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Ergonomic Analysis to Assess Comfort and Risk of Musculoskeletal Injuries in Office Workers at PT X Using Rosa's Method

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Abstract

This study aims to analyze the level of workplace comfort and the risk of musculoskeletal injuries among office workers at PT X using the Rapid Office Strain Assessment (ROSA) and Nordic Body Map (NBM) methods, as well as to examine the relationship between working posture and MSD complaints. This study uses a quantitative descriptive design with a cross-sectional approach involving 50 respondents. The results indicate that most employees are categorized as having a moderate ergonomic risk (ROSA score 4-5), while a small portion has a high ergonomic risk (score 5). Based on the NBM results, most workers experience mild to moderate musculoskeletal complaints, particularly in the neck, shoulders, lower back, and wrists. The main factors contributing to ergonomic risk are non-adjustable office chairs and desks, as well as prolonged static working postures. Overall, the ergonomic conditions at PT X are relatively good. However, improvements in workstation facilities and increasing workers' awareness of ergonomic principles are necessary to reduce the risk of musculoskeletal injuries and enhance workplace comfort. As a large-scale plantation company, PT X faces a high potential risk of Musculoskeletal Disorders (MSDs) among its employees. This risk primarily stems from the nature of the work, which often requires repetitive or static activities.

Keywords: *Ergonomics, Musculoskeletal disorders, Office workers, ROSA*

INTRODUCTION

Occupational Health and Safety (OHS) is an essential component of workforce management and overall organizational performance. OHS is not only a responsibility shared by employees but also an obligation that organizations must fulfill to ensure safe and efficient work conditions. It is also a fundamental right of workers, particularly in relation to ergonomics, which plays a crucial role in reducing injury risks and improving worker well-being. Proper ergonomic implementation can increase productivity, enhance morale, decrease injury rates, reduce absenteeism, and minimize turnover. This importance is further emphasized through the Ministry of Health Regulation PMK No. 48 of 2016, which outlines OHS standards for office environments, including occupational safety, occupational health, environmental health, and ergonomics.

The application of ergonomic principles is vital for creating a safe, comfortable, and efficient work environment. Ergonomically designed workspaces can reduce fatigue, prevent injuries, and improve both physical and mental well-being. Moreover, involving employees in ergonomics implementation fosters a sense of ownership and greater engagement in workplace improvements. Such an approach helps organizations build

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a work environment that supports higher productivity and enhanced work quality.

Field observations and interviews revealed that the company faces several ergonomic-related issues that pose risks to workers' health, particularly musculoskeletal disorders (MSDs). These problems commonly arise from prolonged static postures, such as continuous sitting or maintaining the same position for long periods. Poor workspace design, the use of non-adjustable equipment, and repetitive tasks further exacerbate these conditions. The consequences include muscle tension, back pain, reduced comfort, and decreased work efficiency.

Modern office environments, characterized by intensive computer use, increase the risk of MSDs. Employees frequently sit for extended periods and adopt improper postures, which may harm the musculoskeletal system and lead to long-term health issues. Previous research has shown that non-ergonomic computer use is associated with higher incidences of neck, shoulder, and back pain. In addition, psychosocial factors, work organization, individual characteristics, and physical environmental conditions can intensify MSD risks (Aprianto et al., 2021).

Globally, Work-Related Musculoskeletal Disorders are among the leading causes of disability. The Global Burden of Disease (GBD) data indicates that 16% of all MSD cases contribute to global disability rates (WHO, 2019). Studies in Germany and the United States show high MSD prevalence among computer users. In Indonesia, 40.5% of occupational diseases are MSD-related, with the highest incidence reaching 16% (BPS, 2019). The 2018 National Basic Health Research (Riskesdas) also found that 7.3% of Indonesians aged 15 years and above experience musculoskeletal disorders. A study by Putsa et al. (2020) reported that 37.9% of regular computer users who work more than four hours per day experience complaints in the neck, shoulder, and back due to prolonged static posture.

