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Research Article

Musculoskeletal Complaints Reviewed from an Ergonomic Aspect

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Abstract

Musculoskeletal complaints are pain experienced in the joints, nerves, tissues, muscles, and the spinal column, often resulting from prolonged static postures, work postures, and repetitive movements. The objective of this study was to analyze ergonomic factors that influence musculoskeletal disorders (MSDs) among office workers. This research employed a quantitative approach with a cross-sectional design. The study population consisted of administrative workers, with a sample of 42 respondents. Data were collected through questionnaires to measure the duration of static postures and repetitive movements, the Rapid Office Strain Assessment (ROSA) instrument to evaluate working postures, and the Nordic Body Map (NBM) to assess musculoskeletal complaints. The results indicated that the majority of respondents (66.7%) engaged in static postures for more than one hour per day. The variable of duration working in static postures showed a significant p-value of 0.014, indicating a statistically significant effect on the incidence of MSDs. The Odds Ratio (Exp(B)) was 10.205, suggesting that workers who maintain static postures for more than one hour are 10.2 times more likely to experience musculoskeletal complaints compared to those with static postures lasting one hour or less. The variable of working posture yielded a p-value of 0.008, demonstrating a significant influence of working posture on MSDs. The Odds Ratio (Exp(B)) was 12.135, indicating that workers with hazardous working postures have a 12.1 times higher risk of experiencing MSDs compared to those with non-hazardous postures. It is recommended that workers avoid prolonged static postures to maintain the health of the musculoskeletal system.

Keywords*: ergonomics, repetitive movements, musculoskeletal disorders, work posture, static posture.*

Introduction

Musculoskeletal disorders (MSDs) are complaints of muscle pain experienced by individuals due to a mismatch between their work, work environment, and job demands and their performance (Maulana et al., 2021). These muscle pain complaints can range from mild to severe (Tarwaka & Bakri, 2016). MSDs are reported to be the second most common occupational disease (ILO, 2018). Musculoskeletal disorders are complaints experienced in the joints, nerves, tissues, muscles, and spine due to unnatural work (Tjahayuningtyas, 2019). Musculoskeletal disorders can include pain in the neck, back, shoulders, arms, waist, and legs.

The difference between Musculoskeletal Disorders and low back pain is that MSDs are disorders or abnormalities that affect the structure of the musculoskeletal system, including muscles, tendons, ligaments, joints, peripheral nerves, bones, and blood vessels. These problems arise

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due to biomechanical loads, non-ergonomic work postures, repetitive movements, vibrations, static loads, and psychosocial factors at work. Low back pain, on the other hand, is pain or discomfort in the lower back (lumbar) area that lasts acutely, subacutely, or chronically and is caused by disorders in musculoskeletal structures such as muscles, intervertebral discs, ligaments, or lumbar nerves.

MSD complaints are supported by previous research. Of the 60 respondents studied, the majority of dodol mixers experienced low MSDs (49 respondents (81.7%), moderate MSDs (9 respondents (15%), and high MSDs (2 respondents (1.7%). Complaints of pain in the upper arm, lower arm, and right calf were 45 respondents (75%), and the majority experienced pain in the right hand 12 respondents (20%) (Nasution & Utami, 2022).

Work-related musculoskeletal problems often occur in the back. Back disorders account for 38.5% of all work-related musculoskeletal disorders. The UK Labour Force Survey found 134,550 back disorders out of 349,050 MSD cases in 2019-2020. The prevalence of MSDs in Indonesia, diagnosed by doctors, is 7.3%. Aceh has the highest prevalence of MSDs (13.3%), while West Sulawesi has the lowest prevalence (3.2%) (Nasution & Utami, 2022).

Pain is generally caused by work-related factors such as lifting objects, working posture, and environmental factors. Research by Khairani et al. (2021) conducted at CV Amanah found a significant association between manual handling and musculoskeletal complaints in transport workers, with a p-value of 0.000. The study results showed a negative correlation, indicating that good work posture (ergonomics) during manual lifting (manual handling) correlated with lower rates of musculoskeletal disorders (Khairani, 2021).

