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Influence of Project Risk Management in Micro and Small-Scale Industries on Workers' Occupational Health to Enhance Productivity: An Ergonomic Approach

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ABSTRACT

In recent years, Micro and small-scale industries (MSSIs) have been facing significant challenges such as market competition, rapid technological advancements, evolving customer preferences, and resource constraints. To meet production goals with expensive machinery and limited skilled labor, MSSIs often run operations 24/7 with employees working in rotating shifts. Unfortunately, ergonomic concerns are commonly overlooked, leading to issues that impact worker absenteeism and productivity levels. A survey involving 47 MSSIs and 827 workers was conducted to assess the effects of shift work on health and sleep patterns. The questionnaires were designed and distributed among 1497 workers and 827 workers took part in this study and returned the questionnaire (response rate 55.24%). Statistically, the data was analyzed shift wise and Chi-square test was employed to find out whether the shift schedules were associated with various variables. Pearson correlation analysis was applied to explore the complex relationship between the variables and the correlation between each variable and absenteeism before and after the Ergonomic Training Program (ETP). This study reported that ETP helped to mitigate absenteeism by 3.23% and the labor productivity improved by 2.78% (2.875 labor/h). Workers get benefitted from improved health and well-being, reducing the physical and psychological burdens associated with shift work. Overall, both the industry and its employees gain from the application of ergonomic practices.

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1. Introduction

The Micro and small-scale industries (MSSIs) play significant involvement and crucial role in economic development of every country, acting as catalysts for innovation and expansion and they help to reduce poverty [1]. In the current business situation, the MSSIs are under tremendous pressure due to the free market economy, rapid technological development, and continuous changes in customer demands [2]. In this competitive business environment, MSSIs are facing competition regarding quality, cost, delayed completion of work and delivery to market, limited managerial and technical expertise, lack of financial planning and skilled labor [3]. For the MS-

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SIs, efficiency and productivity are crucial for survival and success. Therefore, all MSSIs need to practice Risk Management (RM) strategies and methodology. MSSIs need to practice risk management much more than larger industries because they suffer from resource limitations to respond promptly to both internal and external risk/hazards which have caused financial loss and productivity issues [4]. However, to maintain their ability to deliver projects creatively and timely, the MSSIs must take risks to get a competitive edge and increase the rate of productivity of their organizations [5].

A survey of the literature on risk management and MSSIs revealed that the key issues with RM implementation in organizations are related to the individuals involved, the nature of the organization, lack of awareness and implementation of the RM process [2], [3]. The major MSSIs are established in urban and rural areas and run 24 hours a day due to costly machinery, lack of skilled labor and achieving production targets [6]. Therefore, the employee works in three different shift schedules and extends long working hours. Implementing shift work in these industries is essential and has several advantages also like maximizing the use of costly equipment, reducing the per-unit production cost, allowing companies to respond quickly to changes in demand, keeping continuous production which helps to minimize lead times in delivering products to customers, and maximum utilization of the skilled labor [7].

The concept of this study is not material input but human beings. The objective is to create awareness of risk management and its involvement to identify the adverse effects of shift work, long extended working hours, and mitigating the ergonomic problems [4]. Moreover, it focuses on exploring the intricate relationship between different shift schedules, extended long hours, sleep, workers' occupational health, MSDs, and productivity variables before and after ETP. The integration of ergonomic principles in project planning and execution can lead to a safer, healthier work environment, reduced accident rates, and increased job satisfaction among workers [6]-[10]. A survey involving 47 MSSIs and 827 workers was conducted to assess the effects of shift work on health and sleep patterns. The questionnaires were designed and distributed among 1497 workers and 827 workers took part in this study and returned the questionnaire with the response rate of 55.24%. Statistically, the data was analyzed shift wise and Chi-square test was employed to find out whether the shift schedules were associated with various variables. Pearson correlation analysis was applied to explore the complex relationship between the variables and the correlation between each variable and absenteeism before and after the Ergonomic Training Program (ETP). This study reported that ETP helped to mitigate absenteeism by 3.23% and the labor productivity improved by 2.78% (2.875 labor/h). Workers get benefitted from improved health and well-being, reducing the physical and psychological burdens associated with shift work. Overall, both the industry and its employees gain from the application of ergonomic practices.

2. Literature review

Risk management is essential for micro and small-scale industries due to several reasons. This study not only explores the importance of risk management in MSSIs but also considers the role of Symvatology theory. Symvatology focuses on the influence of symbols on human behavior and decision-making [11]. Firstly, these industries often operate with limited resources and capital, making them particularly vulnerable to financial losses resulting from unexpected events. Secondly, micro and small-scale industries typically have fewer employees and may lack specialized expertise in risk assessment and mitigation [1], [10]. Given the typically limited resources and workforce in these industries, even minor injuries or health issues can have a disproportionately large effect on productivity and operational continuity. Implementing ergonomic risk management practices enables these industries to systematically assess and address potential hazards, thereby safeguarding their operations and ensuring business continuity. Workplace injuries and health issues resulting from ergonomic hazards can incur significant expenses in terms of medical costs, worker compensation claims, absenteeism, and lost productivity [12]-[14]. Overall, integrating ergonomic risk management into the operations of MSSIs is essential for protecting workers' health and safety to optimize productivity [2], [3], [10].

