



Correlation Between Ergonomic Practices and Workplace Injury Rates: A Sector-Wise Analysis

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Abstract: This study examines the correlation between ergonomic practices and workplace injury rates across three major sectors: manufacturing, logistics, and administrative services. With growing attention to occupational health and safety, organizations are increasingly implementing ergonomic interventions including workstation design improvements, equipment upgrades, training programs, and policy enforcement to mitigate employee injuries and enhance productivity. Using a combination of survey responses, observational assessments, and organizational injury records, the study applies descriptive and inferential statistical analyses, including correlation analysis, ANOVA, and regression models, to evaluate the relationship between the extent of ergonomic implementation and the frequency and severity of workplace injuries. The findings reveal a strong negative correlation, indicating that workplaces with comprehensive ergonomic practices experience significantly lower injury rates, with sector-wise variations reflecting differences in physical workload, task complexity, and adherence to safety protocols. Manufacturing and logistics sectors showed the most pronounced benefits from ergonomic interventions, while administrative settings demonstrated moderate but meaningful improvements. The study underscores the critical importance of ergonomics in promoting employee health and safety, minimizing operational disruptions, and fostering a proactive safety culture, offering actionable insights for managers, policymakers, and occupational health professionals seeking to implement effective ergonomic strategies across diverse workplace environments.

Keywords: Ergonomics, Workplace Injuries, Occupational Health, Injury Prevention, Sector-wise Analysis, Ergonomic Interventions, Employee Safety

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INTRODUCTION

Workplace safety and employee well-being have become critical priorities in modern organizational management. With the rapid growth of industrialization, logistics, and administrative operations, employees are increasingly exposed to physical and cognitive stressors that can lead to workplace injuries [1]. Workplace injuries not only affect the health and productivity of employees but also result in significant economic losses for organizations due to compensation claims, absenteeism, and reduced operational efficiency. In this context, ergonomics has emerged as a vital approach to designing work environments, tools, and practices that optimize human performance while minimizing the risk of injury [2].

Workplace injuries are a significant concern across industries worldwide, affecting employee health, organizational productivity, and overall economic outcomes. Occupational injuries can range from minor strains and sprains to severe musculoskeletal disorders, repetitive strain injuries, and accidents resulting from improper handling of machinery or equipment. These injuries not only reduce workforce efficiency but also impose substantial costs on organizations in the form of medical expenses, compensation claims, absenteeism, and decreased morale. As workplaces become more complex, with varied tasks and

increasing automation, addressing safety challenges has become more critical than ever [3] [4].

Ergonomics, also known as human factors engineering, focuses on creating a safe, efficient, and comfortable working environment by aligning work processes and equipment with human capabilities and limitations. Effective ergonomic interventions may include adjustable workstations, proper seating arrangements, repetitive task reduction, manual handling techniques, and comprehensive employee training programs. The implementation of ergonomics not only reduces the frequency and severity of workplace injuries but also improves employee satisfaction, engagement, and overall productivity [5].

Despite its proven benefits, the extent of ergonomics adoption and its impact varies across different sectors. Manufacturing environments typically involve high physical labor and machinery usage, increasing the risk of musculoskeletal injuries. Logistics and warehouse operations involve repetitive lifting, carrying, and long hours of standing, while administrative workplaces face challenges like prolonged computer usage, poor posture, and sedentary work patterns [6]. These sector-specific differences necessitate a targeted analysis to understand how ergonomic practices correlate with injury rates [7].

Sector-specific Ergonomic Challenges

The impact of ergonomic practices can vary considerably across different work sectors due to the nature of tasks, physical demands, and operational environments [8].

