Ergonomic Risk Analysis of Occupational Safety and Health (K3) in Construction Workers in The Brawa

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Abstract. Various government efforts have been made for economic recovery, especially to mobilize the real sector which directly concerns the lives of many people. Among them, the construction sector is the most dynamic, apart from being a labor-intensive industry, the Construction Services Industry involves various business activities both in its industry and in other industries. The long-term goal of this research is to create a work environment in the construction sector that is healthy, safe, comfortable, efficient, and productive which leads to increasing the degree of occupational safety and health in the implementation of construction work. Based on the results of initial observations, it is known that there are still construction workers who have awkward work postures, therefore, to avoid work-related illnesses or work accidents, it is necessary to assess construction workers' ergonomic risks. This research aims to analyze the level of ergonomic risk in construction workers. The research design in this study was descriptive observational with a case study design and the total object of this the research was 25 construction workers. The object selection technique in this research is a purposive sampling technique. The type of research used is descriptive using the HIRAC method, Nordic Body Map (NBM). After processing the data from filling out the NBM questionnaire, a scoring result of 62 for craftsmen and 64 for workers (servants) was obtained, which means the risk of muscle injury is in the medium category.

Keywords: Ergonomic Risk Analysis, Construction Workers, Nordic Body Map

1 Introduction

A project is an activity that takes place within a certain period and with limited resources. The project management process begins with the planning stage, followed by engineering and design, procurement or tendering, construction, operational tests, and the utilization and maintenance stage (Nurhayati, 2010). Implementing construction projects has risks. Project risks can originate from political, environmental, planning, marketing, economic, financial, natural, project, technical, human, criminal and safety. These risks can affect the cost, quality, and time of project implementation.

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Unnatural work postures are often used in work processes, but awareness of this is often lacking. Of course, this is due to fatigue and muscle injury, which can affect workers' performance while doing their work. The physical conditions that are associated with this context, and which are advised to be avoided by workers are those known as work-related Musculoskeletal Disorders (WMSDs) can affect the performance of workers while doing their work. Of course, in this case, it is very detrimental to a company due to the suboptimal performance of a worker who experiences complaints of musculoskeletal disorders. Complaints in the musculoskeletal system are complaints in parts of the skeletal muscles that are felt by a person, ranging from very mild complaints to very painful (Tarwaka, 2011).

According to Presidential Regulation of the Republic of Indonesia Number 7 of 2019 concerning Occupational Diseases, it explains that there are several classifications of Occupational Diseases including diseases caused by exposure to factors (chemical, physical, biological), diseases based on target organ systems (respiratory, skin, muscle and skeleton, mental and behavioral disorders), work-related cancer, and other specific diseases. Ergonomics is a scientific discipline that studies the relationship between humans and their workplace. Ergonomics also allows people who make tools to create appropriate work systems and work tools according to user comfort (Balaputra & Sutomo, 2017). One of the consequences of non-ergonomic workplaces and tools is the occurrence of Occupational Diseases (PAK) and Musculoskeletal Disorders (MSDs) which can result in loss of work time, reduced work productivity, decreased alertness, and increases the risk of work accidents (Gunawan, 2021).

According to the International Labor Organization, the incidence of occupational diseases due to ergonomic factors in 2016 in 183 countries was 12.27 million cases. The most common complaints are back pain and neck pain due to sitting for too long, exposure to whole-body vibration for too long, and manual handling of materials. Micro, Small, and Medium Enterprises (MSMEs) are an example of informal employment and play a large role in economic activity in Indonesia. The existence of MSMEs can open new job opportunities, reduce unemployment, and improve the community's economy (Nurhayanti, 2010).

Referring to this problem, an analysis was carried out on 2 workers at the construction workstation at Whoops Clothing using the Nordic Body Map. Nordic Body Map is a tool in Ergonomics in the form of a questionnaire that is most often used to determine discomfort or pain in the body and can identify WMSDs in workers. This method is used to indicate the level of risk of WMSDs that may be experienced by workers by directly involving workers in filling out the assessment paper. The research was carried out by observing and distributing questionnaires to 2 construction workers at Whoops Clothing. This research aime aim of this research is to identify muscle and skeletal parts that have the potential to experience complaints and identify the level of risk experienced by the two workers.

2 Methodology

This research was carried out in several stages, namely starting from literature study, problem identification where this activity aims to identify and analyze the ergonomic risks experienced by a worker when screen printing, after identifying the problem, the problem can be formulated to determine the objectives from this research, then carry out observations and distribute questionnaires filled in by both workers, the next stage is to score the questionnaires that have been filled out to find out the total individual score of the workers which will be used as a reference in determining the level of complaint risk later, and stage The last thing is to carry out analysis and conclusions. Population is a generalization area consisting of objects/ subjects that have certain qualities and characteristics determined by researchers to be studied and then conclusions drawn (Sugiyono, 2012). To give more direction or focus more on the selection of samples that really can represent the population, the sampling technique is used with accidental sampling.

