptive statistics of employees` physical well-being, employees 'general well-being, employees` performance. It can be seen in Table 2. that the job of participants was not much mentally and physically demanding. As per the mean response of the participants, the tasks are not carried out in great hurry at the company, they also don't put much of their effort to succeed in terms of tasks they are supposed to do. Moreover, they work hard and they also feel insecure, stressed and irritated at the workplace and they are easily annoyed.

Table 2. Descriptive statistics of the task load of employees

Variables	Minimum	Maximum	Mean	Std. Deviation
My job is mentally demanding.	1.00	5.00	3.5400	1.18166
My job is physically demanding.	1.00	5.00	3.2600	1.24228

I work in an environment where tasks are performed in great hurry and rush.	1.00	5.00	3.7800	1.21706
I succeed in doing whatever I am supposed to do.	1.00	5.00	3.6000	1.39971
I work very hard to perform the assigned task.	2.00	5.00	4.0600	0.89008
I feel secure, happy, and satisfied at the workplace.	1.00	5.00	3.9600	0.98892

As per the assumptions of Pearson correlation analysis, the data should be normally distributed and this is the reason, the normality of data was checked by using the skewness and kurtosis and the values of both measures are calculated. Skewness is the measure of the symmetry of data and kurtosis is the measure of the symmetry of curve. The normal range of skewness and kurtosis is considered to be between ±1 and ±3 respectively. Since the calculated values of skewness and kurtosis are in between ±1 and ±3 respectively, the collected data was considered to be normally distributed and therefore, Pearson correlation analysis can be used to analyze the impact of variables on one another. The Figure 7 presents the skewness and kurtosis of all the numeric variables included in the questionnaire. It can be seen in Figure 7 that the values of skewness are in between ±1 and the values of kurtosis are in between ±3.

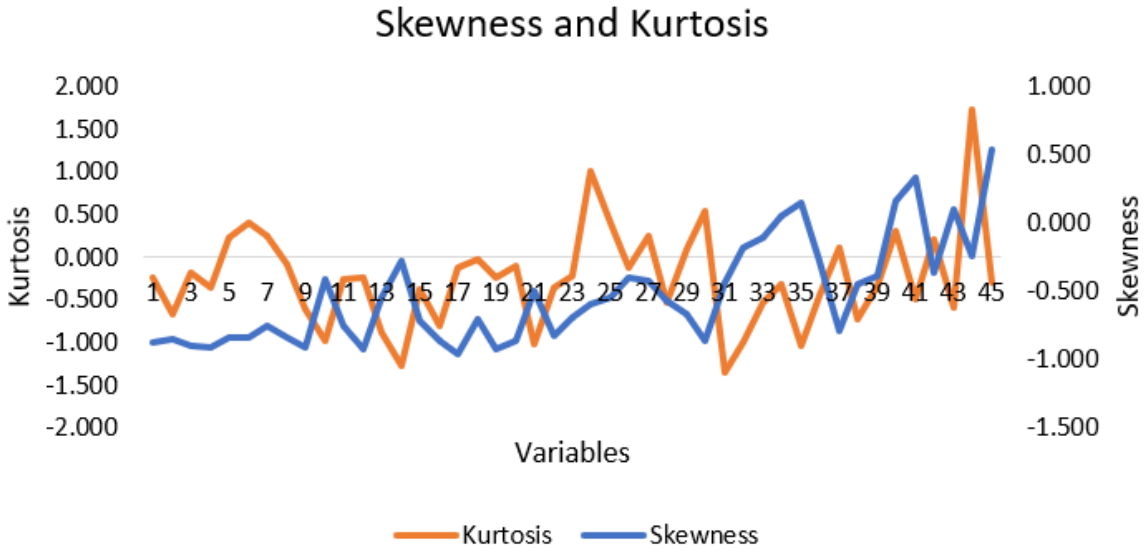


Figure 7: The calculated values of skewness and kurtosis Source: [Author]

Since it was indicated that the data was normally distributed and the assumption of Pearson correlation is met; therefore, Pearson correlation was used to analyze the data as per the discussed research objectives given in section 1.3. Pearson correlation analysis is used to measure the influence of one variable on the other. The value obtained from the Pearson correlation analysis lies between ±1. The value closer to +1 and -1 indicates a strong positive and negative association between the variables respectively. When the value of correlation is 0 and 1, it means there is no and a perfect relationship between the variables respectively.

