



Research Article

Determinant Factors of Musculoskeletal Disorders among Technical Service Workers at PLN of Malang City

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ABSTRACT

Workers are exposed to various occupational hazards that may lead to occupational diseases (ODs), including musculoskeletal pain resulting from work processes, commonly referred to as musculoskeletal disorders (MSDs). Technical service workers at the State Electricity Company (Perusahaan Listrik Negara/PLN) of Malang City are at risk of experiencing MSDs due to manual handling tasks and individual worker characteristics. This study aims to analyze exposure to MSD risk factors. This quantitative study employs a descriptive-analytical approach and involves a total sample of 26 technical service workers. Data were collected through observations and analysed using observation sheets, work posture assessments based on the Ovako Working Posture Analysis System (OWAS), and the Nordic Body Map (NBM) questionnaire to assess MSD complaints. The findings indicate that the key determinants contributing to MSD complaints among workers include work posture, gender, age, body mass index (BMI), and years of service.

Keywords: risk factors, musculoskeletal disorders (MSDs), technical service workers

INTRODUCTION

Occupational health and safety (OHS) is a condition that must be established in the workplace through all available means, grounded in comprehensive knowledge and understanding, to protect workers, individuals, work outcomes, and organizational culture. This is achieved through the consistent application of accident prevention technologies in accordance with applicable standards and regulations. Occupational health refers to efforts and disciplines aimed at maintaining conditions that may be affected by harmful incidents or circumstances—both physical and psychological—in order to support individuals in working optimally while achieving complete physical, mental, and social well-being (Parashakti & Putriawati, 2020).

Ergonomics is one of the main components of the OHS process, and because worker health has a direct impact on business efficiency, it must be given top priority. Ergonomics is defined as the study of human strengths, weaknesses, and characteristics, and it is applied in the design of equipment, products, buildings, workspaces, and work environments. The primary objective of



ergonomics is to ensure optimal performance compromising human safety, health, or comfort (Krismanto & Hidayat, 2020). To achieve maximum productivity and improve quality of life, a work environment that is safe, comfortable, healthy, appropriate, and efficient is required.

Musculoskeletal diseases (MSDs) may result from non-ergonomic working conditions (Oesman et al., 2019). MSDs range from mild to severe conditions affecting the skeletal muscles and the musculoskeletal system. Injuries may occur to joints, ligaments, and tendons—the tissues that connect muscles to bones—as a result of these conditions, which are often caused by excessive muscle strain and prolonged working hours (Jatmika et al., 2022). MSDs can lead to worker injuries, decreased productivity, and increased labor costs (Jannah, 2021).

According to the International Labour Organization (ILO), the most common occupational diseases health problems worldwide include musculoskeletal disorders (MSDs) (40%), occupational accidents (16%), cardiovascular disease (16%), and respiratory diseases (19%). Data from Indonesia's Ministry of Health, based on the 2018 Basic Health Research (Riskesdas), indicate that the prevalence of MSDs in Indonesia is 7.3%, making them the second most commonly reported condition after influenza (Ajhara et al., 2022). Furthermore, the Ministry of Health's Research Report (2019), shows that the prevalence of MSDs diagnosed by healthcare professionals, is 7.3%, while the prevalence based on self-reported survey diagnoses reaches 24.7%, MSD cases are prevalent across both formal and informal work sectors.

One occupation with a high risk of work-related illnesses, including MSDs, is technical service work at the State Electricity Company (Perusahaan Listrik Negara/PLN). This is because technical service workers perform manual tasks, such as repairing and securing power lines. These activities involve physical labor, which increases the risk of non-ergonomic working postures, leading to early fatigue and various health complaints (Ratu, 2020). Therefore, due to the nature of the work and organizational demands, technical service workers at PLN face a high risk of experiencing occupational health problems.

