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Work Posture Analysis and Potential Ergonomic Hazards Evaluation: Case at PT Pertamina Patra Niaga RJBT 4 Semarang

Lintang Ayu Karisma Dewi[1], M. Mujiya Ulkhaq[2*]
Universitas Diponegoro, Indonesia[1-2]
Corresponding email: ulkhaq@live.undip.ac.id

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ABSTRACT

PT Pertamina Patra Niaga Region Central Java (RJBT) 4 is responsible for monitoring, inspecting, and reviewing operations across Central Java and DIY. Among its functions, the health, safety, security, and environment (HSSE) team primarily conduct activities that require prolonged computer use, resulting in workers maintaining static postures for 8 hours a day, 5 days a week—posing a risk for musculoskeletal disorders (MSDs). This study analyzed workers' postures and ergonomic risks using the rapid office strain assessment (ROSA), quick exposure check (QEC), and Indonesian National Standard (SNI) 9011:2021. Results showed that 10 out of 11 workers scored 6 on ROSA, and one scored 7, while 9 workers were classified at action level 3 and 2 at level 4 according to QEC. Based on these findings, recommendations include improving work postures per SNI 9011:2021 and Ministry of Health Regulation No. 48 of 2016, upgrading workstations with ergonomic chairs, footrests, and mouse pads, and fostering healthy habits aligned with Ministry of Health and Ministry of Manpower regulations. Additionally, implementing educational interventions such as awareness posters is suggested to enhance office ergonomics, promoting worker safety and comfort.

Introduction

Occupational safety and health (OSH) plays a critical role in providing protection against workplace hazards, ensuring that all individuals in the work environment remain safe and healthy (Putri & Ulkhaq, 2017a, 2017b; Simbolon, 2024). OSH directly impacts employee effectiveness and productivity, which in turn influences organizational success (Wibowo, 2022; Nugroho & Ratnawati, 2021).

Office ergonomics, which concerns the design of the work environment and tools such as computers and chairs, is essential in preventing work-related injuries (Dewi & Pramono, 2022). Prolonged non-ergonomic postures and static positions commonly lead to musculoskeletal disorders (MSDs)—conditions characterized by pain and damage to joints, ligaments, and tendons (Megawati et al., 2021). MSDs

are the leading cause of workplace-related morbidity, contributing significantly to occupational health burdens (Dwiseli et al., 2023). According to the Indonesian Statistics, MSDs affected 16% of 9,482 workers surveyed in 12 districts/cities in Indonesia. The International Labour Organization estimates that the economic loss associated with these disorders amounts to approximately $14,726 annually, or 150 million rupiah (Putri et al., 2023).

PT Pertamina Patra Niaga Regional Central Java (RJBT) 4 is responsible for monitoring, inspecting, and reviewing operations across multiple locations within Central Java and Yogyakarta. One of its key functions is health, safety, security, and environment (HSSE), which comprises five divisions: Fire & Safety/Ops, Environment, Geosecurity, Marketing Support/Channel, and Planning & Evaluation. The HSSE function mainly conducts monitoring, field controls, policy enforcement, and document and infrastructure reviews (e.g., fire extinguishers, hydrants, medical supplies). While field controls involve active physical tasks, many HSSE activities are computer-based, requiring workers to maintain static postures for 8 hours a day, five days a week. Initial observations and interviews with two HSSE employees revealed complaints of pain in the neck, shoulders, hands, hips, and feet after work.

This study aims to conduct an in-depth analysis of the work postures and ergonomic risks faced by HSSE workers using the rapid office strain assessment (ROSA), quick exposure check (QEC), and Indonesian National Standard (SNI) 9011:2021. Preliminary results indicate that all respondents scored above 5 on the ROSA scale, placing them in a high-risk category. Furthermore, QEC classified most respondents at action levels 3 and 4, signaling the need for further evaluation and immediate intervention.