Extended long-work hours increase exposure to hazards at work and reduce recovery times. These in turn could lead to illnesses and injuries for the worker [15]-[17]. Therefore, shift work and extended longer hours are major potential sources of disruption to achieve productivity [13]. Now more than ever, it's important for employers and workers to find a work-life balance that encourages healthy work-life dynamics to decrease the negative impacts of shift work on workers' life and productivity. Unfavorable ergonomic working conditions have been shown to contribute to an increase in the number of issues related to productivity and quality [8], [18]-[21] with financial losses as a result.

Some employees prefer working long hours and night shifts due to personal preferences or family commitments. Besides eight hours of shift duty, workers must work long hours which are more than 48 hours a week. It's important to recognize that while extended working hours may be a choice for some individuals, others may face mandatory long hours due to the nature of their job or industry, technical need for maintaining continuous production. Some workers may face economic pressures and need to work extra hours to meet financial obligations or achieve specific financial goals. In some cases, employees may feel that working longer hours enhances job security or demonstrates commitment to their roles and believe that putting in extra hours can lead to career advancement. But on other side consistently working with shift, irregular and extended long hours, ergonomic-related concerns one of the most prevalent problems in MSSIs. Ergonomic issues and risk factors related to shift work are mostly addressed by workers that can lead to an increase in the risk of health and safety issues [6], [20], [22]. Prolonged exposure to shift work may result in decreased alertness, concentration, and overall well-being, impacting workers' health issues including sleep disturbances, disruption of the body's circadian rhythm, increased risk of cardiovascular diseases, gastrointestinal disorders, digestive problems, work related musculoskeletal disorder [23], [24] and decline the job performance and overall productivity [14], [25]-[30].

During the risk identification and quantification phase, attention is given to identifying potential disturbance factors /hazards that may pose risks to the project's success. In this process, ergonomic factors/ hazards in the shift work related to sleep and health can also be recognized, such as increased sleepiness and fatigue due to difficulties in sleeping, feel tiredness [31]. The negative impact of shift work on health is also attributed to the disturbances of the normal circadian rhythms of physiological functions [12], [32]-[34]. Another section deals with disorders of the musculoskeletal systems. For many shift workers, injuries to the muscles have grown to be a serious issue. Any illness, pain/injury, or condition that affects the soft tissues of the body, particularly tendons, muscles, and body parts such as the wrists, elbows, shoulders, neck, and lower/upper back, are referred to as a musculoskeletal disorder [12], [35]. As per Symvatology theory, it explores the relationship between symbols, their meanings, and their impact on human behavior. After analyzing symbols used in the workplace, such as warning signs, safety posters, and equipment labels. Are these symbols clear, universally understood, and culturally appropriate for the workforce? Do they effectively communicate potential hazards?

Figure 1 indicates the impact of shift work and long working hours on productivity [11].

Addressing these ergonomic factors/hazards through risk management can prevent /reduce work-related injuries and Musculoskeletal Disorders (MSDs) [36]. Utilizing visual aids like info graphics, flowcharts, and color-coded risk matrices to enhance communication about risks and mitigation strategies. This can improve employee understanding and adherence to safety protocols. After identifying risks, the next step is to develop coping strategies and design the ETP as per the need to decrease the risks associated with the shift work as shown in Figure 2. Introducing symbolic rewards or recognition programs for employees who consistently follow safe practices or report potential hazards. This can create a positive safety culture and encourage proactive risk management, where employees understand the value of these practices and actively participate in maintaining a healthy and productive work environment. Integrating ergonomic considerations into project risk management not only prevents immediate injuries but also leads to long-term health benefits for workers. Reducing the risk of MSDs and stress-related issues can result in healthier employees and lower healthcare costs for the organization [37]. Ergonomic factors have a direct impact on worker productivity.

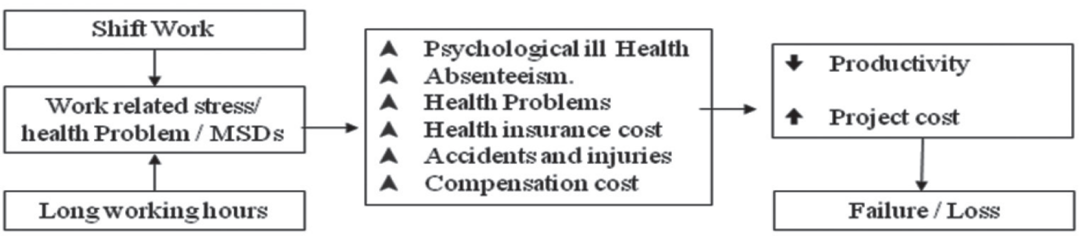

Figure 1. Impact of shift work and long working hours on works' health and productivity