The association of general well-being on the performance of spinning workers was analyzed by using Pearson correlation and the results of the analysis are calculated. The correlation of all the variables with the performance of employees were found to be non-significant except one variable as indicated in red font color in Table 3. . In the same way the association of all the variables of general well-being was analyzed by using Pearson correlation with all the variables of the performance of

spinning workers and the results of the analysis are calculated. The relationship of variables i.e. I have no pain in my hands and wrists at the moment with the performance of spinning workers was found to be statistically significant (sig.=0.042<0.05) indicating a weak positive relationship. It was interpreted as when the workers have no pain in their hands and wrists their performance increase.

Table 3. Results of Pearson correlation analysis between general wellbeing & performance of employees

		Performance of Spinning Workers
I have no pain in my hands and wrists at the moment.	Pearson Correlation	.288*
	Sig. (2-tailed)	0.042

The association of physical well-being on the performance of spinning workers was analyzed by using Pearson correlation and the results of the analysis are calculated. The correlation of all the variables with the performance of employees was found to be non-significant except some variables among them one is mentioned in Table 4. . In the same way the association of all the variables of physical well-being was analyzed by using Pearson correlation with all the variables of the performance of spinning workers and the results of the analysis are calculated. The association of variable (i.e. There is neither tingling in my legs or arms nor I am suffering from numbness) with the performance of spinning workers was found to be statistically significant (sig.=0<0.05) indicating a moderate positive (0.500) association. It was interpreted that when the workers have no tingling and numbness issues, their performance increases.

Table 4. Pearson correlation analysis between the physical well-being & the performance of spinning workers

		Performance of Spinning Workers
There is neither tingling in my legs or arms nor I am suffering from numbness.	Pearson Correlation	.500**
	Sig. (2-tailed)	0.000

Figure 8**:** The association of well-being on the performance of employees **Source:** [Author] presents the pictorial view of significant associations of the variables of general well-being and physical well-being with the performance of spinning workers.

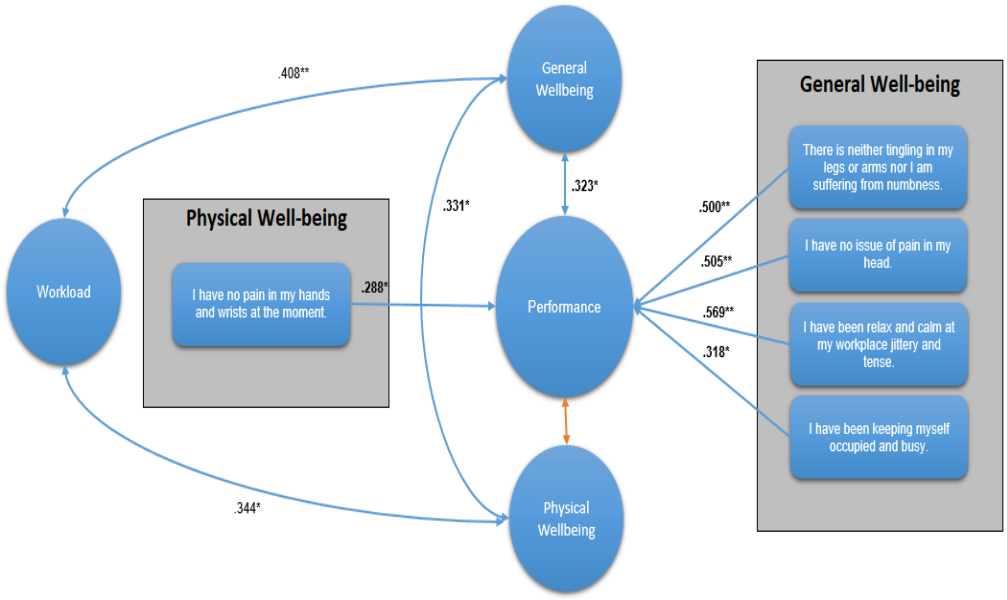


Figure 8: The association of well-being on the performance of employees Source: [Author]

In addition, the association of general well-being, physical well-being, employees` workload, and performance with one another are also presented in Figure 8**:** The association of well-being on the performance of employees **Source:** [Author]. It was indicated that general well-being (0.408) and physical well-being (0.344) were weakly associated with workload indicating that with better general well-being, workers can perform better in the greater workload. General well-being and physical well-being were also found to be in a weak association (0.331) with each other. Table 5. presents the results of the Pearson correlation analysis conducted between one variable of workload and general well-being. In the same way the Pearson correlation analysis was conducted between all the variables of employees` workload with all the variables of employees` general well-being. This correlation was found to be significant in table 5. The correlation of the variable of general well-being Furthermore, General well-being was also found to be in a significantly weak relationship (0.323) with the performance of employees as indicated in Figure 8**:** The association of well-being on the performance of employees **Source:** [Author].