Previous studies have combined work posture analysis methods to improve risk assessment accuracy. Simanjuntak and Susanto (2020) applied both ROSA and the Nordic Body Map (NBM) to analyze work postures of PT Pertamina EP office workers, achieving high segmentation accuracy with 27 respondents. However, their study acknowledged limitations in considering multiple perspectives. Dewi and Pramono (2022) combined ROSA and QEC methods to assess customer service officers at the PLN Mampang Contact Center. Their findings included risk scores and facility improvement recommendations, though suggestions focused primarily on physical equipment without addressing behavioral factors. Despite these advances, existing research often lacks regulatory grounding for ergonomic posture standards and frequently overlooks a comprehensive evaluation from multiple viewpoints. This study then seeks to address these gaps by integrating

standardized assessments and contextual regulations to better understand ergonomic risks in office environments.

Method

This study was conducted by analyzing using ROSA, QEC, and SNI 9011:2021 methods to address complaints experienced by workers in the body parts that are felt. By conducting this study, we can obtain more in-depth analysis results related to the condition of worker posture and the factors that influence the complaints felt by workers.

ROSA is a standardized ergonomic assessment tool designed to evaluate the risk of MSDs in office workers, particularly those engaged in computer-based tasks (Limbong & Ulkhaq, 2024). ROSA focuses on identifying ergonomic risk factors related to the workstation, including chair design, monitor height, keyboard and mouse position, and overall posture. By scoring these factors, ROSA provides a risk level that helps prioritize interventions to reduce strain and improve workplace ergonomics.

QEC is an observational method used to assess workers' exposure to risk factors associated with MSDs. It evaluates body postures, repetitive movements, force exertion, vibration, and work pace across different body regions. QEC results classify exposure into action levels, ranging from low risk (requiring no action) to high risk (requiring immediate intervention), allowing organizations to identify critical ergonomic hazards efficiently.

SNI 9011:2021 is the Indonesian National Standard that outlines the requirements for ergonomic principles in workplace design and management, particularly in office settings. It provides guidelines for safe and healthy work postures, workstation design, and environmental factors to prevent occupational illnesses such as MSDs. Compliance with SNI 9011:2021 ensures that workplaces meet national ergonomic standards aimed at safeguarding employee health and optimizing productivity.

Results and Discussion

The respondents in this study comprised 11 HSSE personnel, including secretaries and representatives from various divisions: Fire & Safety/Ops, Environment, Geosecurity, Marketing Support/Channel, and Planning & Evaluation.

Table 1 presents the final ROSA assessment results for the respondents, based on analysis of documented body postures processed using Ergofellow software alongside the ROSA questionnaire. The ROSA scores for the 11 workers across various divisions within the HSSE function reveal a consistently high level of

ergonomic risk. All respondents scored either 6 or 7 on the overall ROSA scale, corresponding to a "Dangerous" risk level. Specifically, ten workers scored 6, while one worker scored 7. The individual sub-scores, which likely represent factors such as chair and sitting posture (Score A), keyboard and mouse positioning (Score B and C), and monitor and peripheral device setup, showed some variation but remained elevated overall. Scores ranged from 3 to 7 across these components, contributing to the high total risk score. This uniformity of high ROSA scores across all divisions—including Fire & Safety, Geosecurity, Marketing Support, Environment, Planning & Evaluation, and Secretary—indicates that ergonomic risks are systemic rather than isolated incidents. According to ROSA guidelines, scores of 6 and above signal an urgent need for ergonomic interventions to prevent musculoskeletal disorders. Therefore, immediate improvements in workstation design and posture correction are necessary.

Table 1. *ROSA Result*

Worker	Score A	Score B	Score C	Monitor and peripheral	ROSA Score	Level risk
1 (Fire & Safety 1)	6	3	5	5	6	Dangerous
2 (Geosecurity 1)	6	6	5	6	6	Dangerous
3 (Marketing Support 1)	6	3	5	5	6	Dangerous
4 (Environment 1)	6	3	4	4	6	Dangerous
5 (Marketing Support 2)	6	6	5	6	6	Dangerous
6 (Planning & Evaluation 1)	6	4	5	5	6	Dangerous
7 (Secretary)	6	4	4	4	6	Dangerous
8 (Fire & Safety 2)	6	4	4	4	6	Dangerous
9 (Planning & Evaluation 2)	6	5	5	5	6	Dangerous
10 (Geosecurity 2)	7	4	3	4	7	Dangerous
11 (Environment 2)	6	4	5	5	6	Dangerous