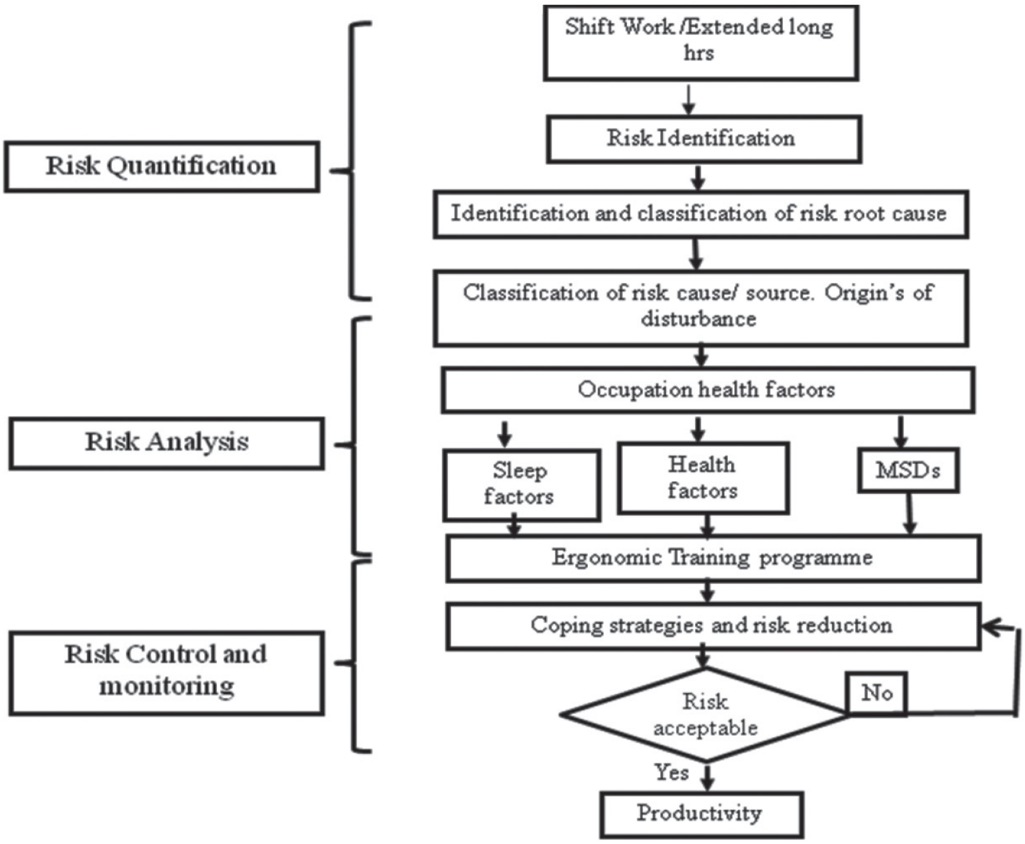

Figure 2. Risk identification and assessment process

When project risk management includes measures to improve ergonomics, such as providing proper training, ergonomic tools, and breaks it can enhance the worker's comfort and performance, leading to increase productivity and efficiency. To improve productivity and cost effectiveness, the absence rate should be less than 3%. An absence rate of 10% is extremely serious and any absence rate of more than 6% should be regarded as an indicator of a situation needing further investigation [38]. Developing training programs with a mix of visual elements (videos, simulations) alongside traditional lectures. This caters to different learning styles and enhances knowledge retention. It helps to improve the worker's productivity and efficiency.

Generally, at MSSIs the total working hours are 48 to 72 hours per week. 24 hours usually are divided into three shifts. Start and end times depend on the length of the shift. First Morning shift starts from 8.00 am to 4:00 pm, including office employees. The afternoon shift starts from 4:00 pm to 12:00 am and the night shift starts from approximately 12:00 am to 8:00 am. Long hours of work extended beyond the regular shift duty hours. This may be either day work or shift work beyond working hours, or it may be work on weekends.

3. Materials and Methods

For this study, to find out how often micro and small-scale industries complete their projects, what resources they use, how they measure success, what tools and techniques they practice, the questionnaires are framed which consist of general and specific questions. These questions are related to predicted sleep, health, MSDs and productivity variables. The variables include difficulty in initiating sleep, insufficient sleep, sleep duration less than six hours, feel tiredness, gastrointestinal problem, meal time disturbance, cardiovascular problem, stress, neck pain, shoulder pain, knee pain, upper back pain, lower back pain, injuries, absenteeism etc. In addition, personal interview method was also used to collect the related data. The methodology is divided into three categories: (a) direct observations by visiting industries, (b) an ergonomics checklist with these self-administered questionnaires (SAQs) and personal interview, and (c) risk identification, risk analysis and risk control methods to propose effective mitigation strategies [12].

The Ergonomics checklist is also used for assessing the potential ergonomic problems at the MSSIs to identify and evaluate the effectiveness in reducing ergonomic injuries and MSDs. The workplace analysis was accomplished by observing the task, watching the employees as they were doing the task to note the main demands of the task and list the risk factors as to which may be present. During the interviews the general information of Employees' job title, shift hours, general health, and some personal data such as age, weight, height, BMI and experience was also collected.

