



Working Position, Work Duration, Ergonomics Knowledge Level on The Risk of Musculoskeletal Disorders among Informal Workers in Slipper Sponge Sandal Manufacturing

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A B S T R A C T

The informal sector may be associated with an increased risk of occupational diseases or accidents. This is due to the absence of an ergonomic workplace, insufficient attention to occupational safety and health, and inadequate supervision. The purpose of this study was to determine the effect of working position, work duration, and level of ergonomic knowledge on the risk of Musculoskeletal Disorders (MSDs) among informal workers in slipper sponge sandal manufacturing. The research design in this study was cross-sectional. The number of respondents was 33. Data collection used field observation and the completion of questionnaires using the REBA (Rapid Entire Body Assessment), Nordic Body Map Questionnaires, and questionnaires measuring ergonomic knowledge. Data analysis used bivariate and multivariate analysis. Multivariate analysis used multiple linear regression with $\alpha=0.05$. Results showed that 63.6% respondents had a high risk of MSDs. Based on bivariate analysis, working position (X1) obtained $p=0.018$, work duration (X2) $p=0.018$, ergonomic knowledge level (X3) $p=0.023$. Multivariate analysis on X1, X2, and X3 got $p=0.000$. In conclusion, Working position, work duration, and ergonomic knowledge level influence partially and simultaneously the risk of musculoskeletal disorders among informal workers in slipper sponge sandal manufacturing.

INTRODUCTION

Musculoskeletal complaints can affect the skeletal muscles, ranging from very mild to severe. When muscles repeatedly receive static loads for prolonged periods, this can cause damage to muscles, nerves, tendons, joints, cartilage, and the discus intervertebralis. Musculoskeletal complaints are often referred to as MSDs (Musculoskeletal Disorders), RSI (Repetitive Strain Injuries), CTD (Cumulative Trauma Disorders), WMSDs (Work-Related Musculoskeletal Disorders), and RMI (Repetitive Motion Injury).

Musculoskeletal Disorders affect the parts of the body used in performing a job. The prevalence rate of Musculoskeletal Disorders worldwide, according to data from the Labor Force Survey (LFS), showed that MSDs among workers were very high, with 1,144,000 cases, of which 439,000 affected the back, 426,000 the lower limbs, and 224,000 the upper limbs. Similar research results in the European Union, Musculoskeletal disorders were the most common health problem, with 25-27% of workers complaining of back pain and 23% of muscle pain. The lack of movement among workers due to low physical activity may potentially increase the incidence of MSDs (Cheisario and Wahyuningsih, 2022).

One job at risk of Musculoskeletal Disorders is the manufacture of slipper sponge sandals, due to repetitive work and long hours. In addition, non-ergonomic work postures occur during work, such as bending. The process for making slipper sponge sandals includes several activities: sponge plunging, mat cutting,

processing, rubbing, packing, and quality control. Although informal workers in the sponge slipper industry are at risk of Musculoskeletal Disorders, in-depth research on the effects of working position, work duration, and ergonomic knowledge level on MSDs in this population is limited. Understanding the impact of these variables on the risk of MSDs among informal workers can inform the development of appropriate prevention and intervention strategies. The purpose of this study was to determine the effect of working position, work duration, and level of ergonomic knowledge on the risk of Musculoskeletal Disorders (MSDs) among informal workers in slipper sponge sandal manufacturing.

METHOD

The research design in this study was cross-sectional. The population consisted of informal workers in slipper-sponge sandal manufacturing in Malang Regency. The number of respondents was 33. Data collection used field observation and the completion of questionnaires using the REBA (Rapid Entire Body Assessment), Nordic Body Map Questionnaires, and questionnaires measuring ergonomic knowledge. Data analysis used bivariate and multivariate analysis. Multivariate analysis used multiple linear regression. If $p > 0.05$, then H_0 is accepted; if $p < 0.05$, then H_0 is rejected.

RESULT

Informal workers in slipper sponge sandal manufacturing had low (36.4%), medium (0%), high (63.6%), and very high (0%) risk of musculoskeletal disorders (Table 1).

Table 1. The Risk of Musculoskeletal Disorders among Respondents

The Risk of Musculoskeletal Disorders	Frequency (n)	Percentage (%)
low	12	36.4
medium	0	0
high	21	63.6
very high	0	0

The significance value (p) in this study was 0.05, and the value of the t table = $t(a/2; n-k-1) = t(0.025; 29) = 2.045$. The Sig. for the working position variable (X_1) was 0.018, which was < 0.05 . The t value was $2.499 > t$ table (2.045), so H_1 was accepted, indicating that the working position variable (X_1) had a significant effect on the risk of musculoskeletal disorders (Y). In addition, the p -value for the work duration variable (X_2) was $0.018 < 0.05$, and the t value was $2.499 > t$ table (2.045), so that H_2 was accepted, which means that the work duration variable (X_2) had a significant effect on the risk variable for musculoskeletal disorders (Y). Furthermore, the p -value for the level of ergonomic knowledge variable (X_3) was $0.023 < 0.05$, and the t -value was $2.398 > t$ -table. H_3 was accepted, indicating that the level of ergonomic knowledge variable (X_3) had a significant effect on the risk of musculoskeletal disorders (Y) (Table 2).

Table 2. T Test Results (Bivariate Analysis)

	t-value	p
Working Position (X1)	2.499	0.018
Work Duration (X2)	2.499	0.018
Level of Ergonomics Knowledge (X3)	2.398	0.023

The significance value of the multivariate analysis was 0.000 ($p < 0.05$). The calculated F value was $17.317 > F$ table 3.34, so that H4 was accepted, meaning that there was an influence between working position (X1), work duration (X2), and the level of ergonomic knowledge (X3) simultaneously on the risk of musculoskeletal disorders (Y) (Table 3).