Routine MSD risk analysis is essential to prevent unexpected events such as injuries, tissue damage, and disabilities that negatively impact individual, organizational, or company activities. This is also supported by the Regulation of the Minister of Manpower (Permenaker) of the Republic of Indonesia Number 5 of 2018 concerning Occupational Health and Safety (K3) in the Workplace, which requires all companies in Indonesia, both large and small, to prioritize worker protection by implementing K3 standards in the workplace to create a safe, healthy, and comfortable work environment and prevent workplace accidents and occupational diseases (PAK) (Kaban et al., 2024). Based on this data, researchers are interested in conducting research on MSDs in office workers and discussing this research based on previous research (Maulana et al., 2021), (Tarwaka, 2016), and (Edwards & Martin, 2017). The results of this study provide benefits for improving ergonomics in the workplace.

Method

This study used a quantitative approach to analyze the impact of ergonomic aspects on musculoskeletal disorders among workers at PT Wijaya Karya Beton. A quantitative approach was chosen because it allows for objective measurement of variables using numerical data, which are then analyzed using statistical techniques (Ahyar et al., 2020), (Utami dkk., 2025). Quantitative research methods are based on a positivistic paradigm, which is measurable and can be proven through numerical and statistical data analysis (Haryoko et al., 2020).

This research was conducted at PT X, located on Jalan Medan-Banda Aceh Sei Semayang, Medan Sunggal District, Deli Serdang Regency, North Sumatra Province, from November 2024 to May 2025. Data collection was conducted through direct surveys and questionnaires distributed to workers during specific periods according to the company's operational schedule. The study location was selected based on the following considerations: 1) No similar ergonomic research has been conducted on administrative workers; 2) Easy access by public or private transportation; and 3) Permission from the research location was obtained.

A population is the entirety of the characteristics or units of measurement that are the object of research (Jannah et al., 2022). The

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population focused on in this study consisted of 42 administrative or indoor (office) workers. Office workers are workers who perform administrative and operational tasks in an office environment. The sample used in this study was the total population, due to the small population size.

The research variables were length of service in static postures, repetitive movements, and work postures. The dependent variable was complaints of musculoskeletal disorders. Data collection used a questionnaire. The length of service questionnaire used a scale and four answer options: never (1), rarely (2), often (3), and very often (4). Work posture was measured using the ROSA, and MSDs were measured using the Nordic Body Map (NBM). Repetitive movements were measured using a four-option questionnaire: "never" (1), "rarely" (2), "often" (3), and "very often" (4). Descriptive data analysis and multiple linear regression were used.

Results

Research on workers requires describing the characteristics of the respondents, particularly in the field of ergonomics, which describes the diversity of respondents. This allows for insight into their age, gender, education, and length of service, thereby deepening the research. Table 1 below presents the characteristics of the respondents in the form of a frequency distribution table and percentages.

Table 1. Characteristics of Research Respondents (n=42)

Characteristics	Frequency	Persentage (%)
Age (year)		
22 – 33	16	38.1
34 – 45	12	28.6
46 – 57	14	33.3
Sex		
Laki-laki	37	88.1
Perempuan	5	11.9
Education		
SMA	16	38.1
DIII	4	9.5
Sarjana	18	42.9
Magister	4	9.5
Length of service (year)		
1 – 10	28	66.7
11 – 20	5	11.9
21 – 30	9	21.4

The study surveyed a total of 42 respondents, primarily administrative workers at a concrete manufacturing company. The demographic and occupational characteristics of the respondents were analyzed to understand the background of the study population and identify the potential influence of individual factors on musculoskeletal disorders (MSDs). The age distribution of respondents showed fairly even diversity. 38.1% of respondents were in the 22–33 age group, 28.6% in the 34–45 age range, and 33.3% in the 46–57 age range. This age variation is important because MSDs are often correlated with aging, particularly with repetitive work activities and prolonged static postures.