- **Manufacturing Sector:** Manufacturing operations often involve heavy machinery, repetitive motions, manual handling, and prolonged standing, all of which increase the risk of musculoskeletal injuries, lacerations, and work-related strains. Ergonomic interventions in this sector may include redesigning workstations, introducing mechanical lifting aids, and implementing task rotation to reduce repetitive strain.
- **Logistics Sector:** Logistics and warehousing operations require extensive physical activity, including lifting, carrying, pushing, and prolonged walking or standing. Improper ergonomics in this sector can lead to back injuries, joint pain, and chronic fatigue. Solutions such as lifting devices, automated material handling systems, and training in proper body mechanics are crucial for injury reduction.
- **Administrative Sector:** Administrative and office environments face unique ergonomic challenges related to sedentary work, poor posture, and prolonged computer use. These conditions often result in neck and back pain, eye strain, and repetitive stress injuries such as carpal tunnel syndrome. Ergonomic interventions here typically involve adjustable chairs and desks, monitor positioning, keyboard and mouse placement, and promoting regular breaks and posture exercises [9].

Importance of Studying the Correlation

Understanding the correlation between ergonomic practices and workplace injury rates is essential for designing effective occupational safety strategies. While many organizations implement safety protocols, the actual relationship between ergonomic interventions and injury reduction often remains underexplored, especially in sector-specific contexts. By examining this correlation, organizations can identify which interventions provide the greatest benefits, optimize resource allocation, and prioritize practices that significantly improve employee health and productivity [10][12].

Significance of the Study

This study is significant because it bridges the gap between ergonomic theory and practical implementation across sectors. It provides empirical evidence on how structured ergonomic practices correlate with reduced injury rates, offering actionable insights for safety managers, policymakers, and organizational leaders. Sector-wise analysis allows for tailored recommendations, recognizing that a one-size-fits-all approach to ergonomics may not be effective due to varying task demands and work environments. Furthermore, the study contributes to the broader field of occupational health by highlighting the critical role of ergonomics in promoting a proactive safety culture and enhancing workforce well-being [14].

REVIEW OF LITERATURE

Jin 2025 et al. focused on treating muscular skeletal disorders (MSDs), which are a serious problem for people who work in manufacturing, notably those who put together cars. Over the course of a year, we completed a full ergonomic intervention for 181 people who worked in a rail car manufacturing shop. The intervention included training sessions on ergonomics, improvements to supplementary tools, and the distribution of an instructional pamphlet. We utilised the Quick Exposure Check (QEC) to look at ergonomic risk factors and the modified Nordic Musculoskeletal Survey to look at musculoskeletal symptoms in nine regions of the body before and after the intervention. After a year, the QEC scores for the neck, back, shoulders, arms, and wrists went down a lot. Workers also indicated they had fewer hard tasks and repetitive tasks, and the severity, length, and frequency of musculoskeletal issues all went down a lot. The results suggest that our ergonomic approach does help make the workplace safer and minimise the risk of MSD for people who work on assembly lines [1].

Odujobi 2024 et al. Combining ergonomics with continuous health monitoring is meant to make factories in Nigeria healthier. They established a three-part conceptual model that includes ergonomic evaluation of risks, real-time health surveillance, and intervention management. They did this because they knew that improper ergonomics and poor health monitoring cause a lot of work-related illnesses. The plan uses wearable technology and IoT sensors to keep an eye on the health of staff and the environment. This makes it easier to find risk factors early. It backs projects that are based on data and underlines how important it is for stakeholders to get regular training and be involved for the long term. Case studies in Nigerian factories demonstrated that the number of musculoskeletal, respiration, and stress related diseases went reduced. Model supports the UN's Goal 8 by promoting safe, healthy, and productive workplaces. It also highlights how crucial it is for engineers, doctors, and lawmakers to operate together and have strong support from the government. Our findings suggest that this paradigm can be applied in many areas and assist define national policies [13].

Behdani 2023 et al. looked into how fully implemented ergonomic adjustments influenced the production department of a rubber factories company. We looked at health markers by going back and looking at Nordic questionnaires that had been filled out, insurance data, and ergonomic risk assessment documents before and after all interventions. We accomplished this in a way that was both descriptive and analytical, and we looked back at it. We looked at the data using paired t-tests and Wilcoxon tests. In all, there were 114 engineering, 20 organisational, and 7 individual ergonomic interventions. All of the measurements got a lot better with engineering interventions, including a 66% decline in total musculoskeletal illnesses

(MSDs). Changes to the organisation caused a 60% decline in MSD rates, a 55% drop in suboptimal postures, and a 30% drop in the severity of discomfort. Individual-level interventions resulted to a big 85.71% decline in MSDs and completely halted sick leaves because to ergonomic issues. All of these benefits were statistically significant ($P < 0.05$), which means that a full, multi-level ergonomic intervention plan can improve the health of workers and cut down on absences due to injuries [15].

