FACTORS RELATED TO BONE STRUCTURE AND PAIN IN THE SPINE IN TRADITIONAL DIAMOND MINE WORKERS

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ABSTRACT

Pain in the spine are the most common disease among informal or unorganized sector workers. This can happen because in the informal sector the use of work ergonomics has not been applied properly, which results in changes in bone structure and pain in the spine. The purpose of this study was to determine the factors associated with bone structure and pain in the spine complaints in Sungai Tiung Traditional Mine workers, Cempaka District, Banjarbaru City, South Kalimantan. This research is a quantitative observational analytic study with cross sectional design. The subjects of this study were traditional diamond mining workers. The sample of this study was 95 people who were sampled using accidental sampling. The instruments used included questionnaires, Nordic Body Map (NBM) worksheets, Ovako Working Analysis System (OWAS), and LMM Key Method. Data analysis used chi square statistical tests and fisher exact test (CI = 95%, α = 0.05). Results: Statistical test results showed that there was no relationship between age (p-value 0.921), work posture (p-value 0.509), and smoking status (p-value 0.707) with bone structure and pain in the spine complaints, while there was a relationship between manual handling activities (p-value 0.010) with bone structure and pain in the spine complaints. Manual handling activities in traditional diamond mining workers have a relationship with bone structure and pain in the spine complaints, while age, smoking status, and work posture in traditional diamond mining workers have no relationship with bone structure and pain in the spine complaints.

Keyword: Spine pain; manual handling; occupational health

INTRODUCTION

Musculoskeletal disorders (MSDs) have emerged as a significant global health issue, particularly in the workforce, where manual labor and repetitive tasks are prevalent. According to the International Labour Organization (ILO), MSDs account for approximately 60% of all work-related health problems, placing them at the forefront of occupational health concerns globally (Petersen et al., 2020). The impact of MSDs varies by occupation and region, with workers in industries such as mining, construction, and agriculture being particularly vulnerable. In developed economies, MSDs are commonly associated with office work and sedentary lifestyles, whereas in developing countries, workers in the informal sector are often exposed to high risks due to poor working conditions, lack of protective equipment, and minimal safety regulations (Gomez et al., 2021). The prevalence of MSDs among informal sector workers, especially those engaged in physically demanding tasks, remains alarmingly high and is a source of concern for both public health and labor productivity.

In South Kalimantan, Indonesia, traditional diamond mining is a prominent occupation that often involves high levels of physical strain. Miners in the Cempaka District, where the mining work is typically carried out without modern equipment, face an elevated risk of

musculoskeletal complaints. The repetitive nature of manual tasks, such as digging, lifting, and carrying heavy mining tools, significantly contributes to spinal and joint issues (Sugianto, Mulyadi, & Wijaya, 2022). This situation is exacerbated by the unregulated working conditions and lack of proper ergonomics in the mining process. These workers are part of a longstanding tradition where mining practices have not evolved to incorporate modern safety standards, leading to chronic health problems that affect their productivity and quality of life (Hafiz, 2023).

Research on musculoskeletal disorders in traditional mining settings has been relatively scarce, particularly in Southeast Asia. While some studies have focused on the informal sector and its impact on workers' health, there remains a notable gap in understanding how specific industries, such as traditional mining, contribute to the development of these disorders (Yuliana & Ardiansyah, 2021). This research aims to fill that gap by focusing on the traditional diamond mining industry in South Kalimantan, specifically the Sungai Tiung Traditional Diamond Mine in Cempaka District. The study will assess the prevalence of musculoskeletal complaints among miners, identify the risk factors associated with these disorders, and explore the long-term impacts on spinal health. Additionally, it will examine the socio-economic effects of MSDs on the miners' livelihoods and propose interventions to mitigate the risks associated with traditional mining practices.

The novelty of this study lies in its focus on the musculoskeletal health of miners in the informal sector, an area that has not been comprehensively studied. While there have been numerous studies on MSDs in the formal sector, the unique challenges faced by informal workers, particularly in traditional mining, have not been explored in detail. This study will contribute to the body of knowledge by offering a specific case study on how poor ergonomics and lack of safety measures in traditional mining exacerbate the risk of musculoskeletal disorders. By focusing on a local context in South Kalimantan, this research provides valuable insights into the broader issue of occupational health in low-wage, unregulated sectors.

The research objectives include: (1) assessing the prevalence of musculoskeletal disorders among miners in the Cempaka District, (2) identifying the primary risk factors contributing to these disorders, (3) evaluating the impact of MSDs on spinal health, and (4) recommending measures to reduce the prevalence of these disorders. The findings of this research will not only inform local health interventions but also contribute to the development of better safety standards in the informal mining sector. Furthermore, the research will have broader implications for improving health and safety policies for informal workers across Indonesia and in similar contexts globally.