The researcher conducted a preliminary study and observation involving ten workers at PLN of Malang City. The findings showed that all workers were male and aged between 18 and 49 years. The workers' body mass index (BMI) indicated that 60% were classified as overweight to obese. Field observations revealed that the workers frequently adopted non-ergonomic postures, such as bending and twisting the body, standing for prolonged periods, climbing, and performing repetitive movements (Tarwaka, 2015). The combination of these worker characteristics and non-ergonomic postures indicates the presence of risk factors for MSDs. The risk of MSDs among PLN technical service workers is further supported by a study conducted by Anggun et al. (2024), which found that 65% of MSDs cases were experienced by workers with a BMI above the normal range or classified as obese. Additionally, Fanjaniaina et al. (2022) reported that 87% of respondents experiencing MSDs were adults.

In light of these issues, this study aims to analyze exposure to MSD risk factors. The analysis was conducted systematically with an emphasis on ergonomic principles (Jannah, 2021). Observations and assessments were performed using the Ovako Working Posture Analysis System (OWAS), a method used to evaluate work postures. In addition, the Nordic Body Map (NBM)—an ergonomics questionnaire—was used to identify areas of pain or discomfort in workers' bodies.

The presence of MSD complaints requires serious attention. However, field findings indicate that many workers remain unaware of these disorders and do not perceive them a serious problem requiring intervention. Therefore, based on the results of the preliminary study conducted among PLN Malang City workers, an in-depth analysis of the determinants of MSD complaints is

necessary. This analysis is expected to enable PLN Malang City to reduce the risk of occupational diseases and to help maintain workers' quality of life and company productivity.

MATERIALS AND METHODS

This quantitative study employed a descriptive analytical approach to identify phenomena through the analysis and description of numerical data. The study was conducted in October 2024 at PLN Malang City. A total of 26 respondents were included to obtain an overall representation of the study population. Data were collected using observation sheets, work posture assessments based on the Ovako Working Postures Analysis System (OWAS) conducted across several work positions, and MSD risk assessments using the Nordic Body Map (NBM) questionnaire administered to all respondents. The OWAS and NBM instruments have been internationally validated, and all participants provided informed consent. Data were analyzed using univariate analysis.

RESULTS AND DISCUSSION

Characteristics of the Technical Service Workers at PLN of Malang City

Data were collected on the respondents' characteristics, including gender, age, BMI, and length of employment. The findings are presented below.

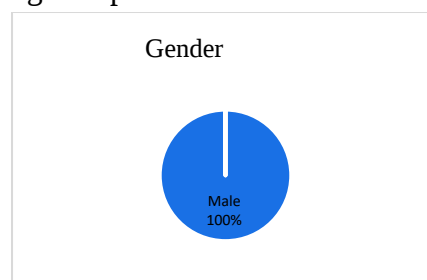


Figure 3.1 Respondents' Gender

As shown in Figure 3.1, all of the workers (100%) were male, with a total of 26 workers.

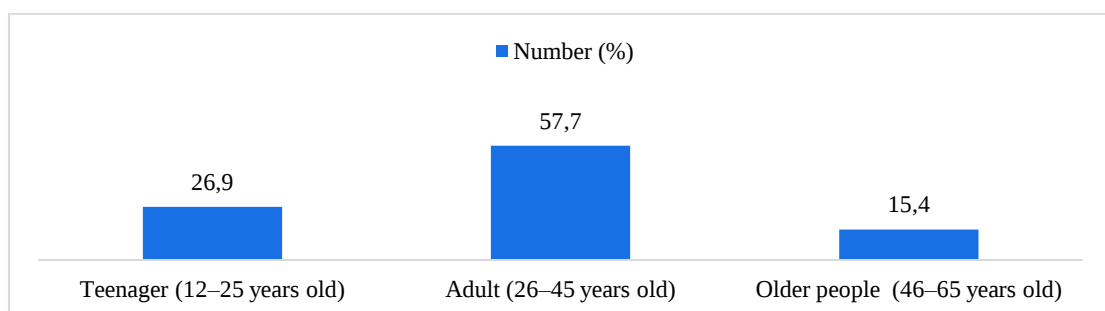


Figure 3.2 Respondents' Age

Referring to Figure 3.2, the respondents were classified into three age groups based on Indah & Junaidi (2021): teenager, adult, and older people. The majority fell into the adult category (ages 26–45), comprising 15 workers (57.7%).