3 Result and Discussion

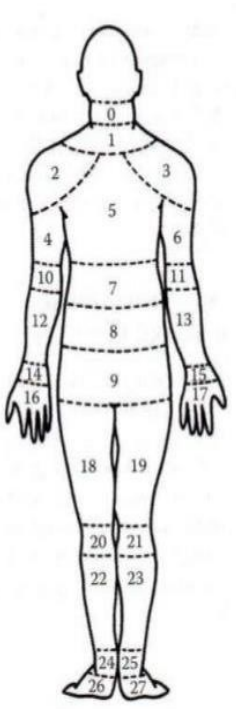
3.1 Result

The risk analyzed in this study is the work on the structure and architecture of the building project. The hazard identifications in structural and architectural work were obtained. From this planning into one with implementation, it can be said that good planning with better implementation can provide good work results in this case can achieve the goals and objectives of the policy or project implementation commitment (Wiratni, 2013). The level of "good" assessment of the implementation carried out by the implementation of the project is not only based on the results of the internal audit but also on the evaluation of the incidence rate (Udiyana, 2012). This research was carried out on 2 workers, namely workers in the 2nd floor structural work section. The initial step taken was to make observations in the construction section. Next, the Nordic Body Map questionnaire was distributed to 10 workers before and after carrying out work. The following is a questionnaire given to workers. Construction projects of dams, tunnels, roads, bridges, and other civil engineering projects require certain specifications, expertise, and technology, which are certainly different from housing or settlement projects (Latupeirissa, 2016). Risk management must be carried out throughout the project cycle from the initial stage to the end of the project (Huzen, 2011). This can help the placement of workers according to their expertise, setting the work area and work environment, as well as setting the sequence of work execution, placing workers according to their expertise, setting the work area and work environment, and setting the order of work execution (Wicaksono, 2011). Work attitudes or working conditions that are not ergonomic will eventually cause complaints such as disorders of the musculoskeletal system (Manuaba, 2000). This study was conducted on workers in the project workers section. The initial step taken was to conduct observations in the project workers section. Furthermore, the Nordic Body

Map questionnaire was distributed before and after doing the work. The following is a questionnaire given to project workers.

Table 1. Nordic body map questionnaire

Nordic body map questionnaire
Name :
Age : Year
Work Time : Year
You are asked to rate how you feel about the body parts indicated on the table.

No.	Type of Complaint	Grade of Complaint NP	SP	P	VP	Body Parts Map
0	Pain/stiffness in the upper	☐	☐	☐	☐	
1	Pain/stiffness in the lower	☐	☐	☐	☐	
2	Pain in left shoulder	☐	☐	☐	☐	
3	Pain in right shoulder	☐	☐	☐	☐	
4	Pain in left upper arm	☐	☐	☐	☐	
5	Pain in the back	☐	☐	☐	☐	
6	Pain in right upper arm	☐	☐	☐	☐	
7	Pain in the waist	☐	☐	☐	☐	
8	Pain in the buttocks	☐	☐	☐	☐	
9	Pain in the buttocks	☐	☐	☐	☐	
10	Pain in left elbow	☐	☐	☐	☐	
11	Pain in right elbow	☐	☐	☐	☐	
12	Pain in left forearm	☐	☐	☐	☐	
13	Pain in right forearm	☐	☐	☐	☐	
14	Pain in left wrist	☐	☐	☐	☐	
15	Pain in right wrist	☐	☐	☐	☐	
16	Pain in left hand	☐	☐	☐	☐	
17	Pain in right hand	☐	☐	☐	☐	
18	Pain in left thigh	☐	☐	☐	☐	
19	Pain in right thigh	☐	☐	☐	☐	
20	Pain in left knee	☐	☐	☐	☐	
21	Pain in right knee	☐	☐	☐	☐	
22	Pain in left calf	☐	☐	☐	☐	
23	Pain in right calf	☐	☐	☐	☐	
24	Pain in left ankle	☐	☐	☐	☐	
25	Pain in right ankle	☐	☐	☐	☐	
26	Pain in left leg	☐	☐	☐	☐	
27	Pain in right leg	☐	☐	☐	☐	

Based on data that has been collected through filling out the Nordic body map questionnaire given to 10 construction workers. Then, from the results that have been obtained, individuals are then scored using a predetermined Likert scale. The scale is in the form of information in the questionnaire, i.e. No Pain (not feeling any disturbance

in certain parts) with a score of 1; Something Pain (feeling a little disturbance or pain in certain parts) with a score of 2; Pain (feeling discomfort in certain parts of the body) with a score of 3; and Very Pain (feeling discomfort in certain parts on a high scale) with a score of 4. Furthermore, the results of the scoring that has been carried out can be seen in Table 2, from these results a total score of 65 was obtained for workers on the 1st floor and a total score of 67 for 2nd-floor workers.