Table 3 F Test Results (Multivariate Analysis)

Anova ^a		
F Table Value	F Value Count	Sig Value.
3.32	17.317	0.000

DISCUSSION

Musculoskeletal diseases (MSDs) usually stem from excessive activity or improper work postures. Skeletal muscle complaints are related to musculoskeletal problems. According to Tarwaka, uncomfortable work postures can affect the musculoskeletal system (Tamala, 2013). This study found that 21 workers (63.6%) had a high risk of MSDs (Table 1). It may be because workers were in non-ergonomic positions and were required to work long hours. Therefore, sponge slipper workers need to make immediate improvements. Based on field observations, the risk of MSDs increased when performing repetitive tasks or working in non-ergonomic postures during the plong, mat, processing, packing, and sack processes, particularly for long periods with a bent neck. It explained the high frequency of musculoskeletal disorders in the upper body among respondents, namely the back, upper right arm, upper left arm, and waist. In addition, the musculoskeletal complaints occurred in the lower body, specifically in the left knee, left calf, and right calf. Repeated work in non-ergonomic positions and poor manual handling practices can cause musculoskeletal disorders (Apriyan Trio Afandy *et al.*, 2023).

The bivariate analysis between working position and the risk of MSDs showed $p = 0.018$ ($p < 0.05$), indicating that working position influences the risk of MSDs among informal workers in slipper-sponge sandal manufacturing (Table 2). It is in line with research (Oktavian, Achmad and Mesak, 2021), which found a significant association between working position and Musculoskeletal Disorders ($p = 0.004$). Based on field observations, the work environment did not emphasize the importance of working in the right position, as workers focused only on meeting the given target. In terms of facilities and infrastructure, it also did not support an ergonomic work system. Non-ergonomic positions can cause fatigue and indirectly increase workload. One of the health impacts arising from non-ergonomic work postures is Musculoskeletal Disorder (Pratiwi, 2020). The application of ergonomic positions for working will reduce workload, significantly reduce fatigue and work-related health problems, and provide a sense of comfort to

the workforce, especially for workers who work long hours. Therefore, if ergonomic work positions cannot be adopted, discomfort or pain may occur in certain parts of the body.

In addition, this investigation showed there was an effect of work duration on the risk of musculoskeletal disorders in the respondents, with $p=0.018$ ($p<0.05$) (Table 2). It is in line with previous research, which found a significant influence between work duration and Musculoskeletal Disorders ($p=0.005$) (Laksana and Srisantyorini, 2020). One factor associated with the risk of musculoskeletal disorders is the duration of work. Work duration is strongly associated with muscle complaints and can increase the risk of MSDs, especially among high-strength work (Mustafah, 2022). According to the ILO (International Labor Organization), the recommended workday is 8 hours, and the recommended workweek is 48 hours (Setiawan, 2012). The work duration in this research was influenced by high consumer demand and each worker's sense of responsibility to complete their work. The respondents had to exceed their working hours and had little time to rest, which made their limbs feel sore. Therefore, to reduce the risk of musculoskeletal disorders, there must be a match between work and rest time.

Moreover, this paper showed there was an effect of the level of ergonomic knowledge on the risk of musculoskeletal disorders among respondents, with $p=0.023$ ($p<0.05$) (Table 2). It is consistent with a previous study that found a significant association between ergonomic knowledge and musculoskeletal disorders ($p=0.000$) (Aminullah, Fauzan and Widyarni, 2020). In the home industry, especially in slipper sponge sandal manufacturing, there was no provision for ergonomic work infrastructure. Therefore, workers worked in positions that were not comfortable for them every day. In line with research by Purwantini et al., the lack of knowledge and education led people to be less concerned about the importance of correct positioning in their work and daily activities (Deria, 2021). The accuracy of the information obtained can influence a person's level of knowledge. Thus, information is one of the factors that affect a person's knowledge and changes in behavior. It is necessary to transition to a work environment that meets adequate infrastructure and occupational health and safety (OHS) standards. Through training and education, workers will also better understand their workplace, enabling them to make adaptations and changes to reduce the risk of occupational diseases (Balaputra, 2020).

Based on the multivariate analysis, working position variable (X1), the work duration variable (X2) and the ergonomic knowledge level variable (X3), the significance value was $p=0.000$ ($p<0.05$), meaning that there was a simultaneous influence of the working position (X1), the work duration (X2) and the ergonomic knowledge level (X3) on the risk of musculoskeletal disorders (Y) (Table 3). Work that forces workers into non-ergonomic postures causes fatigue to set in more quickly and, in turn, increases the workload. Working position is a major consideration in the risk assessment of musculoskeletal system disorders. Other physical factors, namely static and dynamic work postures, repetitive movements, and manual handling, are also highly correlated with musculoskeletal disorders (Safira Nahar Fitriana and

Padoli, 2021). Non-ergonomic working positions are risky for MDs when combined with frequent use, a large angle of inclination, and a long work duration. In addition, workers who work more than 8 hours/day without adequate rest can experience decreased productivity, fatigue, illness, and accidents, as well as an increased risk of musculoskeletal disorders. Between work time, rest must be provided, accounting for 15-30% of all working time (Maulana, Jayanti and Kurniawan, 2021). Moreover, the level of ergonomic knowledge supports other variables. Workers with a good level of ergonomic knowledge tend to adopt a positive attitude, which affects their actions in taking precautions. Likewise, a lack of ergonomic knowledge will affect workers' attitudes and actions when taking precautions to reduce the risk of MSDs.

CONCLUSION

Working position, work duration, and ergonomic knowledge level influence partially and simultaneously the risk of musculoskeletal disorders among informal workers in slipper sponge sandal manufacturing.

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