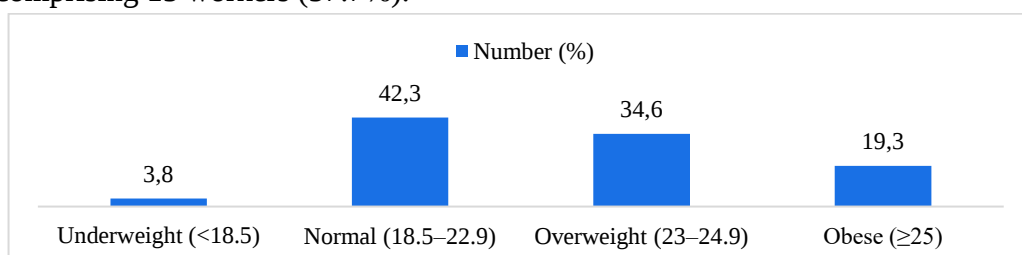


Figure 3.3 Respondents' BMI

According to Figure 3.3, respondents were grouped into four BMI classifications based on WHO standards: underweight (<18.5), normal ($18.5\text{--}22.9$), overweight ($23\text{--}24.9$), and obese (≥ 25). The study found that the majority of respondents—14 workers (53.9%)—had a BMI above the normal range.

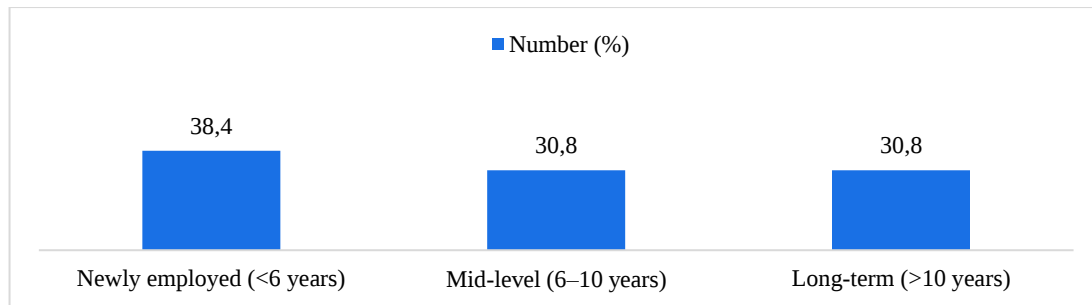


Figure 3.4 Respondents' Length of Employment

Figure 3.4 shows that respondents were grouped into three categories based on Irawan et al. (2023): newly employed (<6 years), mid-level ($6\text{--}10$ years), and long-term (>10 years). A total of 60.2% of respondents had been employed for six years or more.

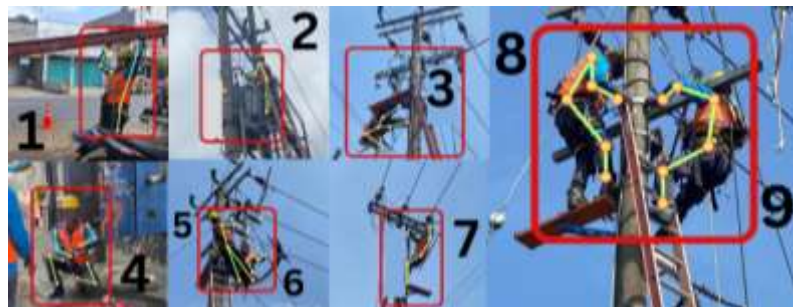


Figure 3.5 Respondents' Work Postures

The figure illustrates various work postures observed among respondents. Based on field observations, work postures were assessed using the OWAS method. The results are presented in the table below.

Table 3.1 OWAS Scores of the Respondents' Work Postures

Work Posture	OWAS Score	Category
Position 1	1	Not harmful to the musculoskeletal system
Position 2	1	Not harmful to the musculoskeletal system
Position 3	3	Harmful to the musculoskeletal system
Position 4	2	Possibly harmful to the musculoskeletal system
Position 5	2	Possibly harmful to the musculoskeletal system
Position 6	2	Possibly harmful to the musculoskeletal system
Position 7	3	Harmful to the musculoskeletal system
Position 8	2	Possibly harmful to the musculoskeletal system
Position 9	3	Harmful to the musculoskeletal system

Based on the assessment of nine work postures, the majority (77.8%) scored between 2 and 3, indicating that these postures are potentially or actually harmful to the musculoskeletal system. Work postures with a score of 3 require immediate correction.