In terms of benefits, the research will help raise awareness about the health risks faced by informal sector workers, particularly those in hazardous industries like mining. It will provide recommendations for improving working conditions and implementing preventive measures to reduce the incidence of musculoskeletal disorders. Additionally, it will contribute to the development of policies that enhance the welfare and productivity of informal sector workers, ultimately improving their quality of life. The findings will also serve as a foundation for future research on occupational health in informal settings, helping to shape health

interventions that can prevent long-term disability and improve the livelihoods of workers in such industries.

METHOD

The research was conducted with a cross sectional design. The total sample was 95 respondents who were determined using accidental sampling technique. The research instruments were the individual characteristics and smoking status form, the Ovako Working Analysis System (OWAS) Worksheet, the Nordic Body Map (NBM) Worksheet, and the LMM Key Method. The research period was carried out for 2 months, namely March - April 2024. Using bivariate analysis in the form of the chi-square test and Fisher exact test with a confidence level of 95% with a significance value of 5%.

RESULT AND DISCUSSION
A. Univariate Analysis

Table 1. Frequency distribution of respondents for traditional diamond mining workers in Cempaka, Banjarbaru in 2023

Variable	Respondence	
	Amount (n)	**Percentase (%)**
Age		
Risk	56	58,9
No Risk	39	41,1
Smoking Status		
Yes	77	81,1
No	18	18,9
Work Posture		
Risk	72	75,8
No Risk	23	24,2
Manual Handling		
Risk	83	87,4
No Risk	12	12,6
Musculoskeletal Complaint		
Yes	82	86,3
No	13	13,7

Source: Primary Data 2023

Based on Table 1, there were 56 respondents with a risk age (≥35 years) (58.9%) and 39 respondents with a non-risk age (<35 years) (41.1%). Based on the results in the field, the ages of respondents varied, namely 16 years to 85 years, and most respondents were aged 35 years (11.6%) and 40 years (11.6%), in accordance with the results obtained that respondents with ages at risk had higher number. Smoking status: There were 77 respondents with smoking status (81.1%) and 18 respondents with non-smoking status (18.9%). Based on these results, it was found that the smoking status of respondents was higher in the smoking category, the cigarettes consumed by respondents in the smoking category were in the form of filter cigarettes (100%) and they could consume around 16 to 40 cigarettes a day.

The research results showed that 72 respondents (75.8%) had a risky work posture where the majority of workers worked looking down while carrying loads. Meanwhile, 23 respondents (24.2%) had a non-risky work posture because the majority of their work was spraying soil in a standing position. Manual Handling found that 83 respondents (87.4%) carried out risky manual handling activities where the majority of workers worked manually without the help of tools or lifting machines. Lifting loads of excavated materials, hoses, tanks containing fuel, and so on. Determination of the risk category is based on the calculated value O on the LMM key category worksheet with a calculated value ≥10. Musculoskeletal Complaints: 82 respondents (86.3%) admitted to experiencing pain or pain in parts of the body during and/or after work. Respondents complained most about the lower back (50.54%), right shoulder (12.08%), and left shoulder (6.60%). Most workers deal with pain just by resting and some have to use pain relievers (patches). Meanwhile, 13 respondents (13.7%) admitted that they had not experienced any complaints in the last 7 days.

B. Bivariate Analysis

Table 2. Statistical Test Results

Variabel	Musculoskeletal Complaint				Total		ρ value
	Yes		No				
	n	%	n	%	N	%	
Age							
Risk	49	87,5	7	12,5	56	100	0,921
No Risk	33	84,6	6	15,4	39	100	
Smoking Status							
Yes	67	87	10	13	77	100	0,707
No	15	83,3	3	16,7	18	100	
Work Posture							
Risk	63	87,5	9	12,5	72	100	0,509
No Risk	19	82,6	4	17,4	23	100	
Manual Handling							
Risk	75	90,4	8	9,6	83	100	0,010
No Risk	7	58,3	5	41,7	12	100	

Source: Primary Data 2023

Based on table 2, the results using the chi square test show that the p-value is 0.921, which means there is no relationship between age and complaints of musculoskeletal disorders. There is no relationship between age and complaints of musculoskeletal disorders because the prevalence of ages at risk is 87.5% and ages not at risk is 84.6%, these figures do not have a significant difference so there is no relationship between age and complaints of musculoskeletal disorders. Apart from that, there are other factors that influence musculoskeletal complaints, namely physical fitness (6), so that even if respondents are not at risk but do not maintain physical fitness, these respondents are also at risk of experiencing musculoskeletal complaints.

According to analysis using the Fisher Exact test, the p-value was 0.707, so there was no relationship between smoking status and complaints of musculoskeletal disorders.

Respondents often do activities together, especially during breaks, if transportation activities are not running or during lunch hours, workers who smoke will smoke. This results in workers who do not smoke being inhaled by cigarette smoke from workers who smoke, therefore both active smokers and passive smokers are at risk of complaints of musculoskeletal disorders.