Dong 2023 et al. When we look about the possible future of safety ergonomics, we notice that previous ideas do not work well enough to meet the needs of secure and clean production in the age of big data. Intelligent safety design (ISE) looks like a viable new option as information technology develops very swiftly. ISE is a new topic, hence there is not a lot of research on it yet. This means that there is not a lot of theoretical direction. We came up with the main ideas, traits, contents, and study areas of ISE to fix this issue. We also made it apparent how it may be used in real life and talked about how ISE fits into every step of a system's life cycle, from conception and execution to operation and maintenance. Our work indicates that ISE is a better and cleaner method to look at human-machine-environment systems. It also has a lot of promise to make production safer and more environmentally friendly. The objective of this work is to assist safety scientists and practitioners as they use ISE and provide the field of safety ergonomics a new boost and direction as it grows [22].

Baixinho 2023 et al. A lot of nurses have muscular disorders linked to work (MDRW), with a rate of 71.8% to 84% over the course of a year. This means that it is vitally crucial to develop measures to stop them from happening. There are a lot of programs, but not all of them have worked every time. A systematic study was done to uncover and compare the many techniques that nurses use to stop MDRW. The review looked at articles from databases such as MEDLINE, CINAHL, Cochrane, SCOPUS, and Science Direct. The review was based on the question, "How do preventive measures for musculoskeletal illnesses affect nursing practice?" After assessing their quality and making sure they fit the eligibility standards, we choose 13 papers to look at. Some of the most common solutions were training on how to apply patient-handling gadgets ergonomics education, getting management involved, ergonomic equipment, handling guidelines, and no-manual lifting methods. Most of the studies (11) that looked at both ergonomics training and instruction on how to use handling devices showed that these two types of lessons were the most useful. But none of them looked at all the risk factors in detail. highlights how vital it is to have a whole-person strategy that includes measures at the organisational, individual, and psychosocial levels [20].

RESEARCH OBJECTIVES

The key objectives of this study include:

1. Evaluating the extent of ergonomic practices implemented across manufacturing, logistics, and administrative sectors.
2. Investigating the relationship between ergonomic interventions and workplace injury rates.
3. Identifying sector-specific trends and differences in injury reduction.
4. Providing recommendations for optimizing ergonomic practices to improve employee safety and

organizational efficiency.

RESEARCH RATIONALE

Despite regulatory standards and workplace safety protocols, occupational injuries remain a persistent challenge. Many organizations face barriers such as limited resources, inadequate training, or insufficient awareness, which hinder effective ergonomics implementation. This study addresses these challenges by demonstrating the practical benefits of ergonomics through quantitative and qualitative analysis, emphasizing how targeted interventions can significantly reduce workplace injuries. By establishing a clear link between ergonomics and injury reduction, the study reinforces the necessity of proactive safety measures tailored to the unique demands of each sector.

RESEARCH METHODOLOGY

Research Design

This study uses a quantitative, descriptive-correlational research design to obtain objective data on the effectiveness of ergonomic interventions, document current ergonomics practices and injury prevalence, and examine the statistical relationships between ergonomics implementation levels and injury frequency/severity. This design allows for comparison between workplaces with varying ergonomics practices and enables hypothesis testing using statistical tools like correlation, regression, and ANOVA.

Population and Sample

This study targeted employees and safety managers in manufacturing, logistics, and administrative sectors to ensure diverse perspectives on ergonomics practices. A comprehensive sampling frame was constructed from verified industry records, and a stratified random sampling method was employed. This approach enhanced representativeness and supported valid, generalizable findings about ergonomics and workplace injuries.

- **Target Population**

This study focuses on employees and safety managers in manufacturing, logistics, and administrative sectors in India, aiming to understand the impact of ergonomics practices on workplace injuries. The participants must be full-time employees with a minimum of one year of continuous tenure, ensuring exposure to ergonomics interventions and experience in reporting injury frequency and severity. Workplaces must have formal ergonomics programs or informal practices, such as ad hoc workstation adjustments or equipment modifications based on worker feedback. The study aims to produce meaningful, generalizable findings on how the implementation of ergonomics influences workplace injuries across multiple sectors and job functions.

