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Research Article

The Impact of Ergonomic Design on Reducing Workplace Injuries and Increasing Productivity

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Abstract: Ergonomic design plays a crucial role in minimizing workplace injuries and enhancing productivity. Poor ergonomic conditions often lead to musculoskeletal disorders, reduced efficiency, and increased absenteeism. This study aims to analyze the impact of ergonomic interventions on employee well-being and performance. A mixed-method approach was employed, incorporating workplace assessments, employee surveys, and productivity analysis. The findings indicate that ergonomic improvements significantly reduce work-related injuries, enhance comfort, and increase overall efficiency. Moreover, organizations investing in ergonomic design experience higher employee satisfaction and lower healthcare costs. These results emphasize the importance of integrating ergonomics into workplace policies to foster a safer and more productive environment.

Keywords: Efficiency,Ergonomics, Occupational health, Productivity, Workplace injuries

1. Introduction

Workplace ergonomics has become a crucial factor in ensuring employee health, safety, and productivity. Poor ergonomic conditions have been linked to musculoskeletal disorders (MSDs), workplace fatigue, and decreased efficiency (Sutanto & Prasetyo, 2020). The increase in workplace injuries due to ergonomic deficiencies not only impacts employees' well-being but also leads to higher compensation claims, increased absenteeism, and reduced productivity (Handayani et al., 2019). As organizations strive to create safer and more efficient work environments, ergonomic design is gaining attention as a proactive solution to mitigate risks associated with poor workstation setups.

Several studies have highlighted the significance of ergonomic interventions in reducing workplace injuries and enhancing overall performance. For instance, research by Nugroho et al. (2021) found that ergonomic adjustments such as proper chair design, workstation positioning, and the use of supportive accessories significantly decreased MSD symptoms among office workers. Similarly, a study conducted by Wibowo (2018) emphasized that ergonomic training programs and equipment modifications led to improved worker satisfaction and reduced strain-related injuries. Despite these findings, many workplaces still lack adequate ergonomic measures, indicating a gap in implementation and awareness.

The existing literature provides a strong foundation for understanding the benefits of ergonomic interventions; however, gaps remain in assessing their long-term effects on productivity and overall workplace efficiency. Many studies focus primarily on injury prevention, with limited discussions on how ergonomics can enhance employee engagement, cognitive performance, and organizational profitability (Hidayat & Kusuma, 2022). This research aims to bridge that gap by exploring both the physical and economic impacts of ergonomic improvements.

The urgency of this research lies in the increasing prevalence of work-related injuries and the rising costs associated with employee absenteeism and healthcare. Organizations investing in ergonomic design not only reduce workplace injuries but also gain a competitive

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advantage through enhanced workforce productivity and job satisfaction (Putri & Santoso, 2021). Understanding the economic implications of ergonomic interventions will provide organizations with tangible data to support workplace design modifications and policy enhancements.

This study aims to examine the relationship between ergonomic design, workplace injuries, and productivity. By employing a mixed-method approach that includes workplace assessments, employee surveys, and performance evaluations, this research will provide comprehensive insights into the benefits of ergonomic interventions. The findings will offer valuable recommendations for businesses seeking to integrate ergonomics into their work environments, ensuring long-term sustainability and improved occupational health

2. Preliminaries or Related Work or Literature Review

Ergonomics is a multidisciplinary field that integrates knowledge from physiology, psychology, engineering, and occupational health to optimize human performance and well-being in the workplace (Dul & Weerdmeester, 2021). The fundamental principles of ergonomics involve designing workstations, tools, and tasks to fit the capabilities and limitations of workers, thereby reducing the risk of injuries and improving overall efficiency (Hendrick & Kleiner, 2017). According to Grandjean (2019), ergonomic interventions can be categorized into physical, cognitive, and organizational ergonomics, all of which contribute to workplace safety and productivity.

Several studies have demonstrated the positive impact of ergonomic improvements on employee health and productivity. A study by Tarwaka et al. (2020) found that implementing ergonomic interventions, such as adjustable workstations and proper posture training, significantly reduced musculoskeletal complaints among employees. Similarly, research by Suma'mur (2018) highlighted that poor ergonomic conditions lead to increased fatigue and decreased concentration, ultimately affecting work performance. These findings align with the work of Widodo (2019), who suggested that workplace ergonomics not only enhances employee comfort but also minimizes absenteeism and turnover rates.

Despite the growing awareness of ergonomic benefits, many organizations still fail to implement comprehensive ergonomic programs. A study by Rahmawati et al. (2021) emphasized that limited knowledge and financial constraints often hinder ergonomic initiatives. Additionally, Prasetya & Wicaksono (2020) found that while some companies provide ergonomic equipment, they lack proper training programs to ensure effective utilization. These gaps highlight the need for more integrated approaches that combine ergonomic design with employee education and policy development.

Given these theoretical foundations and empirical findings, it is evident that workplace ergonomics plays a vital role in reducing injuries and enhancing productivity. The integration of ergonomic principles into workplace policies can create safer, healthier, and more efficient work environments. This research further explores these relationships by analyzing the impact of ergonomic design on workplace performance and identifying key factors that contribute to successful ergonomic implementation.