The outcomes of the data collection were utilized to determine the ETP and mitigation strategies. The ETP involved practical information on effective sleep patterns and naps, and how to balance work and family life. In addition, during ETP participants had opportunity to learn on how poor ergonomics can impact their sleep quality and overall health [39], [40]. A training program on body mechanics including anatomy and physiology, biomechanics, ergonomics, and injury prevention techniques was provided to lower MSDs [12], [40], [41]. The same questionnaire was used for the second time after ETP to collect the feedback and evaluate its effectiveness.

3.1 Measures and Statistical Analysis

This study was conducted in 47 different micro (33) and small scale (14) industries with the capacity of workers from minimum five to maximum 78. Major industries are doing job / batch order production whereas the typical length of a project in small-scale industries is between three to six months. The total number of participants including owners, supervisors and workers was 1497. Only 827 workers filled out questionnaires. Response rate was 55.24%. In morning shift was 56.29%, (n=304), in afternoon shift 57.06 % (n=218), and in night shift 55.06% (n=212), and for long extended hours respond rate was 48.94% (n=93). For the analysis the following statistical techniques were used to meet the objectives of the study:

(1) Descriptive statistics were used to explain response rate, mean, standard deviation, frequency and percentage of demographic data.
(2) The Chi square test was used to determine the association of shift work with various variables (problems related to sleep, health, MSDs and absenteeism and productivity).
(3) Pearson's Correlation was used to determine whether there were any inter and intra relationships between sleep, health, MSDs variables and with absenteeism and productivity variables.

3.2 Demographic Characteristics

The outcome of demographic characteristics of all participants in MSSIs is shown in Table 1. It indicates that most of the workers were in the age group of 36 to 52 years. Their mean ages were found to be nearly 43 years (SD varies from 7.68 to 8.41). Also, the mean years of experience were observed as 21 to

Table 1. Demographic characteristic

Measure	Item	Morning shift	Afternoon shift	Night shift	Long hour shift
Age	Mean	42.89	43.12	43.56	42.23
	Std. Deviation	8.2	7.68	8.41	7.89
	Min-Max	26-56	25-57	22-57	23-54
Weight	Mean	61.67	63.1	64.12	62.32
	Std. Deviation	7.56	8.09	8.11	7.34
	Min-Max	48-82	46-85	48-85	46-81
Height	Mean	1.687	1.682	1.643	1.673
	Std. Deviation	0.06722	0.07110	0.06832	0.07402
	Min-Max	1.5-1.8	1.51-1.8	1.5-1.8	1.52-1.8
BMI	Mean	21.9	22.4	23.8	22.3
	Std. Deviation	1.87	2.01	2.32	2.13
	Min-Max	21.3-25.3	20.2-26.2	21.3-26.2	19.9-25
Year of experience	Mean	22.3	21.87	22.75	22.04
	Std. Deviation	7.09	7.56	7.31	7.12
	Min-Max	2-33	3-34	2-34	2-32

23 years (SD varies from 7.09 to 7.56). Age and years of experience are excluded from this study. BMI was computed using height and weight as inputs. Mean BMI for night shift workers was found to be the highest (23.8; SD = 2.32) and that of morning shift workers it was 21.9 (SD = 1.87).

4. Results and Discussion

4.1 Prevalence of sleep variables

Shift workers frequently complain of irritability, nervousness, and anxiety, in relation to more stressful working conditions and greater difficulties in family and social life. Circadian rhythms play a crucial role in regulating the timing and quality of sleep. The influence of circadian rhythms on sleep and cardiovascular problems is profound and multifaceted [32]. Circadian rhythms are the body's internal clock mechanisms that regulate various physiological processes, including sleep-wake cycles and cardiovascular functions and behavioral processes of living beings that rise and fall across the 24-hour day [29], [42], [43]. Sleep deprivation can negatively impact various aspects of the immune system [32]. Inflammatory cytokines production is generated by sleep loss, which causes an increased risk of cardiovascular and metabolic disorders. Lack of sleep reduces antibody production thus resulting in higher infection risks. One night of restricted sleep to four hours resulted in inflammatory cytokines being made that are important in the development of cardiovascular and metabolic disorders [42].

This study investigated the prevalence of sleep problems among individuals working different shift schedules. The results showed that long-hour shift workers were most likely to report sleeping less than six hours per night (39.78%), followed by night shift workers (31.13%). Additionally, insufficient sleep was the most reported sleep variable across all groups (32.35%), followed by feelings of tiredness (30.10%). Night workers were more likely to report insufficient sleep (38.20%) compared to long-hour shift workers (37.63%). Difficulty initiating sleep was also more prevalent among long-hour shift workers (31.18%). These findings align with previous studies, [15], [32], [34], which also identified insufficient sleep (32.63%), difficulty initiating sleep (19.64%), and feelings of tiredness (29.63%), sleep duration less than six hours (26.22%) as common sleep disturbances among shift workers.