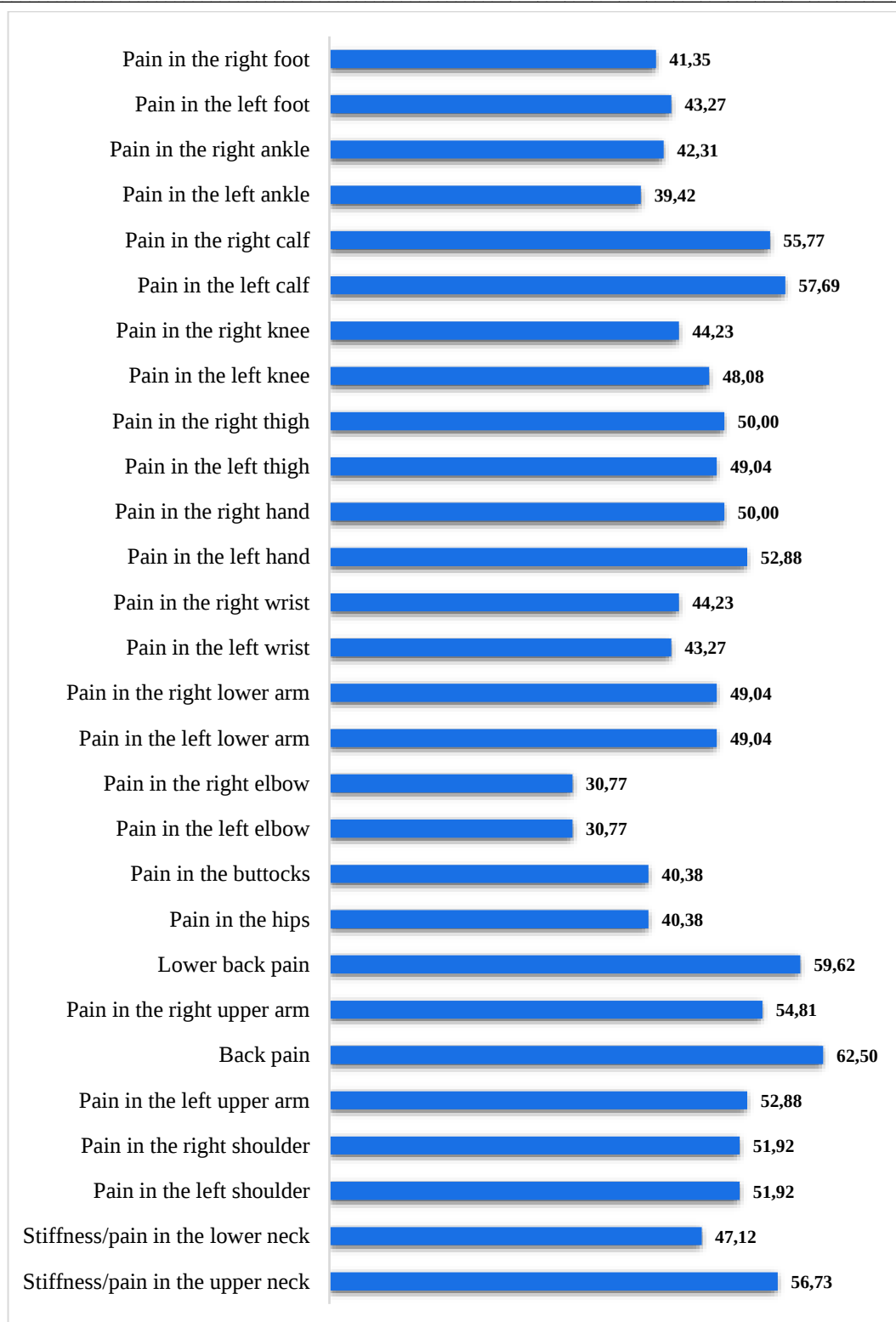


Figure 3.6 Percentage of Types of Pain Experienced by Respondents

Based on Figure 3.6, all of the technical service workers reported experiencing MSDs with a variety of pain types. The most frequently reported complaints were pain in the back (62.5%), lower back (59.6%), and left calf (57.7%).