QEC data were processed using Ergofellow software, which calculates the exposure level (E) based on Equation (1) where X represents the total QEC score. For static work, the maximum score (X_{max}) is 162, while for dynamic work, it is 176. Since HSSE workers primarily perform static tasks, the X_{max} value of 162 was applied in this analysis. The result is displayed in Table 2.

$$E\ (\%) = (X / X_{max}) \times 100\% \quad (1)$$

Table 2. *QEC Result*

Worker	Exposure level	Action level
1 (Fire & Safety 1)	68,52%	*Action Level* 3
2 (Geosecurity 1)	70,37%	*Action Level* 4
3 (Marketing Support 1)	68,52%	*Action Level* 3
4 (Environment 1)	68,52%	*Action Level* 3
5 (Marketing Support 2)	55,56%	*Action Level* 3
6 (Planning & Evaluation 1)	67,28%	*Action Level* 3
7 (Secretary)	66,67%	*Action Level* 3
8 (Fire & Safety 2)	66,67%	*Action Level* 3
9 (Planning & Evaluation 2)	65,43%	*Action Level* 3
10 (Geosecurity 2)	70,37%	*Action Level* 4
11 (Environment 2)	66,67%	*Action Level* 3

The ergonomic assessment results indicate that all 11 workers are exposed to high levels of ergonomic risk, with exposure percentages ranging from 55.56% to 70.37%. Based on these exposure levels, most workers—nine out of eleven—are classified under Action Level 3, which signals a high risk that necessitates prompt investigation and the implementation of control measures to mitigate potential musculoskeletal disorders. Furthermore, two workers have been categorized under Action Level 4, representing a very high-risk level that requires immediate corrective actions. These findings highlight a pervasive ergonomic hazard within the workplace, emphasizing the urgent need to improve workstation design and work practices to enhance employee health and safety.

Based on the QEC results, further investigation is needed using SNI 9011:2021. In SNI 9011:2021 there is a GOTRAK survey and a list of potential ergonomic hazards. The result is shown in Table 3. The ergonomic assessment of 11 workers using the GOTRAK method reveals varied levels of musculoskeletal strain across different body parts. The data on frequency and severity indicate how often and how intensely each body part experiences discomfort, with the resulting risk level reflecting the overall ergonomic hazard. Notably, the neck and shoulders consistently show elevated risk levels across most workers, with risk scores frequently reaching 4 or higher, highlighting these areas as critical points of concern. Upper back discomfort is also prevalent, with many workers exhibiting moderate risk levels. Workers 2 and 9 show particularly high-risk levels for hips (risk levels of 9 and 5 respectively), suggesting significant strain in the pelvic region. Lower back risk scores vary but generally remain moderate, with some workers reaching risk levels of 4, signaling a need for attention. Other body parts such as elbows, arms, thighs, knees, calves, and legs generally present lower risk levels, typically around 1 or 2, indicating less frequent or severe strain. Overall,

the pattern suggests that static postures and workstation ergonomics predominantly affect the upper body—especially the neck, shoulders, and upper back—while certain individuals experience heightened risks in the hips. These findings underscore the necessity for targeted ergonomic interventions focusing on upper body support and posture correction to reduce musculoskeletal disorder risks among these workers.