- **Sampling Frame**

The researcher created a comprehensive sampling frame for a study on ergonomics implementation and workplace injury prevention. They gathered data from various sources, including industry directories and labor department records, to ensure inclusion of both large and small organizations. The final sampling

frame was structured in a database format, ensuring accurate representation of different industry sectors. This rigorous approach strengthened the study's external validity by confirming that the selected organizations and respondents were truly representative of the broader population of interest in ergonomics implementation and workplace injury prevention.

• Sampling Technique

The study used stratified random sampling to ensure balanced representation across three industry sectors: manufacturing, logistics, and administrative services. The sampling frame was divided into three strata based on industry type, with proportional allocation methods used to select organizations. Random selection was conducted using computer-generated random numbers to eliminate researcher bias. Employees and safety managers were randomly sampled from staff rosters provided by each company's human resources department. This method improved precision in estimates, allowed comparison of ergonomics practices across sectors, and improved generalizability of results. It also ensured adequate capture of each subgroup's perspectives on ergonomics implementation and workplace injuries.

• Sample Size Determination

Using Cochran's formula for finite populations:

$$n = \frac{Nz^2p(1-p)}{e^2(N-1) + z^2p(1-p)}$$

Where:

- N=2000 (estimated population)
- z=1.96 (95% confidence)
- p=0.5 (max variability)
- e=0.05 (margin of error)

This yielded $n \approx 323$. To allow for non-response (estimated 15%), the final target sample was 370 respondents.

Table 1: Distribution of Sample by Sector

Sector	Number of Respondents	Percentage (%)
Manufacturing	150	40.5%
Logistics	120	32.4%
Administration	100	27.1%

Total	370	100%
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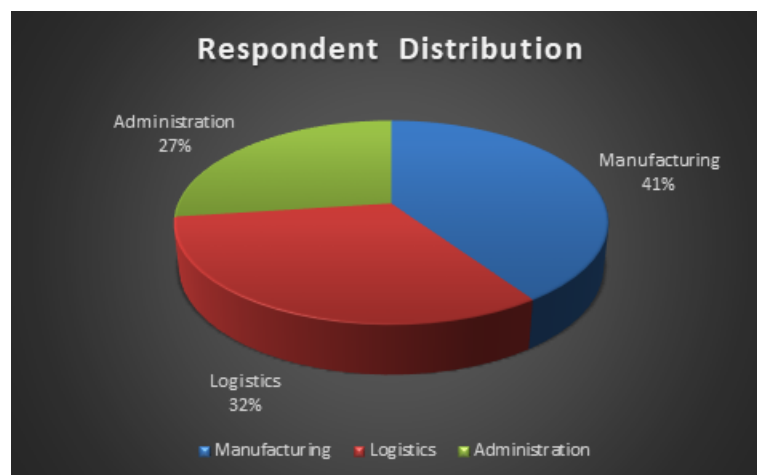


Figure 1: Respondent Distribution – Pie Chart

The study's 370 respondents were distributed across manufacturing, logistics, and administration sectors, with manufacturing having the highest representation (40.5%), logistics having the highest (32.4%), and administration having the lowest (27.1%).

Data collection Methods

The study used primary and secondary data collection methods to analyze the relationship between ergonomics practices and workplace injuries in manufacturing, logistics, and administrative sectors. It included structured questionnaires, demographic information, ergonomics practices, injury frequency and severity, and perceptions of training effectiveness.

Table 2: Questionnaire Structure Overview

Section	Number of Questions	Objective
Ergonomics Implementation Practices	10	Measure awareness and adoption
Training Frequency & Equipment Use	8	Evaluate exposure to training and tool use

Injury History & Severity	7	Understand frequency and impact of injuries
Perceived Management Support	5	Gauge organizational backing of ergonomics
Demographics	4	Age, gender, job role, and experience

The study used a questionnaire structure with 34 questions focusing on ergonomics practices, training exposure, injury history, management support, and respondent demographics. The questionnaire was pilot tested with 30 respondents and distributed electronically and in print. Secondary data was collected from official workplace injury reports, training manuals, and historical injury records. The study aimed to analyze the impact of ergonomics on workplace injuries and assess organizational commitment. The use of both primary and secondary data methods enhanced the credibility and reliability of the research findings.