The study employed a Chi-square test to check the association between sleep variables and shift schedules. The findings revealed a statistically significant association between difficulty in initiating sleep ($\psi^2 = 19.21$, $p = 0.0002$), insufficient sleep ($\psi^2 = 34.53$, $p = 0.0001$), sleep duration less than six hours ($\psi^2 = 31.12$, $p < 0.0001$), and feelings of tiredness ($\psi^2 = 21.03$, $p = 0.0001$) are highly associated with different shift schedule.

The Pearson correlation analysis was conducted to explore potential relationships among the variables listed in Table 2. Notably, difficulty in initiating sleep exhibited significant correlations with gastrointestinal problems ($r=0.962$, $p<0.05$), stress ($r=0.951$, $p<0.05$). Insufficient sleep and sleep duration of less than six hours was positively correlated with various health issues except mealtime disturbance ($r=0.877$) and ($r=0.871$), respectively. Additionally, feelings of tiredness were correlated with cardiovascular problems ($r=0.951$, $p<0.05$).

It was observed that difficulty in initiating sleep, insufficient sleep, and feelings of tiredness strongly correlated with all MSDs variables, as indicated in Table 2. The substantial impact of insufficient sleep on reduced worker productivity and poor-quality work was evident ($p<0.0001$). Furthermore, insufficient sleep

Table 2. Correlation between Sleep variables with health, MSDs, and Productivity variables

Sleep Variables	Gastrointestienal problem	Meal time disturbance	Cardiovascular problem	Stress	Neck pain	shoulder pain	Knee pain	Upper back pain	Lower back pain	Low worker productivity	Poor quality work	Injury/accidents	Absentism
Difficulty in initiating sleep	0.962*	0.775	0.935	0.951*	0.971*	0.955*	0.955*	0.973*	0.956*	0.943	0.952*	0.923	0.93
Insufficient sleep	0.998**	0.877	0.996**	0.985*	0.987*	0.997**	0.998**	0.982*	0.974*	0.999**	1.00***	0.981*	0.987*
sleep duration <6hrs.	0.968*	0.871	0.949*	0.978*	0.935	0.936	0.939	0.932	0.905	0.942	0.951*	0.960*	0.960*
Feel tiredness	0.967*	0.751	0.951*	0.936	0.998**	0.986*	0.985*	0.999**	0.998**	0.969*	0.972*	0.918	0.93

Note. *P<0.05, **p<0.01, ***p<0.001

and sleep durations of less than six hours were significantly correlated with poor work quality, incidents of injury/accidents, and absenteeism ($p<0.05$), although feelings of tiredness did not exhibit such correlations with injury/accidents and absenteeism.

Figure 3 presents the percentage of respondents against sleep variables before ETP, whereas Figure 4 depicts post-ETP results for sleep variables, revealing reductions in all sleep problems following ETP implementation. After ETP difficulty in initiating sleep decreased from 20.73% to 15.80%, marking a 4.93% improvement, while insufficient sleep decreased from 32.35% to 28.82% post-intervention. Notably, the effect of ETP was significant in reducing sleep durations of less than six hours for long working hours shift by 9.68%. Additionally, insufficient sleep and sleep durations of less than six hours decreased by 3.53% and 5.425%, respectively. This study also revealed that sleep variables are strongly correlated with low worker productivity, injuries/accidents and absenteeism. These findings are similar to the previous result of [31], [32], who stated that sleep quality and quantity have been considered as a key factor in modulating the performance of shift workers during night shift [41].

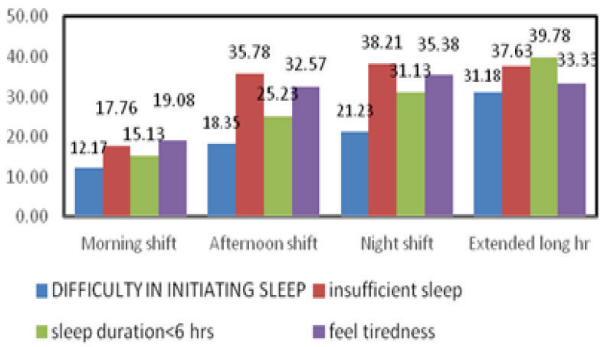

Figure 3. Percentage of respondents against sleep variables (before ETP)

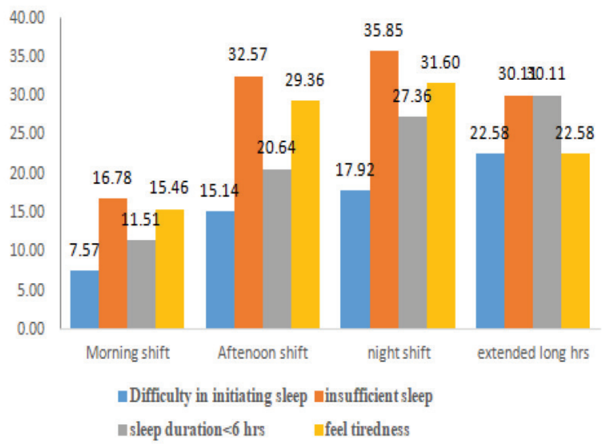

Figure 4. Percentage of respondents against sleep variables (After ETP)

4.2 Prevalence of Health variables

The variability of health variables among shift workers before ETP are illustrated in Figure 5. Cardiovascular problems showed similar prevalence among night shift workers (25.94%) and long-hour shift workers (25.80%), long-hour shift workers were notably more affected by stress (31.18%) compared to night shift workers (27.83%). The Chi-square test analysis indicated a strong association between shift schedules and all health variables ($p<0.01$).