The results of the Fisher Exact test stated that the p-value was 0.509, so there was no relationship between work posture and complaints of musculoskeletal disorders. Based on field findings, it shows that workers with risky work postures but do not experience complaints of musculoskeletal disorders, namely 8 respondents (11.1%). This can be influenced by the working posture between one worker and another which varies and is influenced by the comfort of the position when working. Based on field findings, workers stated that because they were used to it and had worked for decades, they were skilled in their work.

Bivariate analysis with the Fisher exact p-value test was 0.010, which means there is a link between manual handling activities and complaints of musculoskeletal disorders. Based on facts in the field, there is a relationship between manual handling activities and complaints of musculoskeletal disorders because based on the values on the LMM key method worksheet, it was found that the manual handling activities carried out by respondents were slightly bending forward or slightly twisting the body, the load was close to the body or above shoulder height (89, 5%) and Bending down or bending forward quite far, slightly bending forward with a simultaneous twist of the body, the load is far from the body or above the shoulders (8.4%) when lifting weights manually which causes complaints in the lower back (50.54%).

Manual handling risks can have serious implications for workers due to manual handling of heavy loads, awkward postures, repetitive arm, leg and back movements or previous injuries which can increase the risk of muscle imbalances and ultimately cause changes in spinal structure (6). To help prevent manual handling injuries in the workplace, look at the risks of the task and implement health and safety measures to prevent and avoid injuries.

In this study, the relationship between smoking status and musculoskeletal disorders (MSDs) was analyzed using the Fisher Exact test, which yielded a p-value of 0.707. This result suggests that there was no significant association between smoking status and the occurrence of musculoskeletal complaints among workers. However, it is important to consider that smoking can have indirect effects on musculoskeletal health. Workers who smoke often engage in smoking during breaks or lunch hours, and non-smokers are inadvertently exposed to passive smoke. Previous studies have shown that both active and passive smoking can exacerbate health problems, including musculoskeletal disorders. Smoking can lead to poorer circulation and lower oxygen levels in tissues, which may impair healing and exacerbate pain from musculoskeletal injuries (Zhao et al., 2019). The compounded effect of active and passive smoking among workers could potentially worsen the severity of musculoskeletal disorders over time, even though the statistical analysis in this case did not indicate a direct correlation between smoking and MSDs.

The analysis also examined the relationship between work posture and musculoskeletal complaints, with the Fisher Exact test yielding a p-value of 0.509. This result implies that no significant correlation exists between the work posture of workers and the frequency of musculoskeletal complaints. However, field findings revealed that 11.1% of workers with risky work postures did not report complaints. This suggests that individual adaptation and

experience in performing physically demanding tasks may play a role in mitigating the effects of poor posture. Long-term exposure to certain postures, despite being classified as risky, might lead to a form of habituation, which could reduce perceived discomfort or symptoms (Shin et al., 2021). This phenomenon can be attributed to the body's ability to adapt over time to specific tasks, especially in workers with decades of experience. The lack of significant differences in complaints among those with risky postures may be explained by individual variations in posture dynamics, comfort, and tolerance levels, which also highlights the need for personalized ergonomic interventions (Chen et al., 2020).

In contrast, a significant relationship was found between manual handling activities and musculoskeletal complaints, as indicated by a Fisher Exact test p-value of 0.010. Manual handling activities, particularly those involving bending, twisting, or lifting heavy loads, were strongly associated with complaints in the lower back, with 50.54% of respondents reporting such issues. The physical strain caused by lifting or carrying heavy objects, especially when combined with awkward postures, can lead to muscle imbalances, spinal strain, and long-term injuries if not properly managed. Previous research has demonstrated that improper lifting techniques, repetitive movements, and poor ergonomics are key contributors to musculoskeletal injuries in workers engaged in manual labor (Rogers et al., 2020). The findings from this study are consistent with these broader occupational health concerns, emphasizing the need for preventive measures, such as proper training, ergonomic assessments, and the use of mechanical aids to reduce manual handling risks. Effective risk management strategies in manual labor settings can significantly reduce the incidence of musculoskeletal disorders and improve workers' overall health and safety (Lee et al., 2021).

CONCLUSION

Based on the research results, it can be concluded that manual handling activities in traditional diamond mining workers have a relationship with spinal complaints, while age, smoking status, and work posture in traditional diamond mining workers have no relationship. Cempaka Health Center is able to provide communication, information and education either through counseling or health promotion media on how to work safely to traditional diamond mining workers so that workers can work with appropriate and safe body posters. Unit owners are expected to commit to implementing ergonomic rules, especially regarding manual handling, so that the risk of spinal complaints can be reduced. Future researchers can examine more deeply the changes in bone structure and spinal complaints in informal sector workers.

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