

Analysis of Working Position Improvement to Minimize Musculoskeletal Disorder for Furniture Workers In UD. Jati Semi Dusun Sudimoro District of Nganjuk

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ABSTRACT

Musculoskeletal disorder is one of the risks due to improper working position. The most common problems in UD. Jati Semi were started from woodcutting up to finishing processes were the poor material arrangement, unergonomic working position, and dust from the wood cutting process. The risk assessment was performed by HIRA (Hazard Identification, Risk Assessment) method. The results showed that there were 4 risks in the accepted category, 1 risk in the moderate category, and 3 risks in the unaccepted category. The methods for analyzing working postures were performed by RULA (Rapid Upper Limb Assessment) and OWAS (Ovako Work Posture Analysis). The RULA results showed that the first installation and the cutting processes were classified as high-risk category, the second installation and the machine sanding processes were classified as the moderate-risk category, and the engraving by machine, the manual engraving, and the staining processes were classified as small-risk category. The OWAS results showed that the first installation, the sanding by machine, the engraving by machine, and the second installation processes were classified as the moderate category, the staining process was classified as quite category, the cutting process was classified as the highest category, and the engraving process was classified as the low category.

Keywords: Musculoskeletal disorder, HIRA (Hazard Identification, Risk Assessment), RULA (Rapid Upper Limb Assessment), OWAS (Ovako Work Posture Analysis)

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1. Introduction

According to Rahawarin (2011) in Randang's research (2017) that unergonomics of work attitudes in working especially kind of work are using high workforce, repetitive activities, and excessive muscle stretching can cause musculoskeletal disorder potentially. The worker will feel muscle pain, aches, and pain in the bone joints, tendons, nerves, and other muscular systems. [1]

Musculoskeletal disorder is one of the health problems for workers that can cause temporary or permanent disability working. Several studies have mentioned that the factors causing Musculoskeletal disorders (MSDs) are lack of work posture, high workload, work culture, and repetitive activities. [2]

The furniture industry is one of the industries which is growing rapidly in Indonesia. The raw and semi-finished materials management to be of high value for users are economic activities which are included in the industrial design. The furniture industry in Indonesia is spread almost in all provinces, both in Java or outside of Java. [3]

One of the furniture industries in Nganjuk district is UD. Jati Semi. It is located in Dusun Sudimono Nganjuk district. The furniture production processes are started from cutting wood, construction, sanding, installation until finishing. The using of the traditional machine is still used in the process. The situation requires the expertise of craftsmen or furniture worker. So the workers have to stay fit and be careful when they are working so as not to affect work productivity.

The design and quality of furniture products need to be considered by craftsman furniture. So, the craftsman needs to be careful in the production process. One of the causes of working errors is human error and working environment conditions. Safe and comfortable working environment cause the workers can be working for long hours. The improper conditions potentially make the workers get Musculoskeletal disorder (muscle injuries). [4]

Occupational Health and Safety is one of the requirements to improve the working productivity of workers which is related to production results. In general, work accidents caused by two factors, the environmental factor, and the human factor. The human factor is unsafety action and posture and the environment factor is unsafety conditions and working environment including equipment and workplaces. [5]

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Occupational Health and Safety is a protective effort aimed at ensuring that workers are always safe and healthy in the workplace and each production is used safely and efficiently. [6]

From an initial survey of 10 furniture employees, it was found that all employees experienced muscle pain in the neck, hands, shoulders, legs, and back. For this reason, a method is needed to solve the problems experienced by furniture employees in order to increase productivity.

This aims of the study are to decrease musculoskeletal disorder risk by risk measured using HIRA (Hazard Identification, Risk Assessment) method, body posture analyse by using RULA (Rapid Upper Limb Assessment) method and OWAS (Ovako Work Posture Analysis).

2. Methods

This research is descriptive research. Descriptive research is research that discusses a number of data which is then analyzed and further analyzed about the research carried out in order to solve existing problems. [6]. This study begins with a publication that discusses the issue of hazards in the work environment with the HIRA method, data conversion is done by conducting interviews with 10 employees of UD Jati Semi furniture. Apart from environmental factors, next is the approval of K3 (Occupational Safety and Health) which is seen from human factors. The initial survey conducted was preliminary data using the Nordic Body Map questionnaire. From the results of the questionnaire examination, there were musculoskeletal complaints that were often attended by the employees, pain in the hands, pain in the back, stiffness in the upper neck and shoulders. To analyze complaints experienced by employees, the RULA (Rapid Upper Limb Assessment) and OWAS (Ovako Work Posture Analysis) methods are used to ensure the safety of employee work postures.

The evaluation is carried out by analyzing the work posture with RULA and OWAS worksheets to find a safe work posture, then using the Nordic Body Map questionnaire distributed before and discussing the improvement, whether the company still needs help with musculoskeletal disorders or not. then poured into the Nordic Body Map questionnaire.