Impact of Workload on General Wellbeing

The analysis of impact of employees` workload on the general well-being of employees was conducted by using the Pearson correlation analysis.

(I feel energetic at the moment) with the variable of employees` workload (my job is mentally demanding) was found to be weakly positive (0.295) and statistically significant (sig.0.038<0.05). The correlation can be interpreted as with increase in the mental demand of the task the energy among the workers increase.

Table 5. Results of Pearson correlation analysis between the workload of employees & physical wellbeing

		My job is mentally demanding.
I feel energetic at the moment.	Pearson Correlation	.295*
	Sig. (2-tailed)	0.038

Impact of Workload on Physical Wellbeing

The analysis of impact of employees` workload on the physical well-being of employees was conducted by using the Pearson correlation analysis. Table 6. presents the result of the Pearson correlation analysis conducted between the one variable of workload and physical well-being. In the same way the Pearson correlation

analysis was conducted between all the variables of employees` workload with all the variables of employees` physical well-being. The correlation was found to be significant in table 6. The correlation of the variable of general well-being (I have been well and healthy these days) with the variable of employees` workload (my job is mentally demanding) was found to be moderate (0.506) and statistically significant (sig.0<0.05).

Table 6. Results of Pearson correlation analysis between the workload of employees & general wellbeing

		My job is mentally demanding.
I have been well and healthy these days.	Pearson Correlation	.506**
	Sig. (2-tailed)	0.000

The Figure 9 presents the pictorial view of significant associations of the variables of general well-being and physical well-being with the employees` workload. Majority of the associations were found to be weak and positive. **Error! Reference source not found.**Figure 9 brings all the significant correlations of general well-being and physical well-being with the employees' workload on one page.