Effective ergonomic implementation requires a comprehensive approach that considers not only physical workspace design but also job structure, work distribution, workload control, and adequate training. Unfortunately, many organizations still do not consider ergonomics and OHS as primary priorities, often due to the misconception that ergonomic improvements require substantial financial investment. In reality, employees are valuable organizational assets, and ensuring their well-being is a critical investment to enhance productivity and maintain optimal work performance (Omry Pangaribuan et al., 2022).

Tarwaka et al. (2004) emphasized that non-ergonomic postures, repetitive movements, and excessive muscle exertion can cause MSDs. Additional factors such as vibration, pressure, and environmental conditions may further increase risks when experienced simultaneously. Individual factors including age, physical strength, smoking habits, and anthropometric

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characteristics also influence susceptibility to MSDs. Similar findings were reported by Siregar (2020) and Astuti, who observed that poor work posture significantly contributes to musculoskeletal complaints. Although previous studies have extensively examined the relationship between ergonomic conditions, work posture, and MSD risks, limited research has specifically analyzed ergonomic conditions within the targeted office environment using direct observation, interviews, and ergonomic risk assessment methods. Additionally, few studies offer practical, workplace-specific ergonomic recommendations tailored to the characteristics and work patterns of the organization under study.

Previous ergonomics research generally only focused on work posture, without delving deeply into how the limitations of non-adjustable work facilitiessuch as chairs, desks, and static monitorscan increase the risk of musculoskeletal disorders (MSD). In fact, the lack of adjustability in work facilities is one of the main causes of non-ergonomic work postures. The limited research analyzing the direct relationship between the inability of equipment to be adjusted and high ROSA scores represents an important gap. The findings of this study, that most work facilities are not adjustable, contribute new insights by showing that ergonomic facilities play a significant role in reducing the risk of poor work posture.

This study aims to analyze the ergonomic conditions in the workplace and identify musculoskeletal disorder (MSD) risks, as well as to propose appropriate ergonomic improvements to enhance worker health, comfort, and productivity.

METHOD

This study employed a quantitative analytical study with a cross-sectional design. The cross-sectional approach was selected because it allows the researcher to measure ergonomic risk factors (ROSA scores) and musculoskeletal disorder (MSD) complaints at a single point in time. This design is efficient, cost-effective, and commonly used to determine associations between risk factors and health outcomes among workers. The research was conducted at ptpn, an office-based work environment where employees perform daily computer-based tasks.

Data collection was carried out during the period of 1 month, which included observations, questionnaire distribution, and ergonomic assessments using the ROSA method. The study population consisted of 50 respondents at PT X who use computers for at least 4 hours per day. The analysis in this study used the chi-square method to determine whether there is an association between work posture and musculoskeletal disorder (MSD) complaints.

A total sampling technique was applied, meaning that all eligible employees who met the inclusion criteria were included as research subjects. This technique was chosen because:

1. The population size was manageable;

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2. All workers were exposed to similar ergonomic conditions;
3. It increased the accuracy and representativeness of the findings.

Inclusion Criteria, participants were included if they met the following criteria: Full-time office employees at PT X, Routinely use a computer for ≥ 4 hours per day, Willing to participate by completing both the ROSA assessment and the questionnaire.

Exclusion Criteria, participants were excluded if they: Had a documented history of musculoskeletal injury unrelated to work, Were on long-term sick or medical leave during the study period. Did not complete the assessment forms or questionnaire.