Table 3. *GOTRAK Result*

Worker	GOTRAK Category	Body Parts											
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Worker 1	F	2	2	1	2	1	1	1	2	1	2	1	1
	S	2	2	1	2	1	1	1	2	1	2	1	1
	RL	4	4	1	4	1	1	1	4	1	4	1	1
Worker 2	F	2	2	1	2	1	1	2	3	1	1	1	2
	S	2	2	1	2	1	1	2	3	1	1	1	3
	RL	4	4	1	4	1	1	4	9	1	1	1	6
Worker 3	F	1	1	1	2	1	1	1	1	1	1	1	2
	S	1	1	1	2	1	1	1	1	1	1	1	2
	RL	1	1	1	4	1	1	1	1	1	1	1	4
Worker 4	F	1	2	1	2	1	1	2	1	1	1	1	1
	S	1	2	1	2	1	1	2	1	1	1	1	1
	RL	1	4	1	4	1	1	4	1	1	1	1	1
Worker 5	F	2	1	1	2	1	1	1	1	1	2	1	2
	S	1	1	1	1	1	1	1	1	1	1	1	1
	RL	2	1	1	2	1	1	1	1	1	2	1	2
Worker 6	F	2	2	1	2	1	2	1	1	1	1	1	1
	S	2	2	1	2	1	2	1	1	1	1	1	1
	RL	4	4	1	4	1	4	1	1	1	1	1	1
Worker 7	F	2	2	1	1	1	2	1	1	1	1	1	1
	S	2	2	1	1	1	2	1	1	1	1	1	1
	RL	4	4	1	1	1	4	1	1	1	1	1	1
Worker 8	F	2	1	1	1	1	1	1	1	1	1	1	1
	S	2	1	1	1	1	1	1	1	1	1	1	1
	RL	4	1	1	1	1	1	1	1	1	1	1	1
Worker 9	F	3	3	1	2	1	1	3	1	1	1	1	1
	S	3	2	1	2	1	1	2	1	1	1	1	1
	RL	9	5	1	4	1	1	5	1	1	1	1	1
Worker 10	F	1	3	1	2	1	1	1	1	1	1	1	1
	S	1	2	1	2	1	1	1	1	1	1	1	1
	RL	1	5	1	4	1	1	1	1	1	1	1	1
Worker 11	F	2	2	1	2	1	1	1	2	1	1	1	1
	S	2	2	1	2	1	1	1	2	1	1	1	1
	RL	4	4	1	4	1	1	1	4	1	1	1	1

*Note: (1) neck; (2) shoulders; (3) elbow; (4) upper back; (5) arm; (6) lower back; (7) hand; (8) hips; (9) thighs; (10) knee; (11) calves; (12) leg; F: frequency; S: severity; RL: risk level

Discussion

Based on the data collection and analysis of HSSE workers, several improvements are proposed in accordance with SNI 9011:2021, the Ministry of Health Regulation No. 48 of 2016, and the Ministry of Manpower Regulation No. 5 of 2018.

A. Work Posture

Recommendations to improve work posture follow the guidelines of the Ministry of Health Regulation No. 48 of 2016 and SNI 9011:2021. For the head and neck, adjustments include positioning the monitor, so the top of the screen is at eye level, arranging documents parallel to the monitor, and ensuring the workstation allows workers to sit fully back in their chairs with the keyboard placed close enough to maintain a neutral posture. For the shoulders, the mouse and other peripherals should be positioned adjacent to the keyboard at the same height, armrests should support the elbows without elevating them excessively, and chair width should be appropriate for the user. Wrist posture can be improved by removing keyboard support legs and using wrist pads to maintain a straight wrist alignment. Regarding the legs, the chair height should be adjustable to keep knees at approximately a 90-degree angle, with footrests provided if needed to accommodate keyboard height adjustments.

Figure 1. Recommended work posture

B. Work Facilities

An ergonomic chair should fit the worker's body size and be suited to their specific tasks. It must have a stable base with five legs (with or without wheels) and a flexible backrest that supports the lumbar curve, adjustable in height to align with the lower back. The backrest angle should range between 100° and 110° to enhance comfort and prevent lower back pain. Chair seats should provide adequate support, and armrests should reduce pressure on the shoulders and spine. Additional facility improvements include ergonomic chairs as necessary and adding footrests and mouse pads. The chair equipped with adjustable neck rests, armrests, and seats contribute to maintaining proper posture. According to Pexio, ergonomic chairs cost around IDR 3,570,000. Investing in such chairs helps reduce posture deviations by allowing individual adjustments for seat height and armrest position. Footrests (Arkan & Ulkhaq, 2025) help adjust desk height to the worker's comfort and can contribute to ergonomic posture maintenance during work. Mouse pads could help minimize awkward body movements by keeping the mouse closer to the body.

(a) Recommended ergonomic chair (b) Recommended footrest

Figure 2. Recommended work facilities

C. Habits and Physical Work Environment

Workers are encouraged to adopt healthy habits as outlined in Ministry of Health Regulation No. 48 of 2016 and Ministry of Manpower Regulation No. 5 of 2018. These include regular stretching exercises, practicing the 20-20-20 rule (taking a 20-second break every 20 minutes by focusing on an object 20 feet away to reduce eye strain), and awareness of the physical work environment. Optimal office conditions include noise levels below 85 dBA for an eight-hour workday, lighting around 300 Lux, and temperature between 24°C and 27°C. To reinforce these habits, educational posters can serve as visual reminders and

guides for applying ergonomic principles during work. These posters aim to increase worker awareness of simple but effective ergonomic practices. Additionally, top-down communication from management can enhance adherence to ergonomic policies. This involves disseminating guidelines such as scheduled break times (e.g., at 10 a.m.) for workers to engage in activities outside the workspace, helping reduce fatigue and boredom during long work periods (Mulyono et al., 2024).