2.1. HIRA

Refer to Hazard Identification and Risk Assessment workbook published by Ministry of Community Safety and Correctional Services Ontario Canada HIRA is defined as: A risk assessment tool that can be used to assess which hazards pose the greatest risk in terms of how likely they are to occur and how great their potential impact may be. It is not intended to be used as a prediction tool to determine which hazard will cause the next emergency. There are four steps to create and maintain a HIRA.[7]

- Hazard Identification
- Monitor and Review
- Risk Analysis
- Risk Assessment

2.2. Rapid Upper Limb Assessment

RULA was developed without the need for special equipment. This provided the opportunity for a number of investigators to be trained in doing the assessments without additional equipment expenditure. As the investigator only requires a clipboard and pen, RULA assessments can be done in confined workplaces without disruption to the workforce. Those who are trained to use it do not need previous skills in observation techniques although this would be an advantage.[8]

The RULA method comprises three stages: 1) the recording of working posture; 2) the scoring system; and 3) the scale of action levels. This method analyzes two parts of the body: Part A consists of the upper and lower arm and wrist; Part B consists of the neck, trunk, and legs. RULA is based on the OWAS system. According to this methodology, posture score is calculated for each body part. Based on the total score, four action levels, indicating the level of intervention required to reduce the risk of injury, are suggested: Action level 1: posture is acceptable; Action level 2: further investigation is needed and changes may be needed; Action level 3: investigation and changes are required soon; and Action level 4: investigation and changes are required[9]

2.3. Ovako work posture analysis

OWAS is a simple method to verify safety level which related to work posture, and to evaluate risk level which leads to corrective action. OWAS method can define the movement of all parts of the body and can recommends suggestion to safer and comforter feeling while working.[10]

Owas Analysis :

1. Record the images of the work postures to be analyzed.
2. Classify and score the posture for each job examined, including back, arms, feet, and load. Classification of postures to be analysed on OWAS method are back, arms, feet, and load.
3. Calculate the work posture score with OWAS table.
4. Categorize the OWAS score of 1) Category 1: Improvements are not necessary, 2) Category 2 : Improvements are necessary in the longterm future, 3) Category 3 : Improvements are necessary as soon as possible, and 4) Category 4 : Implement improvements now.

2.4. Nordic body map questionnaire

Nordic Body Map (NBM) is a body map that can identify parts of muscle or joint which resulted to complaints from the workers. NBM divided body parts into numbering from 0 to 27 which covering from neck to feet. NBM questionnaire was gave to and filled by six workers working in the factory.[10]

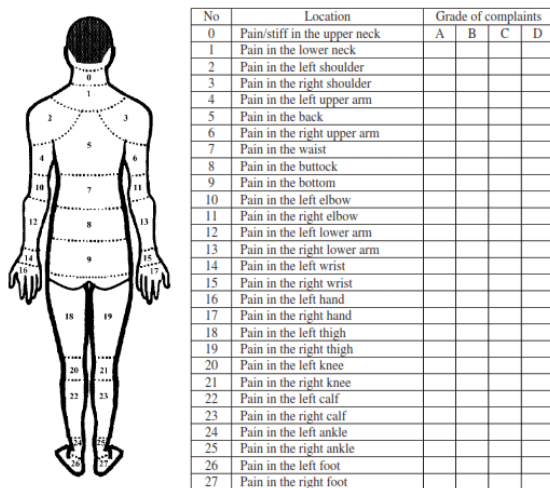


Figure 1. questionnaire body mapping

3. Results and analysis

3.1. Musculoskeletal disorder survey

The NBM questionnaires were distributed to 10 furniture workers and the results showed that all the furniture workers got muscular disorders, from painful to very painful complaints. The body parts complained of were the neck, shoulders, hands, back and legs. From the workers interviews, the result showed that they considered that muscular disorder was a common problem and can be solved by stretching the muscles.

3.2. HIRA identification

After knowing the worker's complaints, the next step was identifying the dangers in the furniture environment. It was known that there were 5 available sources of danger to identify whether there was a priority source of danger for repairing immediately. In Table 1. was explained about the work accidents risk assessment that occurred in the furniture making process.

Table 1. Risk Assessment

Process	Danger Description	The risk	Risk =L X S	Likelihood	Consequence	The Risk Category
Cutting	1. wood dust from cutting process	Respiratory allergy	4	4	1	Moderate risk
	2. improper working position	Eye irritation Muscle and back pain	4 15	4 5	1 3	Moderate risk Extreme Risk
Installing	1. bad material arrangement	Tripping overwork material	4	4	1	Moderate risk
	2. lack of supervision in laying down of the material and process	nail puncture	6	3	2	Moderate risk
	3. improper working position	Muscle pain	15	5	3	Extreme
Finishing	1. chemical vapor	Respiratory disorder	4	4	1	Moderate risk
	2. Unergonomic working position	Muscle and back pain	15	5	3	Extreme




From Table 1. was known that there were sources of danger, such as wood dust from the cutting process, improper working position, bad material arrangements, lack of supervision in laying down the materials, and chemical vapors with 5 moderate risks, and 2 extreme risks category.


The extreme risk category was derived from the unergonomic working position source can causes muscle and back pain and related to the production process productivity. According to UNSW Health and Safety (2008) in Kurniawati's study, the risks which are classified as "Extreme" must get priority for improvement immediately. But, in this condition, all of the risks will be given the improvements but not based on priority.