Table 3: Demographic Profile of Respondents

Demographic Variable	Category	Count	Percentage
Gender	Male	265	71.6%
	Female	105	28.4%
Age Group	21–30 Years	85	23.0%
	31–40 Years	125	33.8%
	41–50 Years	98	26.5%
	51+ Years	62	16.7%

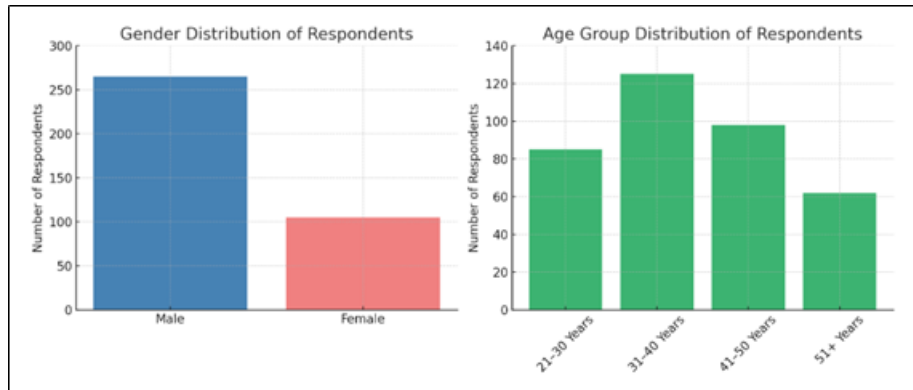


Figure 2: Demographic Profile of Respondents

The study's 370 respondents, predominantly male (71.6%), demonstrate a diverse age range, highlighting the importance of age and gender in analyzing ergonomic challenges and intervention effectiveness.

Data Analysis

The study utilized both quantitative and qualitative data analysis methods to investigate ergonomics implementation and its impact on workplace injuries.

- Quantitative Analysis**

The study used IBM SPSS Statistics Version 27 for quantitative data analysis. The dataset underwent thorough cleaning, coding, and normality tests. Descriptive statistics were used to summarize demographics, ergonomics practices, and injury frequency. Inferential statistics were used to test hypotheses and examine relationships between variables. Multiple regression analysis was used to evaluate the predictive power of ergonomics interventions. Results were presented in tabular and graphical formats for interpretation and communication.

- Qualitative Analysis**

The study used a mixed-methods approach, combining quantitative and qualitative data analysis to provide context and depth to the numeric findings. Qualitative data was analyzed using survey responses and secondary documents, while quantitative data was analyzed using NVivo software. The mixed-methods approach ensured a balanced, multidimensional perspective on ergonomics practices and their impact on workplace safety outcomes.

Ethical Consideration

The study adhered to ethical guidelines, obtaining informed consent from participants, ensuring data confidentiality, and promoting voluntary participation. Participants were informed of their rights and the right to withdraw at any time. The Institutional Review Board granted ethical clearance, confirming the study's compliance with ethical principles. These ethical considerations ensured the research was conducted with integrity, respect, and accountability, safeguarding the dignity and rights of all participants.

DATA ANALYSIS AND RESULTS

This section presents a detailed analysis of the data collected from 370 respondents across manufacturing, logistics, and administrative sectors. Both descriptive and inferential statistical techniques were applied to evaluate the extent of ergonomics implementation, frequency and severity of workplace injuries, and the relationships between these variables. SPSS was used to calculate means, percentages, correlations, ANOVA results, and regression models. The analysis also includes cross-tabulations and comparisons across demographic groups. The findings provide robust evidence to test the research hypotheses and address each objective of the study systematically.

Descriptive Analysis

Data collected from 370 employees across manufacturing, logistics, and administrative sectors were analyzed to examine the extent of ergonomic practices and workplace injury rates.