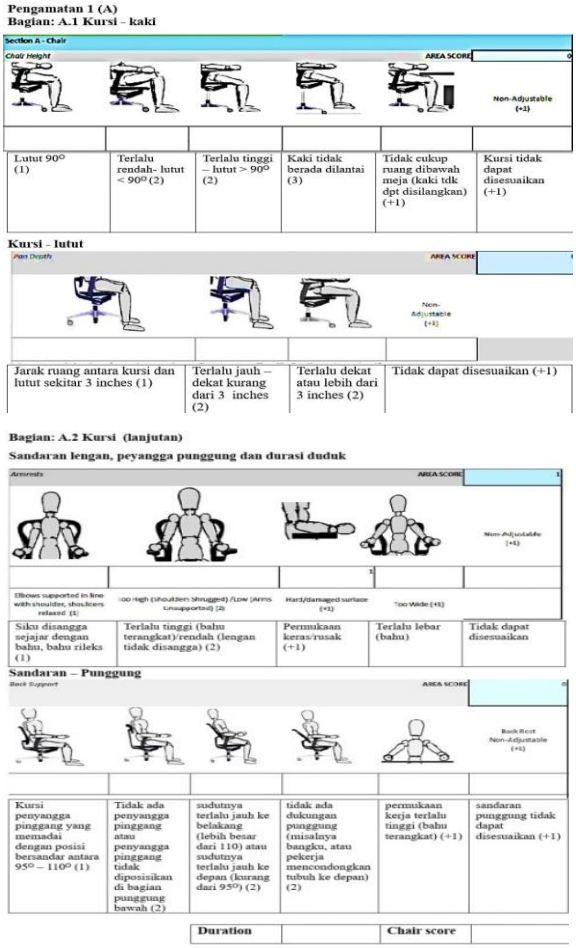

Figure 1. Form observation part A

Part B: Evaluating use of monitors and telephone by employees, including monitor position to eyes, settings monitor lighting, range telephone, and technique answer. Form observations that have been filled shown on image below This.

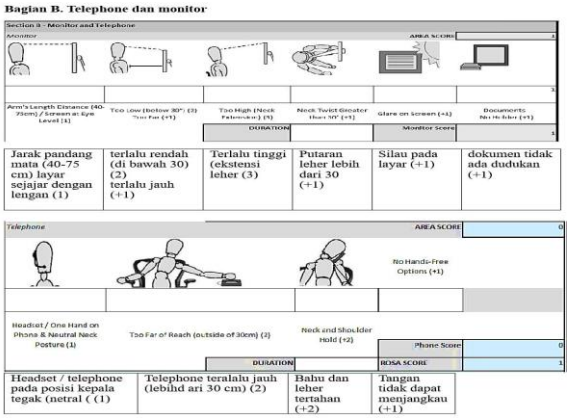

Figure 2. Form observation part B

Part C: Evaluating use mouse And board type , including placement mouse And board type during work, and position hand moment use mouse And board type. Form necessary observations shown on image below This.

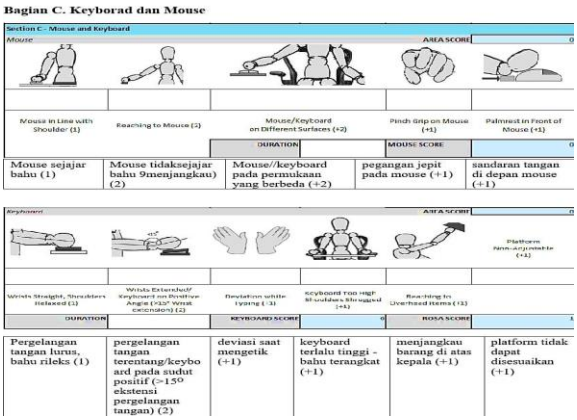

Figure 3. Form observation part C

Evaluation end determined with add up score from parts B and C, namely part mouse And board type as well as monitor section and telephone. Results evaluation from parts B and C (Monitor and Peripherals) will combined with score from

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Part A (chair) for get score end of ROSA. Diagram below This illustrate the assessment process end use ROSA method.

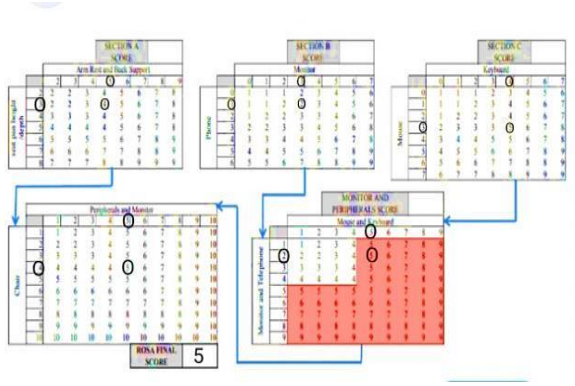

Figure 4. Diagram of the final ROSA score determination process based on the assessment of parts A, B, and C"

The final ROSA assessment results will be categorized based on the level of ergonomic risk, as follows:

1. Low risk with a final ROSA score of 1-2.
2. Moderate risk with a final ROSA score of 3-4.
3. High risk with a final ROSA score of 5-7.
4. very high with a final ROSA score of 8-10.