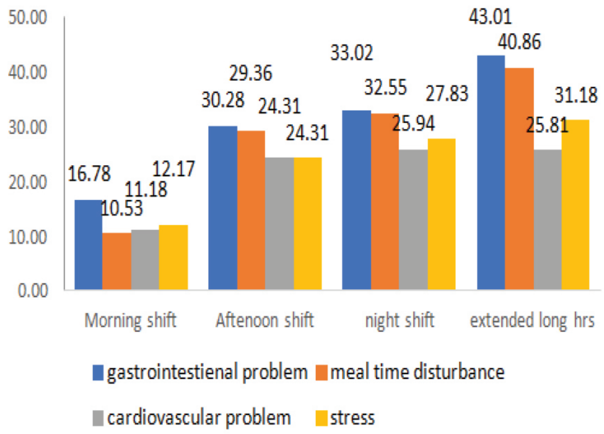

Figure 5. Percentage of respondents against health variables (before ETP)

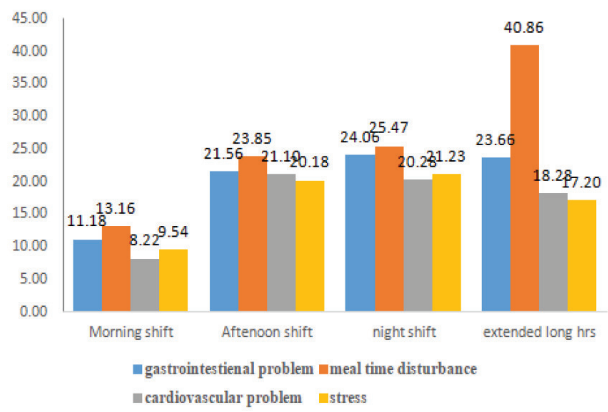

Figure 6. Percentage of respondents against health variables (After ETP)

Furthermore, Table 3 presents the results of the Pearson correlation analysis conducted on health, MSDs, and productivity variables. Interestingly, mealtime disturbances showed no impact on MSDs variables before the ETP. However, gastrointestinal, and cardiovascular problems exhibited significant correlations with all MSDs variables ($p<0.05$). Stress demonstrated positive correlations with neck pain, shoulder pain, and knee pain ($p<0.05$).

Moreover, health variables, except mealtime disturbances, notably impacted productivity variables.

Table 3. Correlation between health variables with MSDs and productivity variables

Health variables	Neck pain	Shoulder pain	Knee pain	Upper back pain	Lower back pain	Lower worker productivity	Poor quality work	Injury/ accidents	Absenteeism
Gastrointestinal problem	0.979*	0.991**	0.922**	0.975*	0.962*	0.996**	0.998**	0.989*	0.997**
Meal-time disturbance	0.788	0.842	0.848	0.774	0.747	0.884	0.883	0.951*	0.941*
Cardiovascular problem	0.968*	0.987*	0.989*	0.961*	0.950*	0.997**	0.997**	0.994**	0.997**
Stress	0.953*	0.971*	0.973*	0.947	0.928	0.983*	0.987*	0.997**	0.997**

Note. *p<0.05 ** p<0.01 ***p<0.001

Gastrointestinal problems were associated with low worker productivity (r=0.996, p<0.01), poor quality work (r=0.998, p<0.01), and injury accidents (r=0.989, p<0.05). Both gastrointestinal problems and stress were identified as predominant factors contributing to absenteeism (p<0.01). Additionally, cardiovascular problems significantly correlated with all productivity variables (p<0.01) and led to increased absenteeism (r=0.997, p<0.01).

Figure 6 illustrates the reduction in the average percentage of all health variables after ETP. Prior to ETP, gastrointestinal problems were reported on average by 30.77%, which decreased to 20.11% after ETP. Similarly, cardiovascular problems and stress averaged reductions of 4.84% and 6.80% respectively after ETP. This is consistent with the findings of a number of studies [26], [27] which reported that the complaint about gastrointestinal problems is higher (41.93%) and associated with poor sleep.

4.3 Prevalence of MSDs variables

Night shift workers exhibit notable MSDs issues [12], [31] reported the prevalence of neck pain (20% and 25.45%), shoulder pain (22.6% and 26.3%), and upper back pain (32.2% and 30.36%), with shoulder pain also noted at 15.8%. Comparatively, a recent study found that night shift workers had even higher incidences, with 30.66% reporting neck pain and knee pain at 37.73%. Additionally, upper back pain (31.10%) and lower back pain (31.31%) were prevalent among shift workers, ranking highest among all MSDs problems Figure 7.