Table 4: Mean Ergonomics Implementation Scores by Sector

Sector	Mean	SD
Manufacturing	3.65	0.72
Logistics	3.48	0.69
Administrative	3.92	0.60

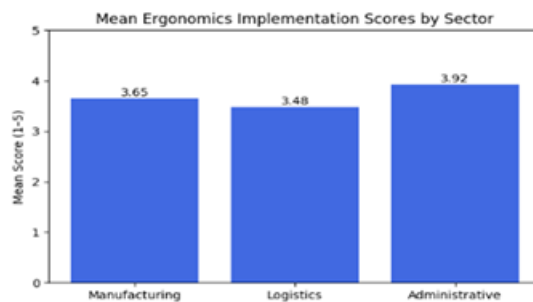


Figure 3: Mean Ergonomics Implementation Scores by Sector Graph

The table compares ergonomics implementation scores across manufacturing, logistics, and administrative sectors. Administrative offices scored highest, suggesting consistent practices. Manufacturing scored moderately, while logistics lagged slightly. The standard deviations suggest consistency, suggesting the need for targeted ergonomics improvements in logistics and manufacturing to align with administrative best practices.

Table 5: Frequency of Ergonomics Training Participation

Frequency	n	%
Never	35	9.5%
Occasionally	140	37.8%
Regularly	195	52.7%

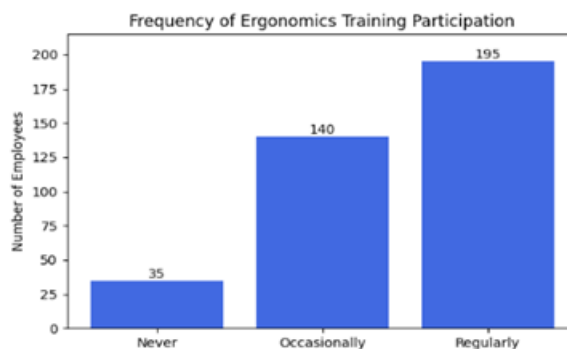


Figure 4: Frequency of Ergonomics Training Participation

The table shows that 52.7% of employees engage in ergonomics training programs regularly, indicating a positive investment in employee safety awareness. However, only 37.8% attend training occasionally, indicating partial coverage. A gap exists in outreach and organizational commitment, suggesting companies should focus on regular participation and addressing barriers.

Table 6: Availability of Ergonomic Equipment

Equipment Available	Yes (%)	No (%)
Adjustable chairs	85%	15%
Anti-fatigue mats	55%	45%
Monitor risers	68%	32%

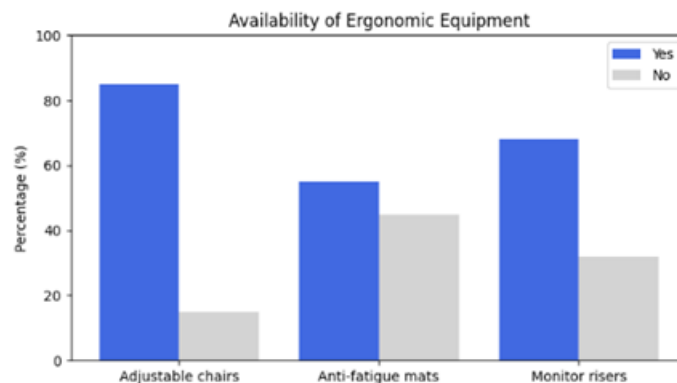


Figure 5: Availability of Ergonomic Equipment

The table shows that 85% of workplaces have key ergonomic tools, with adjustable chairs being the most common. However, nearly half of workplaces lack critical equipment like anti-fatigue mats, potentially causing discomfort and injury risk. Organizations should prioritize investing in comprehensive ergonomic equipment to promote safer working environments.