By gender, the majority of respondents were male (88.1%), while females accounted for 11.9%. This disparity reflects the gender composition of the work unit studied and was taken into consideration in the analysis, as physiological differences between genders can influence the perception and severity of physical complaints. By education level, the majority of respondents had a bachelor's degree (42.9%) and

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a high school degree (38.1%). Meanwhile, 9.5% of respondents each had a Diploma III or Master's degree. Education level can influence understanding of ergonomic principles and awareness of the importance of proper work posture.

More than half of respondents (66.7%) had 1–10 years of work experience, 21.4% had 21–30 years of work experience, and the remaining 11.9% had 11–20 years of work experience. Length of service is an important indicator in assessing the potential for accumulation of musculoskeletal complaints due to long-term exposure to unergonomic work postures.

Table 2. Frequency distribution of research variables

Research Variable	Frequency	Percentage (%)
Long working hours in static postures		
< = 1 jam	14	33.3
> 1 jam	28	66.7
Repetitive movements		
Non-recurrent	4	9.5
Recurrent	38	90.5
Working posture		
Not Dangerous (1-5)	19	45.2
Dangerous (>5)	23	54.8
Musculoskeletal disorders		
Mild (28-49)	26	61.9
Moderate (50-70)	26	38.1

Table 3. Logistic Regression Analysis

Variabel	B	Sig	Exp (B)	95% CI for Exp (B)	
				Lower	Upper
Long working hours in static postures	2.323	.014	10.205	1.603	64.966
Working posture	2.496	.008	12.135	1.942	75.830
Contant	-8.441	.001	.000		

Based on the research results [table 2], it was found that the majority of respondents (66.7%) worked in static postures for more than 1 hour per day, while another 33.3% worked in static postures for less than 1 hour. These findings indicate that prolonged static postures constitute a significant part of the daily activities of administrative workers. Prolonged static postures are known to be a major cause of increased risk of musculoskeletal disorders, particularly in the neck, lower back, and shoulder areas.

Regarding repetitive movements, 90.5% of respondents performed repetitive movements between 12 and 20 times in their work activities. Only 9.5% of respondents reported non-repetitive movements (<12 times). This high figure indicates that the majority of workers are exposed to repetitive activities, such as typing or operating work equipment continuously, which have the potential to cause biomechanical stress on the muscular and joint systems.

Furthermore, analysis of work posture categories showed that 54.8% of respondents were in the hazardous work posture category (score >5), while 45.2% were considered to have a non-hazardous work posture (score 1–5). These results indicate that more than half of workers experience work postures that pose a risk of injury, such as incorrect sitting, unsupported ergonomic chairs, or the use of work equipment that is not adapted to their anthropometrics.

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Regarding musculoskeletal disorders, the majority of respondents (61.9%) experienced mild complaints, while 38.1% reported moderate complaints. No severe complaints were found in this study. However, the high prevalence of mild complaints remains a concern as they can develop into more serious ones if not addressed preventively.

The results of the logistic regression analysis in [table 3] indicate that two independent variables significantly influence musculoskeletal disorders (MSDs): length of work in a static posture and work posture. The variable length of work in a static posture showed a regression coefficient (B) of 2.323 with a significance value (p-value) of 0.014. This value is below the significance limit ($\alpha = 0.05$), thus concluding that length of work in a static posture significantly influences the incidence of MSDs. The Exp (B) value of 10.205 indicates that workers who work in a static posture for more than 1 hour are 10.2 times more likely to experience MSDs compared to those who work in a static posture for less than 1 hour, with a 95% confidence interval between 1.603 and 64.966.

The other variable, work posture, had a regression coefficient of 2.496 and a p-value of 0.008, indicating a significant effect of work posture on musculoskeletal disorders. The Exp (B) value of 12.135 indicates that workers with hazardous work postures have a 12.1 times greater risk of experiencing MSDs compared to those with non-hazardous work postures. The confidence interval (CI) range of 1.942 to 75.830 reinforces the interpretation that this effect is strong and statistically significant.