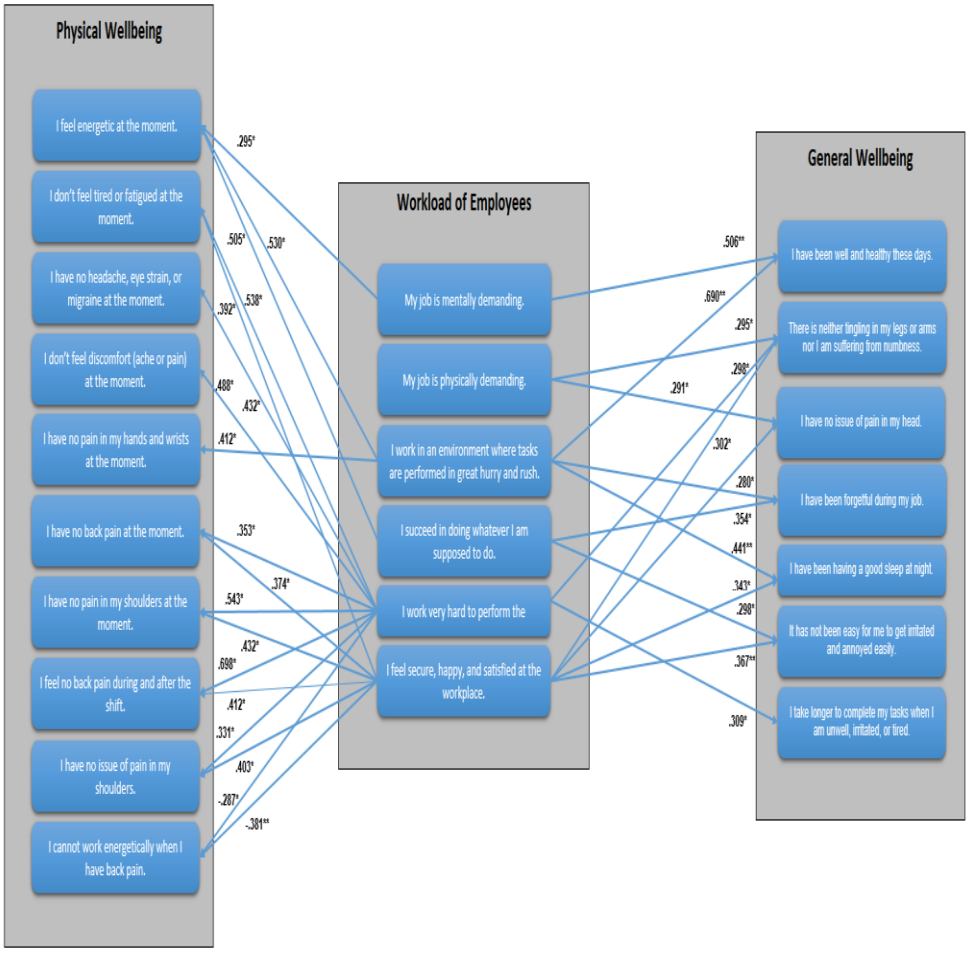


Figure 9: The association of workload & general well-being of employees Source: [Author]

Workload and Performance

The association of employees` workload on the performance of spinning workers was analyzed by using Pearson correlation and the results of the analysis are calculated. The association of the variable of employees` performance (My

performance decreases when I feel bored) with all variables of employees` workload was calculated. In the same way the association of all variables of employees` performance with all variables of employees` workload was calculated. The association of the variable of employees` performance (My performance decreases when I feel bored) with the variable of employees` workload (My job is mentally demanding) was found to be weakly negative (-0.335) and statistically significant (sig.0.017<0.05).The association between the variables was interpreted that with the increase in the mental demand of task, the boredom of the employees decreases.

Table 7. Results of Pearson correlation analysis between Employees workload & performance

		My job is mentally demanding.
My performance decreases when I feel bored.	Pearson Correlation	-.335*
	Sig. (2-tailed)	0.017

Figure 10: presents all the statistically significant relationships of the variables of employees` workload with the performance of employees. A few significant correlations were found between them and all of them were weak positive correlation as can be seen in Figure 10:

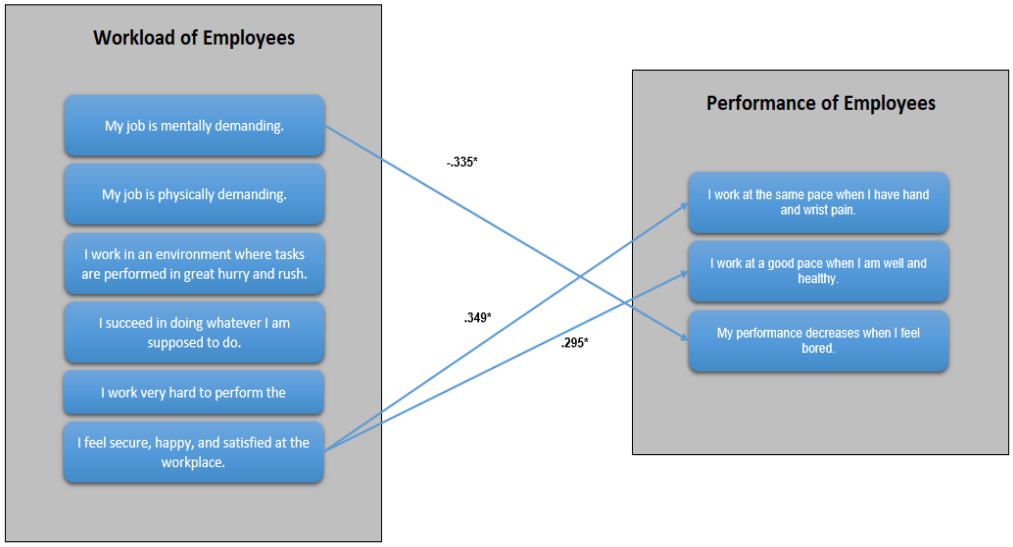


Figure 10: The diagram indicating the association among the variables Source: [Author]

Analysis Across Departments

The analysis of workload, physical well-being, general well-being, and performance of spinning workers is conducted (see Table 8) across the various spinning sections. This analysis was conducted using an analysis of variance (ANOVA) test. Table 8. The analysis of general well-being, physical well-being, workload, and performance of workers across various departments

Table 8. Analysis of general & physical well-being, workload & performance across departments

Factor	Sig.	Remarks
Workload of Spinning Workers	0.010	Significant difference
Physical Well-being of Spinning Workers	0.712	No significant difference
General Well-being of Spinning Workers	0.394	No significant difference
Performance of Spinning Workers	0.120	No significant difference