RESULTS AND DISCUSSION

Research results based on observations, interviews, and ergonomic assessments conducted on 50 employee respondents at PT X are as follows:

Table 1. Frequency distribution of respondent characteristics based on age

No.	Usia	Jumlah Responden	Persentase %
1.	25-35 tahun	7	14%
2.	36-45 tahun	25	50%
3.	46-55 tahun	18	36%
Total		50	100%

From the table above, it can be seen that respondents aged 36 to 55 tend to be more numerous compared to respondents aged between 25 and 35.

Table 2. Frequency distribution of respondent characteristics based on length of service.

No.	Masa Kerja	Jumlah Responden	Persentase %
1.	< 10 tahun	14	28 %
2.	> 10 tahun	36	72 %
Total		50	100 %

Based on the table above, it can be seen that the majority of respondents have a fairly long tenure at PTPN IV Regional I, namely more than 10 years, totaling 36 people. This indicates that most workers have considerable work experience in that environment.

Table 3. General overview of respondent frequency distribution based on the results of the nordic body map assessment.

No.	Kategori NBM	Jumlah Responden	Persentase
1.	Rendah	10	20 %
2.	Sedang	24	48 %
3.	Tinggi	16	32 %
Total		50	100%

Based on the Results of the Nordic Body Map Assessment. Based on the analysis from Table 3 regarding the distribution of respondent frequencies according to the results of the Nordic Body Map (NBM) assessment, it is known that: 10 respondents (20%) fall into the low-risk category, 24 respondents (48%) fall into the medium-risk category, and 16 respondents (32%) fall into the high-risk category for musculoskeletal complaints. These results indicate that most employees work with relatively safe postures, but there are still some employees at medium to high risk of experiencing muscle complaints, particularly in the neck, back, shoulders, and wrists.

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Table 4. Overview of respondent frequency distribution based on final rosa score assessment results

No.	Level Risiko Ergonomi	Skor Akhir ROSA	Jumlah Responden	Persentase %
1.	High risk	5	24	48 %
2.	Medium risk	4	15	30 %
3.	Medium risk	3	8	16 %
4.	Low risk	2	3	6 %
Total			50	100 %

Based on the final ROSA (Rapid Office Strain Assessment) risk scores used to determine the level of ergonomic risk in the office environment of PT X, it was found that most employees were within the score range of 5. A total of 24 respondents (48%) obtained a score of 5, which is categorized as a high ergonomic risk. This condition indicates that the working positions or workstation layouts in this group require immediate improvement and adjustment to reduce the potential for injury or work-related discomfort. Furthermore, 15 respondents (30%) obtained a score of 4. This result shows that the jobs within this category have a low to moderate ergonomic risk level, meaning that immediate workstation corrections are not urgently required. Meanwhile, 8 respondents (16%) scored 3, which also falls into the low to moderate risk category and therefore does not require immediate corrective action. Lastly, 3 respondents (6%) obtained a score of 2, indicating the lowest ergonomic risk level, and no workstation improvements are needed in the near future for this group.

Overall, these assessment results illustrate that most employees at PT X work under ergonomic conditions that are relatively adequate, although there remains a significant portion who require attention and adjustments to reduce higher ergonomic risks.