Table 2. Recapitulation of total score results for construction workers

No.	Jenis keluhan	Grade of complaint							
		1st-floor Worker				2nd-floor Worker			
		NP	SP	P	VP	NP	SP	P	VP
1	Pain/stiffness in the upper neck Pain/stiffness in the lower	1					2		
2	neck Pain in the left shoulder		2				2		
3	Pain in right shoulder				4				4
4	Pain in left upper arm				4				4
5	Pain in the back				4				
6	Pain in right upper arm		2			1			
7	Pain in the waist							3	4
8	Pain in the buttocks			3					
9	Pain in the buttocks			3				3	
10	Pain in the left elbow	1				1			
11	Pain in the right elbow	1				1			
12	Pain in left forearm		2				2		
13	Pain in right forearm		2				2		
14	Pain in left wrist								
15	Pain in right wrist			3				3	
16	Pain in the left hand			3				3	
17	Pain in the right hand			3				3	4
18	Pain in the left thigh			3					
19	Pain in the right thigh			3		1			
20	Pain in the left knee			3			2		
21	Pain in right knee	1				1			
22	Pain in left calf	1				1			
23	Pain in right calf	1				1			
24	Pain in the left ankle	1				1			
25	Pain in the right ankle	1							
26	Pain in the left foot	1					2		
Total		65				67			

Based on the results of the processed data, it can be seen that the level of complaints that have a risk of muscle injury are the left shoulder, right shoulder, left upper arm, and right wrist. This muscle part can be seen in Table 2 which has been filled in by worker one and worker two where the muscle part is on a scale of four (very painful). Then, after knowing which parts of the muscles are at risk of injury, scoring is carried

out on individual workers, which is done so that the company can know what steps to take next. Risk level classification based on total individual score is shown in Table 3.

Table 3. Risk level classification based on total individual score

Likert Scale	Total individual score	Level of risk	Corrective action
1	28-49	Low	No corrective action is required.
2	50-70	Medium	Action may be needed at a later date.
3	71-90	High	Immediate action is required.
4	92-122	Very high	Comprehensive action is needed as soon as possible.

From the results of the scoring that has been carried out, the scoring results are 65 for worker one and 67 for worker two, which means that on this scale the level of risk will occur in the "medium" category, which means corrective action for the work station perhaps action will be taken at a later date. A summary of causes of complaints is shown in Table 4.

Table 4. Summary of causes of complaints

No.	Parts of Body	Results Data
1	Shoulder	feels pain when pressed during construction work
2	Upper Arm	soreness due to repetitive movements during construction work
3	Wrist	soreness due to being a heavy burden when construction work

3.2 Discussion

Working in a standing position for long periods continuously can cause sore feet, swelling of the legs, varicose veins, muscle fatigue, back pain, and stiffness in the neck and shoulders. This is caused by the body being influenced by the non-ergonomic arrangement of the work area so that the worker's body positions during activities feel restricted, giving rise to body problems such as the worker's body bending too much, resulting in pain in the worker's back. Standing for too long makes the muscles stiff which can reduce the blood supply to the muscles. This results in reduced blood flow that should be received by the muscles and causes very rapid fatigue and pain in certain parts of the body. This is certainly very concerning. The level of concern of the business community for OHS (Occupational Health and Safety) is still low even though workers are important tools for project implementers (Sucita, 2011).

In Table 4, the causes of the pain felt by the two workers are explained, such as shoulder pain when pressing on the screen printing process, then the upper arm feeling sore due to repetitive movements during the screen printing process, and finally, the wrist feeling sore due to becomes the support of the load when workers carry out the screen printing process. Ergonomic intervention is needed so that work can be safe,

healthy, and productive (Kroemer, 2009). To carry out ergonomic interventions, tools are sometimes needed in the form of appropriate technology so that work becomes more effective, safe, efficient, and productive (M. Yusuf, 2021). Therefore, based on the results of this study, it is highly recommended to conduct further research in the form of ergonomic interventions for construction workers in Bali.

4 Conclusion

Based on the initial objectives of the research on ergonomic risks due to musculo-skeletal disorders in the two construction workers using the Nordic Body Map questionnaire as well as the results and discussions that have been made, several conclusions were obtained, namely the muscle parts of the two construction workers that were at risk of injury, namely the left shoulder, right shoulder, upper arm left and wrist. This happens because there is a contraction in the muscles of the two workers so they experience pain and soreness. After scoring the two construction workers, the total score was 65 for worker one and 67 for worker two. The total score obtained can be categorized as "medium" which means that no improvements need to be made at this time, but improvements may be needed in the future if the risk of muscle injury in both workers increases. From the conclusions that have been made, further observations should be carried out in the future to determine the level of risk that occurs to workers so that improvements can be made to the workplace.

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