The constant value of -8.441 with a significance level of 0.001 indicates that under conditions where all predictor variables are zero, the baseline probability of MSDs occurring is very low, with the Exp(B) value approaching zero. This reflects that ergonomic factors such as static posture and work posture are the main components driving the increased risk of MSDs in the studied administrative worker population. This logistic regression model indicates that both variables are significant predictors of musculoskeletal disorders and are important in planning ergonomic interventions to reduce the prevalence of musculoskeletal disorders in the workplace.

Discussion

Respondent Characteristics

This study was motivated by the high prevalence of musculoskeletal disorders among office workers who spend their working hours in static sitting positions, often in unergonomic (and potentially harmful) postures. Data were collected through direct observation, completing the Nordic Body Map (NBM) questionnaire, assessing static posture, and assessing work posture using the Rapid Office Strain Assessment (ROSA) method. This research analyzes ergonomic aspects, not individual characteristics. However, individual characteristics are important in public health research, so the respondent characteristics are shown in the following [table 1].

The results of the study, as shown in Table 1, show that the age distribution of respondents was of working age (productive). Respondents working in the survey ranged in age from 23 to 57. The working age range in state-owned enterprises generally follows national labor regulations and company policies, which refer to Indonesian labor regulations. Generally, the working age in Indonesia is regulated by Law No. 13 of 2003 concerning Manpower and its implementing regulations, which stipulates that the minimum age for employment is 15 years and the maximum age is 56 years, with the official retirement age being 57 years according to Minister of Manpower Regulation No. 19 of 2014 concerning the Retirement Age of Workers/Laborers and Government Regulation No. 45 of 2015 (Government Regulation, 2015) (Ministry of Manpower Regulation, 2014) (Law No. 13, 2003). In state-owned enterprises (BUMN), the working age range typically follows these provisions, namely from 15 to 58 years, although many companies have earlier retirement policies, for example at age 57.

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The importance of this age range in the context of this research is because various aspects of worker health and productivity, including the risk of MSDs, can be influenced by working age and the aging process that occurs during that period. This age variation is an important aspect in this research because Musculoskeletal Disorders (MSDs) are often related to the aging process and the physiological changes that occur with age. This is relevant to references explaining that increasing age physiologically implies degenerative processes in the musculoskeletal structure, which include decreased muscle mass, decreased strength, and changes in connective tissue and bones. This condition increases an individual's vulnerability to musculoskeletal injuries and increases the risk of developing musculoskeletal disorders (MSDs) (Tarwaka & Bakri, 2016). Therefore, age is an important factor in understanding the predisposition to musculoskeletal disorders, especially in workers who engage in repetitive activities or maintain static postures for long periods.

Based on the data obtained, the majority of respondents had 1 to 10 years of work experience. Some respondents had worked for 21 to 30 years, and the remainder had worked between 11 and 20 years. This distribution of length of service indicates that the majority of workers have a relatively moderate range of work experience, while a small proportion have worked for longer periods.

The results of this study are similar to those of a previous study of workers at CV Sada Wahyu Bantul. The chi-square analysis found a significance value of 0.009, indicating a statistically significant relationship between length of service and the incidence of musculoskeletal disorders among workers at CV Sada Wahyu Bantul. Those with long tenure (≥5 years) have a significantly higher risk of developing musculoskeletal disorders (MSDs) compared to those with younger tenure (<5 years). The odds ratio (OR) was 7.333 with a 95% confidence interval (CI 1.815–29.630). Respondents with ≥5 years of tenure were 7.333 times more likely to experience MSDs than those with less than 5 years of tenure. Workers with longer work experience were significantly more likely to experience MSDs. This suggests that the longer a person works, the greater the risk of developing musculoskeletal disorders (Wildasari & Eko, 2023).

Length of tenure is an important indicator in assessing the potential accumulation of musculoskeletal disorders. The longer a person works in repetitive, non-ergonomic positions, the greater the likelihood of muscle fatigue, tissue thinning, and structural changes in the musculoskeletal system. Long-term exposure to non-ergonomic work postures can lead to the accumulation of biomechanical stress, which contributes to the gradual emergence of musculoskeletal disorders. This factor can be scientifically explained by the fact that prolonged work has the potential to accelerate the accumulation of biomechanical stress and muscle fatigue, especially if the work involves repetitive movements and non-ergonomic body positions.