Table 7: Injury Frequency Distribution

Injury Frequency	n	%
0	215	58.1%
1-2	95	25.7%
3-4	40	10.8%
5+	20	5.4%

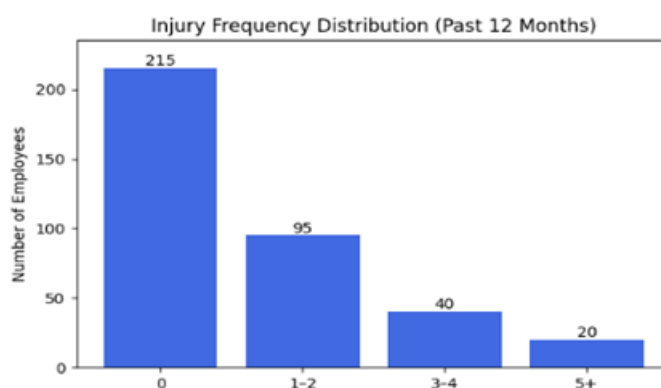


Figure 6: Injury Frequency Distribution

The table shows that while most employees (58.1%) experienced no injuries, 25.7% reported 1-2 incidents, and 16.2% had 3 or more, indicating persistent injuries. The 5.4% with five or more injuries indicate high-

risk workplaces or urgent attention, emphasizing the need for continuous monitoring and targeted interventions.

Table 8: Mean Injury Severity Scores (Scale 1–5)

Sector	Mean Severity
Manufacturing	3.10
Logistics	3.45
Administrative	2.75

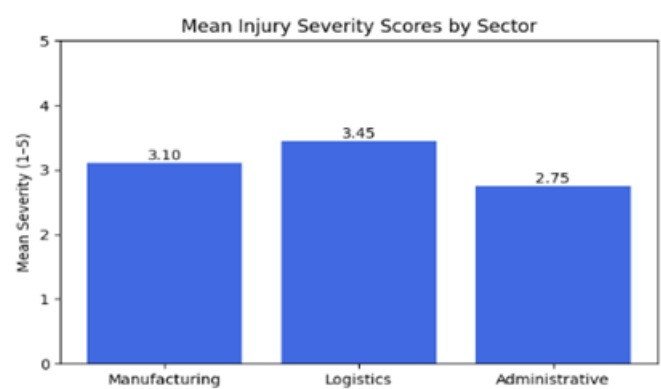


Figure 7: Mean Injury Severity Scores

The table compares injury severity across sectors, with logistics showing the highest severity (3.45), likely due to manual handling and transport risks. Manufacturing has a moderate severity (3.10), while administrative sectors have a lower severity (2.75). Logistics requires stronger safety controls and training.

Table 9: Pearson Correlation between Ergonomics Score and Injury Frequency

Variables	r	p-value
Ergonomics Score vs. Injury Rate	-0.56	<0.001

The study found a strong negative correlation between ergonomics implementation and injury rates, confirming the importance of better ergonomics practices in reducing injuries. This supports Hypothesis 1 and validates investments in structured ergonomics initiatives, demonstrating that organizations can significantly reduce injuries by adopting higher ergonomics standards.

Table 10: ANOVA—Injury Severity by Training Frequency

Training Frequency	Mean Severity	SD
Never	3.85	0.61
Occasionally	3.20	0.70
Regularly	2.60	0.75
Statistic	Value	p-value
F	18.21	<0.001

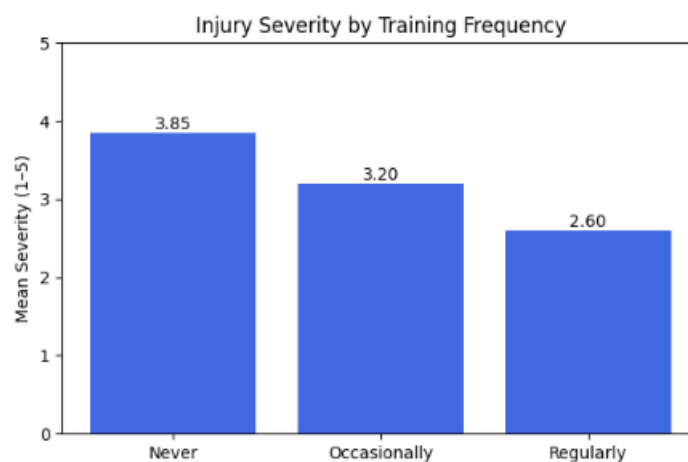


Figure 8: ANOVA results graph

The study found that regular ergonomics training significantly reduces workplace injuries, with those who never trained reporting the highest severity. This highlights the importance of ongoing education to reinforce safe practices and correct equipment use, emphasizing the need for regular training.