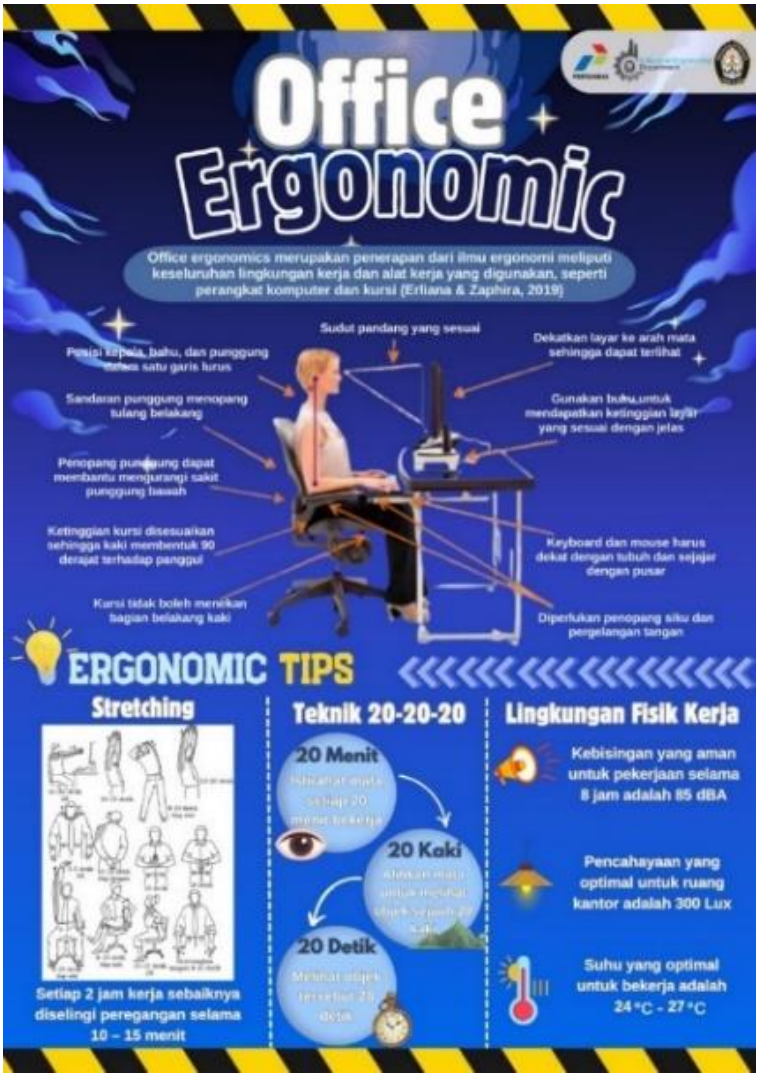

Figure 3. Educational poster

Conclusion

The objectives of this study are to analyze work postures and identify potential ergonomic hazards using the ROSA and QEC methods, alongside the Indonesian National Standard SNI 9011:2021. Worker complaints regarding posture were observed across various workspaces, revealing suboptimal

ergonomic conditions among HSSE employees that contribute to fatigue and musculoskeletal disorders (MSDs). The study found that all workers scored above 5 on the ROSA scale, classifying them as at risk. Additionally, nine workers were categorized at action level 3 and two at action level 4, indicating the need for further investigation and intervention. High-risk body parts identified include the neck, shoulders, hands, hips, and feet. Proposed improvements are categorized into three areas: work posture adjustments, enhancements to work facilities, and modifications to worker habits and the physical work environment. This study serves as an initial assessment of ergonomic risks and work posture analysis. Future steps involve implementing these recommendations to promote a safer and more comfortable working environment for employees.

Declarations

Author contribution.

Lintang Ayu Karisma Dewi – Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing–original draft

M. Mujiya Ulkhaq – Methodology, Supervision, Validation, Writing-review & editing

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