Ergonomic Aspects Influencing Musculoskeletal Disorders

Based on the results of the study (Table 6), it is known that the majority of respondents (66.7%) work in static positions for more than one hour per day, while the remainder (33.3%) work in static positions for one hour or less. This finding indicates that prolonged static postures constitute a significant part of the daily activities of administrative workers. Prolonged static postures are known to be a major factor increasing the risk of musculoskeletal disorders, particularly in the neck, lower back, and shoulders, as they can cause muscle tension and biomechanical stress on musculoskeletal tissue.

Muscle complaints are reviewed from a non-ergonomic perspective, such as age and length of service. This research, however, analyzed the ergonomics aspect. The results of this research align with Tarwaka's (2020) theory that repetitive postures and work cause muscle pain complaints (MSDs). This study surveyed administrative

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workers, the majority of whom perform work activities that require them to sit for hours in front of a computer, particularly using laptops. Working for more than one hour without adequate breaks is a major risk factor for musculoskeletal disorders. This condition is exacerbated by the fact that workers tend not to change positions during work, resulting in static and repetitive body positions for long periods.

According to ergonomics experts, excessive muscle stretching and exertion of maximum force can lead to MSDs (Tarwaka & Bakri, 2016). This condition occurs when muscles are stretched or pulled beyond their normal elastic limits. This typically occurs when a person engages in intense physical activity, such as exerting maximum force, without proper technique or adequate rest. Excessive muscle stretching can cause microdamage to muscle fibers, potentially leading to pain, inflammation, and temporary or long-term muscle function impairment (Putri et al., 2023).

Furthermore, exerting maximum force during physical activity or strenuous work can increase the risk of muscle fatigue and musculoskeletal injuries. When muscles are forced to work beyond their normal capacity, excessive tension occurs in the muscle fibers and supporting tissues. This condition not only increases the risk of injury severity but also causes prolonged muscle tension, which contributes to complaints of pain and muscle stiffness, especially in parts of the body that are frequently used intensively.

Furthermore, observations of work facilities revealed that the chairs used were not adjustable to the work desks, for example, they could not be raised or lowered as needed. Some workers were not even equipped with chair backrests, forcing them to bear their body weight without optimal back and neck support. This condition results in an unergonomic body position, which can increase stress and strain on muscles and joints, particularly in the neck, shoulders, and back.

This lack of ergonomic facilities is directly related to an increased risk of MSDs in administrative workers. Sitting in an unergonomic position, especially without a backrest and without changing positions, causes excessive muscle tension and buildup of pressure on the musculoskeletal system. Over the long term, this condition can lead to pain, stiffness, and various other musculoskeletal disorders that interfere with comfort and productivity. Therefore, it is important to improve ergonomic aspects of the work environment, including providing adjustable chairs, adding backrests, and encouraging workers to change positions periodically during work.

Repetitive movements or repetitive activities that force muscles to work at maximum capacity without adequate rest can accelerate the development of musculoskeletal disorders (ILO, 2022). This is especially true in jobs requiring high physical strength, non-ergonomic body positions, or repetitive activities that put excessive stress on the muscles.

Observations on the repetitive movement variable revealed that 90.5% of respondents engaged in repetitive movements during their work activities, while only 9.5% engaged in non-repetitive movements (score <12). This high proportion indicates that the majority of workers are exposed to continuous repetitive activities, such as typing or operating devices, which can potentially increase the risk of muscle fatigue and musculoskeletal injuries due to excessive biomechanical stress.