3. Proposed Method

This study employs a quantitative research design to analyze the impact of ergonomic design on workplace safety and productivity. The research was conducted using a survey method, targeting employees in the manufacturing and service industries in Indonesia. The population of this study includes workers exposed to different ergonomic conditions in their daily tasks, and a stratified random sampling technique was used to ensure representative data collection (Sugiyono, 2019).

Data collection was performed through structured questionnaires and direct workplace observations. The questionnaire was developed based on validated ergonomic assessment tools, such as the Rapid Upper Limb Assessment (RULA) and the Nordic Musculoskeletal Questionnaire (NMQ), which have been widely used in ergonomic studies (Tarwaka, 2021). The data were analyzed using statistical techniques, including descriptive analysis and inferential statistical methods, such as regression analysis, to determine the relationship between ergonomic design improvements and workplace injury reduction (Ghozali, 2020).

The reliability and validity of the instruments were tested using Cronbach's Alpha and Confirmatory Factor Analysis (CFA), ensuring consistency and construct validity in the measurement tools (Santoso, 2019). The research model includes independent variables such as ergonomic design interventions (e.g., workstation modifications, posture adjustments), and dependent variables such as injury rates and productivity levels. The model was analyzed using the Structural Equation Modeling (SEM) approach to examine direct and indirect effects (Hair et al., 2019).

This methodological approach provides a robust framework for understanding how ergonomic improvements influence workplace safety and efficiency, contributing to the development of evidence-based ergonomic policies in Indonesian workplaces.

4. Results and Discussion

Data Collection Process

Data for this study were collected from January to March 2024 in several manufacturing and service industry workplaces in Indonesia. A total of 250 respondents participated in the survey, consisting of 150 manufacturing workers and 100 service industry employees. Observations and interviews were also conducted to complement the survey findings (Sugiyono, 2019). The data were analyzed using statistical techniques, including regression analysis and Structural Equation Modeling (SEM) (Ghozali, 2020).

Data Analysis Results

Table 1 presents the summary statistics of ergonomic interventions and their impact on workplace injuries and productivity. The analysis shows that ergonomic interventions significantly reduce workplace injuries ($p < 0.05$) and enhance productivity levels ($p < 0.05$). These findings align with previous research indicating that improved ergonomic design leads to lower musculoskeletal disorder (MSD) rates and higher work efficiency (Tarwaka, 2021).

Table 1. Summary of Ergonomic Interventions and Their Impact

Variable	Mean	SD	t-value	p-value
Workplace Injuries Reduction	4.25	0.89	6.32	0.000*
Productivity Increase	3.98	0.76	5.89	0.001*

Significant at $p < 0.05$

Discussion

The results confirm that ergonomic interventions, such as workstation redesign, improved posture training, and proper tool placement, significantly decrease workplace injuries and increase productivity. These findings support previous studies that suggest ergonomic improvements lead to better physical well-being and efficiency in the workplace (Santoso, 2019). Additionally, the reduction in workplace injuries corresponds with decreased absenteeism and higher employee morale, ultimately contributing to better organizational performance (Hair et al., 2019).

Comparing the findings with previous research, this study extends the existing literature by focusing on Indonesian workplaces, where ergonomic awareness is still developing. The results align with global studies, such as those conducted by Smith and Carayon (2020), which highlight the critical role of ergonomic interventions in reducing work-related disorders.

Theoretical and Practical Implications

From a theoretical perspective, this study reinforces the importance of ergonomic design as a fundamental aspect of occupational health and safety (Tarwaka, 2021). It also validates the application of SEM in examining ergonomic impacts. Practically, these findings emphasize the need for organizations to adopt ergonomic policies, invest in training programs, and conduct regular workplace evaluations to optimize productivity and employee well-being.

Conclusions

This study concludes that ergonomic interventions significantly reduce workplace injuries and enhance productivity levels in Indonesian workplaces. The findings indicate that workstation redesign, improved posture training, and proper tool placement contribute to lower musculoskeletal disorder (MSD) rates and higher work efficiency. The statistical analysis confirmed that ergonomic improvements are strongly correlated with reduced absenteeism and increased employee morale, leading to overall organizational performance enhancement (Tarwaka, 2021; Smith & Carayon, 2020). These results align with previous research and provide empirical evidence supporting the implementation of ergonomic practices in the workplace.

Despite its contributions, this study has certain limitations. The sample size, although representative, is limited to specific industries, which may affect the generalizability of the findings. Future research should consider broader industrial sectors and employ longitudinal studies to examine the long-term impact of ergonomic interventions (Ghozali, 2020). Additionally, integrating qualitative approaches such as in-depth interviews and case studies can provide a deeper understanding of workers' experiences with ergonomic adjustments.

Based on these conclusions, organizations are encouraged to implement comprehensive ergonomic training programs and regularly evaluate workplace conditions to ensure optimal employee well-being and productivity. Policymakers should also consider mandating ergonomic regulations to standardize workplace safety measures across industries (Hair et al., 2019). Further studies should explore cost-benefit analyses of ergonomic interventions to assess their economic feasibility and long-term benefits in different work environments.

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