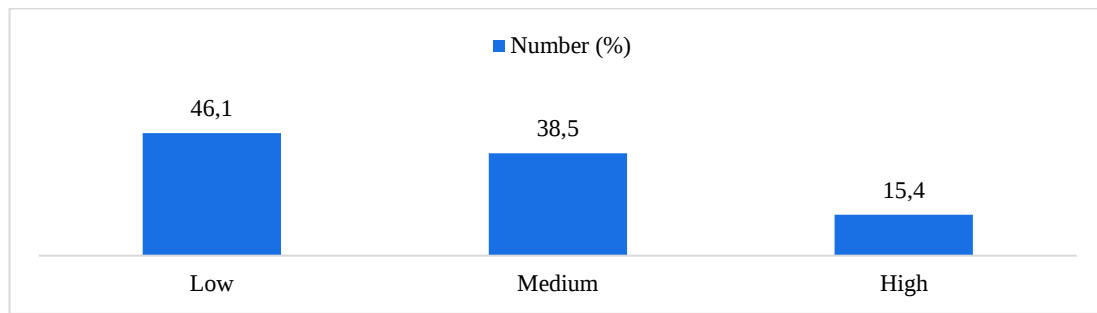


Figure 3.7 Risk Levels of Respondents' MSD Complaints

Referring to Figure 3.7, MSD complaints were classified into three risk levels: low, medium, and high. Based on the Nordic Body Map (NBM) questionnaire, 14 workers (53.9%) were identified as having a medium to high risk of developing MSDs.

The technical service workers at PLN of Malang City are exposed to various occupational hazards during their work, which may lead to occupational diseases (ODs). ODs refer to diseases or health conditions that arise as a result of job routines or the work environment. Several factors contribute to the occurrence of ODs, including the nature of the job, work processes, tools used, work environment, and materials handled (Safitri et al., 2023). According to Tarwaka (2015), improper manual handling activities—such as pushing, bending, repeated lifting, and working on uneven surfaces—can weaken the intervertebral disc walls, potentially leading to disc protrusion. The condition may compress nerves within or around the discs, resulting in pain, and can also place excessive strain on spinal muscles and ligaments.

The work performed by technical service workers at PLN of Malang City is predominantly manual and heavily reliant on muscular strength. Tasks such as lifting and moving equipment are often performed in non-ergonomic positions, which can lead to musculoskeletal disorders. This is supported by Khairani (2021), who stated that forced body postures during prolonged manual handling tasks may cause musculoskeletal problems. Furthermore, Tjahayuningtyas (2019) explained that non-ergonomic working positions can lead to faster fatigue and increase the overall workload, thereby contributing to fatigue-related health problems.

Interviews with the technical service workers revealed that they experienced symptoms of MSD, particularly pain in skeletal muscles in the shoulder and hand areas. These findings are supported by OWAS assessments, which indicated that 77.8% of the working postures were harmful to the musculoskeletal system. Additionally, NBM measurements showed that 53.9% of workers were at medium to high risk of MSDs. Moreover, workers were found to adopt inadequate ergonomic working positions and to be exposed to additional risk factors. These findings are consistent with a previous study on MSDs among workers at PT PLN Transmission and Substation Service Unit Jeneponto, which reported 68% of workers at high risk of MSDs (Zulhijjah, 2021).

According to Hanne et al. (1995), individual factors that contribute to MSDs include age, years of employment, exercise habits, and smoking behavior. Environmental factors, such as temperature, vibration, and lighting intensity, have also been identified as contributors to MSDs (Bridger, 1995, as cited in Nurtasyaningsih, 2020). In addition, Tarwaka (2015) stated that MSDs are associated with ergonomic factors—such as awkward working postures, excessive muscle stretching, and repetitive movements—as well as worker-related factors, including gender, years of employment, age, body size, smoking behavior, physical activity, and physical strength. This study examined several MSD-related risk factors, namely working posture, gender, age, Body Mass Index (BMI), and years of employment.