Repetitive work over long periods of time can cause sustained stress on certain body parts, such as the neck, back, and shoulders. This stress, if sustained without rest or position changes, can cause structural damage and lead to musculoskeletal disorders. Furthermore, analysis of work posture categories showed that 54.8% of respondents were in the high-risk category (score >5), while 45.2% had work postures deemed relatively safe (score 1–5). These results indicate that more than half of workers engage in body positions that could potentially lead to injury, such as non-ergonomic sitting positions, chairs that lack optimal support, or work tools that do not match the user's anthropometry.

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The level of musculoskeletal disorders showed that the majority of respondents (61.9%) experienced mild symptoms, while 38.1% reported moderate symptoms. No cases of severe symptoms were found. Nevertheless, the prevalence of these mild symptoms remains a concern because they have the potential to develop into more serious disorders if appropriate and ongoing preventative interventions are not implemented. Regular computer use in the office contributes to the emergence of many risk factors associated with work-related musculoskeletal disorders (WRMSDs), such as maintaining a static sitting posture for long periods and uncomfortable head, neck, and upper limb postures, which lead to increased muscle activity in the cervical spine and shoulders (Agustin et al., 2021).

The results showed that most respondents experienced complaints in the neck, lower back, and shoulder areas. This finding indicates that an inappropriate sitting position, desk and chair heights that are not adjusted to the user's anthropometrics, and prolonged work without sufficient stretching breaks are the main factors causing discomfort and the risk of musculoskeletal injuries. Based on the results, the variable of repetitive movements did not show a significant effect on musculoskeletal disorders (MSDs), as indicated by a p-value above the threshold of statistical significance ($p > 0.05$). Scientifically, there are several possible explanations for this finding.

First, the frequency of repetitive movements performed by respondents is likely within the body's physiological tolerance limits, especially if the intensity of the movements is low and accompanied by adequate rest breaks. While repetitive movements are theoretically a risk factor for MSDs, their impact depends heavily on the duration, strength, speed, and posture involved. If these ergonomic aspects remain within safe limits, the risk of injury or musculoskeletal complaints is minimal.

Second, it is possible that ergonomic compensatory factors in the work environment have been effectively implemented, such as the use of work aids, redesigned workstations, or training in proper work techniques, thereby reducing the impact of repetitive movements on the musculoskeletal system. Previous research has shown that static and unergonomic work postures significantly influence the development of musculoskeletal disorders (MSDs) (Prayogi et al., 2024). Repetitive and fixed postures without change can lead to muscle fatigue, soft tissue strain, and structural disorders of the musculoskeletal system.

Third, individual characteristics of respondents, such as age, physical fitness level, work experience, and body adaptation to repetitive tasks, can also be protective factors that reduce the risk of MSDs. Respondents who are accustomed to or have good muscle endurance tend to be more resistant to biomechanical stress caused by repetitive movements. Theoretically, repetitive movements are a risk factor for MSDs, but this study did not find a significant effect. This indicates that the influence of ergonomic risk factors is highly contextual and influenced by various interacting variables, including work, environmental, and individual aspects.

Conclusion

Prolonged work in static postures influences respondents' MSD complaints. Prolonged static postures can cause increased stress on muscles, tendons, and joints. If sustained without ergonomic compensatory mechanisms, they can potentially lead to accumulated muscle fatigue and biomechanical disorders. The study found that repetitive movements did not influence musculoskeletal disorders. The frequency of repetitive movements performed by respondents was within the body's physiological tolerance limits. The intensity of the movements was low and accompanied by adequate rest breaks, so they were within safe limits and the risk of injury or musculoskeletal disorders was minimal. Factors such as repetitive work activities and long-term static postures, which are common among administrative workers in concrete manufacturing

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companies, can trigger MSD complaints, especially in the elderly.

Modifications to equipment and work layouts are recommended to minimize repetitive movements and non-neutral work postures. Adjusting workbench height, using adjustable chairs, and designing handling aids can reduce biomechanical loads on the upper extremities and lumbar region. Companies should implement job rotation and micro-break systems to reduce exposure to repetitive movements and prolonged static work. Scheduled breaks of 5–10 minutes every 1–2 hours of work have been shown to reduce muscle fatigue and the risk of musculoskeletal injuries.

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