Statistical analysis using the Chi Square test revealed significant associations for neck pain (ψ^2 = 19.34, p = 0.0002), upper back pain (ψ^2 = 24.21, p < 0.0001), and lower back pain (ψ^2 = 26.00, p <0.0001).

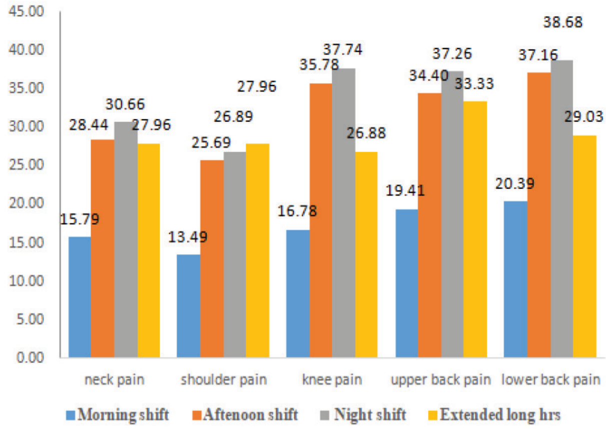

Figure 7. Percentage of respondents against MSDs variables (before ETP)

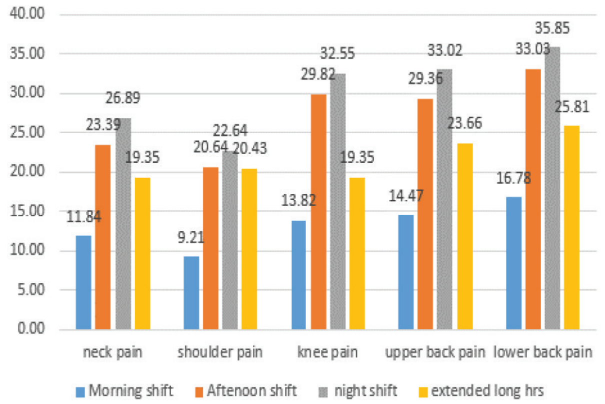

Figure 8. Percentage of respondents against MSDs variables (After ETP)

The Pearson correlation analysis, as depicted in Table 4, highlighted a positive correlation between MSDs variables like neck pain, shoulder pain, and knee pain with productivity variables (p<0.05). These MSDs were identified as leading factors contributing to increased absenteeism.

Figure 8 shows that the ETP significantly reduced the average percentage of MSDs problems. On average, MSDs variables decreased from 28.18% be-

Table 4. Correlation between MSDs and Productivity variables

MSDs Variables	Lower worker productivity	Poor quality work	Injury/accidents	Absenteeism
Neck pain	0.982*	0.984*	0.939	0.950*
Shoulder pain	0.996**	0.996**	0.965*	0.973*
Knee pain	0.997**	0.997**	0.968*	0.976*
Upper back pain	0.978*	0.980*	0.931	0.943
Lower back pain	0.971*	0.971*	0.913	0.927

Note. *p<0.05 **p<0.01 ***p<0.001

fore ETP to 23.09% after ETP, marking a reduction of 5.08%. Specifically, neck pain decreased from 25.71% to 20.37%, and shoulder pain from 23.50% to 18.23%, representing reductions of 5.34% and 5.27% respectively.

4.4 Prevalence of Productivity variables

Productivity variables revealed higher occurrences of injuries/accidents and absenteeism during night shifts compared to other shifts. Figure 9 indicates the impact of shift work on productivity variables. Analysis revealed that on average, 18.93% of shift workers exhibited low worker productivity, with 23.11% attributed to the night shift. Moreover, the percentages of injury/accident and absenteeism were highest during night shifts, recorded at 8.01% and 11.79% respectively before ETP.

Shift timing emerged as a significant factor affecting productivity variables, as confirmed by the Chi-square test. Associations between shift timings and variables such as injury/accident (ψ^2 = 12.26, p = 0.0065) and absenteeism (ψ^2 = 11.31, p = 0.01) were prominent. Notably, low worker productivity (ψ^2 = 19.21, p = 0.0002) and poor-quality work (ψ^2 = 18.38, p = 0.0004) were also influenced by shift timings.

Analysis from Table 5 concluded that low worker productivity (r=0.988, p<0.05) and poor-quality work (r=0.989, p<0.05) were positively correlated with absenteeism. Injuries/accidents emerged as a predominant variable for absenteeism (r=0.999, p<0.001).

The implementation of ETP leads to a significant reduction in productivity variables. Figure 10 demonstrates a notable decrease in the average percentage for low worker productivity, decreasing from 18.93% to 12.35% post-ETP.