Table 5. Relationship between work posture position and musculoskeletal disorder complaints

Variabel	Rendah		Sedang		Tinggi		Total		P value
	n	%	n	%	n	%	N	%	
Sedang	10	90,9%	1	9,1%	0	0%	11	100%	0,001
Tinggi	0	0%	23	59 %	16	41%	39	100%	
Total	10	20 %	24	48 %	16	32%	50	100%	

The results of the statistical test show that a p-value of 0.001 was obtained, which is smaller than 0.05, meaning there is a significant relationship at a 95% confidence level (α = 5%) between work posture and musculoskeletal disorder complaints. Therefore, it can be concluded that non-ergonomic work posture affects the occurrence of musculoskeletal disorder complaints among employees. Consequently, improvements and monitoring of work posture are necessary to minimize the risk of musculoskeletal disorders.

Based on the results of the study conducted at PT X, there was a significant relationship between work posture and musculoskeletal complaints, with a p-value of 0.001. This indicates that the poorer a person's work posture is, the higher the likelihood of experiencing musculoskeletal disorders (MSDs). This finding is consistent with ergonomic theory, which explains that non-neutral postures such as bending forward, looking upward, or reaching too far while working can increase strain on the musculoskeletal system. Therefore, this study scientifically demonstrates that work posture is a critical factor that must be improved to reduce the risk of

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musculoskeletal complaints in the workplace.

Overall, the study findings show that although the ergonomic conditions at PT X are generally considered adequate, a substantial proportion of employees remain at risk of developing musculoskeletal disorders. This condition is primarily caused by non-ergonomic work facilities, long durations of exposure due to extended work experience, and improper body positions while working. Thus, efforts to improve workstation design, provide adjustable work equipment, and enhance employee awareness through education on proper working posture are necessary to minimize risks and improve comfort and productivity in the workplace.

The ergonomic factors identified through the ROSA assessment show that most of the work facilities at PT X do not adequately support optimal working posture. The most influential findings contributing to the high ROSA scores include chairs that cannot be adjusted, where 83% of chairs lack adjustable seat height, 96% lack adjustable armrests, and 78% do not have adjustable backrests. This lack of adjustability forces workers to adapt their bodies to non-ergonomic seating conditions. In addition, observations revealed that 30% of workstations had desks cluttered with stacked documents, 91% of employees did not have hands-free options for telephone use, and 87% of keyboard trays could not be adjusted.

These conditions collectively indicate that several aspects of the workstation do not fully support ergonomic principles, thereby increasing the risk of non-neutral postures and musculoskeletal complaints.

The results of this study have several important implications for the company. The non-ergonomic workstation conditions such as chairs and desks that cannot be adjusted and the improper placement of work equipment show that the company needs to improve its facilities so employees can work more comfortably and safely. If left unaddressed, musculoskeletal complaints among employees may increase and negatively impact their health. This issue not only affects the workers but also the company, as it can lead to reduced productivity, higher absenteeism, and lower work quality. In addition, the company may face extra costs related to medical treatment or compensation due to these complaints.

Therefore, the company needs to pay more attention to ergonomic aspects by providing adjustable chairs, rearranging monitor and keyboard positions, and offering education on proper working posture. Through these improvements, the company can protect employee health while also increasing overall performance and work efficiency.

This study has several limitations. First, the ergonomic assessment relied on observations and questionnaires, which may be influenced by respondent subjectivity. Second, the methods used ROSA and the Nordic Body Map provide general assessments and do not capture more detailed posture analysis. Third, the study was conducted at a single location with a

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limited number of respondents, so the findings may not represent all work units. Additionally, other factors such as stress, exercise habits, and individual health conditions were not examined in depth. Therefore, further studies are needed to obtain a more comprehensive understanding.

CONCLUSION

This study shows that there is a significant relationship between work posture and musculoskeletal disorders (MSDs) among employees at PT X, where most workers fall into the moderate to high ergonomic risk categories. This condition is primarily caused by non-ergonomic and non-adjustable work facilities. The findings imply that PT X needs to improve ergonomic workstation design, provide proper posture training, and schedule micro-breaks to reduce muscle strain. Recommendations include adjusting chair and desk heights, optimizing monitor placement, and conducting routine ergonomic evaluations. This study has several limitations, including the use of observational and questionnaire-based methods that may introduce subjectivity, a limited study setting, and the exclusion of other influencing factors such as stress and physical activity habits. Further research is needed to obtain more comprehensive and robust results.

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