Working posture refers to the position of the body during work activities. Incorrect posture can increase energy demands, resulting in inefficient muscle activity and skeletal strain. This condition makes workers more susceptible to fatigue, and when sustained over long periods and performed repeatedly, it may lead to MSDs (Soamole et al., 2025). In this study, working posture was analyzed using the OWAS, which assesses posture on a four-point scale. The results showed that 77.8% of the observed working postures were harmful to the musculoskeletal system. These findings are consistent with a study by Aisyah et al. (2023), which identified a relationship between working posture and the occurrence of MSDs among workers. However, this results differs from the findings of Tjahayuningtyas (2019), who reported no significant association between working posture and MSD complaints. The discrepancy may be attributed to the subjective nature of complaint assessments in the latter study, which relied on workers' self-reported symptoms after completing their tasks.

MSDs are also associated with gender due to physiological differences and variations in muscular strength differences between men and women (Tarwaka, 2015). Previous study have shown that men generally have greater physical strength and work capacity than women. consequently, women, who typically possess lower average physical strength, are at higher risk of experiencing musculoskeletal pain and developing MSDs. In this study, all respondents were male, as the technical service positions are designated exclusively for male workers only.

According to Rahmah and Herbawani (2021), age affects muscle function and constitutes a risk factor for MSDs. Beno et al. (2022) further explained that age-related tissue degeneration, replacement with scar tissue, and thinning of muscle tissues can reduced the stability of muscles and bones, thereby increasing the likelihood of MSDs with advancing age. In this study, 57.7% of respondents were aged 26–45 years. These findings are supported by Maksuk et al. (2022), who reported that MSD complaints occurred among respondents aged 25–56 years, with prevalence increasing as age increased. Initial MSD symptoms are commonly experienced around the age of 35 and tend to worsen over time due to declining endurance and muscle strength (Tarwaka, 2015).

Body Mass Index (BMI) is also associated with MSDs, as skeletal alignment influences how physical loads are distributed across the body. Individuals with a normal nutritional status tend to have better physical endurance and work performance. Conversely, an increased BMI can impair musculoskeletal function and reduce quality of life (Afro & Paskarini, 2022). Anggun et al. (2024) reported a strong association between BMI and MSDs, with overweight individuals being at higher risk of developing musculoskeletal disorders. In this study, 53.9% of respondents who reported MSD complaints had a BMI above the normal range.

Length of employment refers to the duration of time a person has been working, starting from the beginning of their employment. It is a contributing factor to MSDs, as prolonged exposure to workplace hazards increases the risk of developing Occupational Diseases (ODs) (Ferusgel & Rahmawati, 2018). MSDs are chronic conditions that develop gradually, often requiring a long period before symptoms become apparent (Beno et al., 2022). According to Azizah et al. (2024), there is a significant relationship between length of employment and MSDs. This finding is consistent with the result of the present study, in which 60.2% respondents had worked for six years or more, indicating a higher occurrence of MSDs among technical service workers. In addition, Mardiani et al. (2022) found that MSDs are more frequently experienced by workers who have been employed for more than five years.

CONCLUSION AND RECOMMENDATIONS

The results of this study indicate that all respondents experienced MSDs at varying levels, with the majority reporting moderate to high severity. Work-related MSDs may be caused by both individual and ergonomic factors. Based on observations and analysis of technical service workers at PLN in Malang City, several key determinants were identified as contributing to the occurrence of MSDs, namely working posture, gender, age, BMI, and length of employment. These findings may serve as a basis for evaluation by PLN of Malang City to give greater attention to workers' health conditions and to implement follow-up actions aimed at minimizing the incidence of MSDs among workers, who are valuable assets to the company. Preventive efforts may include educating workers about safe working postures and encouraging the practice of stretching exercise before starting work.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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