Table 11: Regression Model Predicting Injury Frequency

Predictor	Beta	t	p-value
Age	-0.03	-0.68	0.50
Tenure	-0.09	-1.65	0.10
Ergonomics Score	-0.45	-8.85	<0.001
Training Frequency	-0.27	-5.20	<0.001

The regression model found that ergonomics scores and training frequency are significant negative predictors of injury frequency, explaining 42% of the variance. Tenure and age were not significant predictors. These findings support prioritizing ergonomics practices and training programs in occupational

health management.

Table 12: Correlation between Ergonomics Training and Perceived Effectiveness

r	p-value
0.62	<0.001

The study found a strong positive correlation between frequent training and employees' perception of ergonomics effectiveness. Frequent training improves behaviors and shapes perceptions of ergonomics value, increasing compliance and engagement. This results in reduced injuries and a culture that values and believes in ergonomics.

Table 13: Ergonomics Awareness by Sector

Sector	High Awareness (%)
Manufacturing	60%
Logistics	55%
Administrative	75%

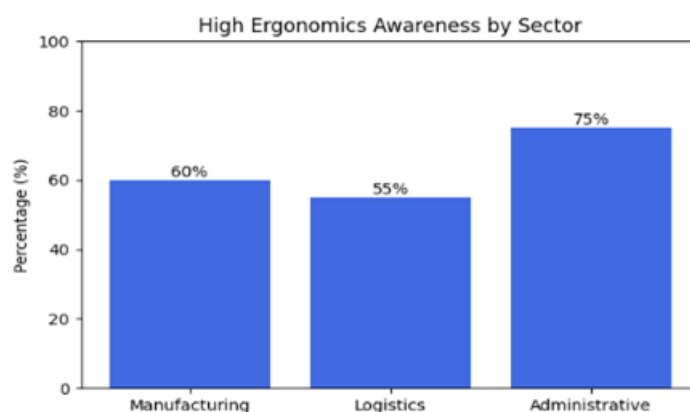


Figure 9: Ergonomics Awareness

The table shows that administrative employees have the highest awareness of ergonomics practices (75%), followed by manufacturing (60%), and logistics (55%). This suggests communication and training gaps in logistics and manufacturing, which could help meet administrative safety standards, reduce risks, and improve outcomes.

CONCLUSION

The study reveals a strong negative correlation between ergonomic implementation and workplace injury rates across manufacturing, logistics, and administrative sectors. It emphasizes the importance of continuous ergonomic assessment and intervention, emphasizing the need for tailored workstation design, equipment upgrades, employee training, and policy enforcement.

FUTURE SCOPE

Future research on the correlation between ergonomic practices and workplace injury rates can explore several promising directions:

1. **Integration of Advanced Technologies:** Use of AI, VR, AR, IoT, and wearable sensors for real-time monitoring and predictive injury prevention.
2. **Longitudinal and Experimental Studies:** Conducting long-term studies to establish causal relationships between ergonomic interventions and reduced injury rates.
3. **Sector-Specific Solutions:** Developing customized ergonomic strategies for industries like manufacturing, IT, healthcare, logistics, and construction.
4. **Economic Impact Analysis:** Evaluating cost-benefit aspects of ergonomic interventions to improve organizational decision-making.
5. **Cognitive and Psychosocial Ergonomics:** Studying the effects of stress, mental fatigue, and workload on workplace safety.
6. **Remote and Hybrid Work Models:** Investigating ergonomic risks in work-from-home setups and proposing effective solutions.
7. **Policy Development:** Formulating sector-wise ergonomic guidelines and safety standards at national and global levels.
8. **Global and Cross-Cultural Studies:** Comparing ergonomic practices and injury trends across countries to design globally adaptable strategies.
9. **Predictive Analytics and Machine Learning:** Using big data to forecast injury risks and develop proactive safety measures.
10. **Employee Training and Awareness:** Designing effective training programs to promote ergonomic behavior and improve workplace safety.

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