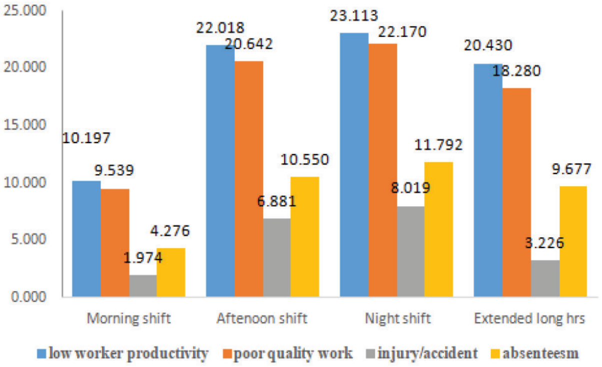

Figure 9. Percentage of respondents against productivity variables (before ETP)

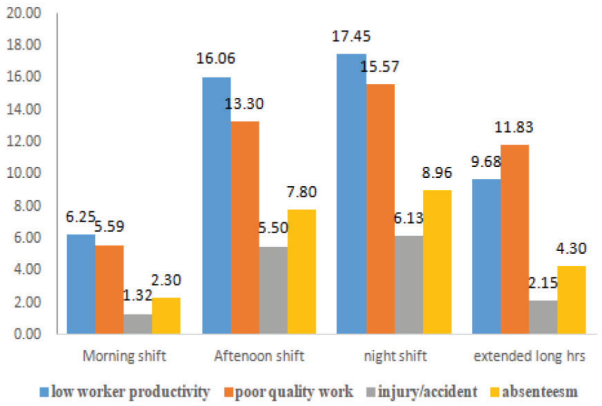

Figure 10. Percentage of respondents against productivity variables (After ETP)

Table 5. Correlation between productivity variables

Productivity variables	Lower worker productivity	Poor quality work	Injury/accidents	Absenteeism
Lower worker productivity		1.00***	0.982*	0.988*
Poor quality work			0984*	0.989*
Injury/accidents				0.999**
Absenteeism				

Note. *p<0.05 ** p<0.01 ***p<0.001

Overall, the introduction of rest breaks and the ETP resulted in a reduction in low worker productivity by 6.58%, poor quality work by 6.08%, and a decrease in the number of injuries/accidents by 1.25%. This overall reduction, coupled with the impact of the ETP, contributed to a mitigation of absenteeism of 3.23%, as shown in Table 6. This finding has a close affinity with the previous research [13], [31], who found that after conducting Managing a shift work lifestyle and ETP, absenteeism was reduced by 1.5% and 3.4% respectively. Consequently, labor productivity increased by 2.875 labor/h, representing a 2.78% improvement, which is slightly lower than the 2.95% improvement found by Dande and Sharma [31].

5. Conclusion

After reviewing all the literature and conducting an actual survey, along with analyzing the experimental findings, it can be strongly concluded that shift work is necessary for micro and small-scale industries and cannot be avoided despite its negative impact on sleep, health, and productivity. The study shows that shift work disrupts circadian rhythms, leading to increased absenteeism primarily due to sleep issues, followed by MSDs and health problems. The experimental findings of this study show that the percentage of absenteeism before EIP was 9.07%, which was higher and can place a huge financial burden on the organizations and also increase the workload of other employees and can also have detrimental effect on productivity. Implementing ergonomic training significantly reduces absenteeism from 9.07% to 5.84%, marking a 3.23% reduction and improves labor productivity by 2.78% (2.875 labor/h). Ergonomic training enhances employee well-being, reduces pain, fatigue, and stress, and promotes a safer, more productive work environment, proving to be a crucial solution for mitigating financial losses and improving the workers' quality of life. Overall, incorporating ergonomic training into risk management strategies is essential for balancing the demands of shift work with the well-being of employees, leading to sustained productivity and financial stability for micro and small-scale industries.

Overall, the Ergonomic Approach to risk management through ergonomics leads to several benefits (1) improved employee well-being – reduced pain, fatigue, and stress, leading to happier and healthier employees, (2) increased productivity – reduced discomfort and improved focus contribute to a more productive workforce, (3) reduced absenteeism – fewer work-related injuries and illnesses lead to consistent employee presence and lower overall costs, and (4) enhanced safety – fewer accidents and injuries create a safer work environment for everyone.

Every research study has its limitations. In this study, potential limitations include the subjectivity of self-reported data, the limited scope of the selected industries, and the inability to establish causal relationships due to the cross-sectional design. The management system in individual industries and other workplaces may have differing assumptions about the varying demands of job tasks. Many of them do not follow labor legislation and other relevant standards. Future studies should explore the influence of environmental factors like noise, light, temperature, and odors on the health and productivity of shift workers, and how ergonomic interventions can mitigate these impacts. Also, future research should focus on broader range of health variables, such as mental health, cardiovascular health, and metabolic disorders, to understand the full impact of shift work on health. The workers were hesitant to co-operate with the researcher due to a lack of trust in the interview and questionnaires studies for fear of losing jobs on the speculation that this study might prove them to be physically weak and inefficient.

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Table 6. Improvement in Labor Productivity affected by absenteeism due to various factors

Variables	Reduction in various factors (%)	Reduction in absenteeism (%)	Improvement in labor productivity (%)
Sleep	4.80	0.7481	0.6428
Health	6.202	0.967	0.8322
MSD	5.0857	0.793	0.6824
EBP (except absenteeism)	4.635	0.732	0.6222
Total	20.722	3.23	2.78

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