ANOVA results showed a significant difference in workload among departments ($p = 0.010 < 0.05$), indicating that employees experience varying levels of workload across the spinning unit. However, there were no significant differences in physical well-being ($p = 0.712 > 0.05$), general well-being ($p = 0.394 > 0.05$), or worker performance ($p = 0.120 > 0.05$) across departments, suggesting that while workloads differed, overall well-being and performance remained consistent among workers

Rufeng, Nan, and Jianqiang (2023) described how worker well-being influences organizational performance, and the present study also found that both physical and general well-being were associated with the performance of spinning workers. Haddon (2018) highlighted that mental health is a key factor in productivity and that the well-being of one employee can affect the entire team [74]. Mandal and Goswami (2022) similarly observed that psychological well-being positively impacts work outcomes [68]. Harshitha and Senthil (2019) reported no significant relationship between employee well-being and organizational performance [71]. In this study, no significant differences were found in the physical well-being ($p = 0.712 > 0.05$) or general well-being of workers across spinning departments. Herdiana and Sary (2023) demonstrated that workload negatively affects performance through work stress [104] and the findings of this research also indicated an association between workload and spinning workers' performance. Purwanto and Meilani (2024) found that workload did not influence performance, while motivation and the working environment contributed positively [105]. In this study, workload was shown to differ significantly across departments ($p = 0.010 < 0.05$), while performance did not vary significantly across units. These results reinforce that both workload and well-being are critical determinants of worker performance in textile spinning operations. Khan (2018) emphasized that integrating Lean manufacturing with ergonomic principles enhances productivity, sustainability, and worker well-being in textile industries [20], [34], [84], [35]–[38], [63], [81]–[83]. Lean Six Sigma, TPM, and OEE collectively improve quality, efficiency, and employee health, while Value Stream Mapping helps identify inefficiencies and minimize ergonomic risks [20], [45], [60]–[66], [88]–[90], [46], [92]–[94], [47]–[52], [59]. Furthermore, combining Industry 4.0 technologies with Lean practices promotes data-driven optimization, waste reduction, and prevention of work-related musculoskeletal disorders, ensuring long-term sustainable performance [59]–[66]. Shaikh et al. (2012a) highlighted that maintaining balanced takt time and workload is essential, as excessive physical or cognitive demands elevate musculoskeletal disorder risks, whereas ergonomic management enhances worker well-being and productivity [40], [56], [87], [91].

V. CONCLUSION

Musculoskeletal disorders (MSDs) are a major challenge in the spinning industry, particularly in countries relying on conventional methods and labor-intensive work. This study confirmed that MSDs negatively affect both the physical and general well-being of spinning workers, as well as their performance. Symptoms such as back, shoulder, hand, and leg pain were common, reflecting the impact of repetitive and awkward postures. Data analysis showed that while workload varied significantly across departments, physical well-being, general well-being, and performance did not differ. Overall, MSDs were found to significantly influence worker health and performance, underscoring the need for preventive measures and ergonomic improvements in textiles.

VI. RECOMMENDATIONS

Workers in the spinning section frequently report problems such as wrist pain, tingling in the legs, headaches, fatigue, and reduced concentration, all of which negatively affect their performance. Since musculoskeletal disorders (MSDs) are closely linked to awkward postures and poor ergonomic practices, management should introduce awareness and training programs to educate workers about MSDs and safe working postures. Ergonomic training can help employees adopt healthier body positions and reduce the risk of injury. In addition, engaging workers in meaningful tasks during periods of low workload can enhance motivation and maintain productivity. These

steps will not only improve worker well-being but also strengthen overall organizational performance.

VII. LIMITATIONS

This study is limited by its small sample size of 50 participants from a single textile company, which restricts the generalizability of the findings. Additionally, the research focused only on physical and general well-being, without examining psychological well-being, which may also be significantly affected by workplace stress.

VIII. FUTURE WORKS

For future work, studies should include larger and more diverse samples across multiple companies to strengthen validity and generalizability. Researchers are also encouraged to incorporate psychological well-being factors such as stress and anxiety, alongside physical health measures, to provide a more holistic view. Furthermore, the use of ergonomic assessment tools such as RULA is recommended to analyze posture-related risks among workers operating different textile machines.

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CONFLICT OF INTERESTS

There was no conflict of interest among the authors of the present research paper.

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