3.3 RULA identification

RULA analysis was used to identify of worker's working position. Table 2. was result of risk factor survey assessment by using the RULA method


Table 2. RULA Analysis

No	Activity	Risk Category	Explanation
1	The first installing process 	High	The activity was a static activity or repetitive activity, squatting position but resting on 1 foot. The body and head were bent forward. So, its position must be fixed immediately.
2	The sanding by machine 	Moderate	The activity was static activity, the worker has to move the sanding machine continuously. The back position was bent forward, hand and legs positions were still in the normal condition, so it needs to be fixed as soon as possible
3	The cutting Process 	High	The activity was static activity. The back and neck were very high risk. The arms and wrists positions were too far from the body. So its positions must be fixed immediately

No	Activity	Risk Category	Explanation
4	The engraving process 	Small	The engraving process was static activity, the use of chair and the engraving machine placement can help the worker to minimize heavy loads around the back and legs, thus this condition was safe. Its position must be fixed as soon as possible

5	The manual engraving 	Small	The using of table can help the posture in the safe condition. The positions of back and neck were safe. The wrist and arms positions were located at 90° approximately. Its position must be fixed needed as soon as possible.
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6	The staining process 	Small	The sitting position was low, thus it made body and neck little bit bend. The legs and hands positions were safe. It was needed to be fixed as soon as possible.
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7	The second installing process 	Moderate	The worker was doing installing process by crouching barefoot, the body and neck positions were bent. The hands' position can cause fatigue due to repetitive activity. Thus, its conditions must be fixed needed soon
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From Table 2, was known that 2 processes were classified as the high-risk category, 2 processes were classified as the moderate-risk category, and 3 processes were classified as the small-risk category.

3.4 OWAS Analysis

After the body posture analyzing by using RULA method, the next step was the OWAS analysis, which referred to Table 3.

Table 3. OWAS Analysis

No	Activity	Risk Category	Explanation
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No	Activity	Risk Category	Explanation
1	The first installing process	moderate	The attitude was dangerous for Musculoskeletal system, the working posture causing significant tension effect. It must be fixed needed.
2	The sanding with machine	moderate	The attitude was dangerous for Musculoskeletal system, the working posture causing significant tension effect. It must be fixed needed.
3	The cutting process	very high	The attitude was dangerous for Musculoskeletal system, the working posture causing clearly tension effect. It must be fixed needed now.
4	The engraving process	moderate	The attitude was dangerous for Musculoskeletal system, the working posture causing significant tension effect. It must be fixed needed.
5	The manual engraving	small	The attitude was no problem for musculoskeletal system. Thus, it was no need to must be fixed
6	The staining process	quite high	The attitude was dangerous for Musculoskeletal system, the working posture causing significant tension effect. It must be fixed needed soon.
7	The second installing process	moderate	The attitude was dangerous for Musculoskeletal system, the working posture causing significant tension effect. It must be fixed needed.

The results of OWAS analysis method were showed that the first installing, the sanding by machine, the engraving by machine, and the second installing processes were classified as the moderate-risk category, the staining process was classified as quite a high-risk category, the cutting process was classified as very high-risk category, and the manual engraving process was classified as low-risk category.

3.5 Recommendations for improvement

Recommendations for improvements were given to furniture based on the risk and working posture analysis, such as:

1. The best position improvement was done by finding scores combination based on RULA and OWAS analysis. In Table 4., the score simulation was recommended to get small risk result or minimize the improvement.

Table 4. RULA and OWAS analysis

Part of Body	score	Information
Upper Arm	2	Upper arm position
Lower Arm	3	The material work placement can be adjusted, so that the lower arm didn't form an angle more than 90°.
Wrist Twist and twist	1	The wrist score was affected by upper and lower arm position
Neck	2	The using of table can be equipment so that the neck position was not too bent
Trunk	1	The back position was not more than 20°, because it was causing back pain

2. According to Ageng's study (2012), the using of tools such as a small chair with a height of only 15 cm can help the worker position. Then, the recommendations of neck position were perpendicular with right and left shoulders and were designed so as not to bend to the side. [4]
3. According to Suhardi (2015) squatting position was allowed as long as it was not more than 2 hours.[11]
4. For improvement analysis by using the OWAS method was obtained score combination 1-1-2-1. It was referred to as the manual engraving process. Its position was classified as a small-risk category, thus It was cannot cause musculoskeletal disorder.
5. From the improvement analysis above, the next step was distributed NBM questionnaire to know the worker complaints. From NBM

questionnaire result was known that there were 7 out of 10 the worker who still got muscle pain in their back and neck. This number has decreased from the number of previous complaints.

4. Conclusion

The conclusions from this study were :

1. From the risk assessment result by using HIRA method were showed that there were sources of danger, such as wood dust from the cutting process result, improper working position, bad material arrangement, lack of supervision in laying down the material and chemical vapor were 5 moderate-risks category, and 2 extreme-risks category. The extreme-risk category was derived unergonomic working position so that it was can cause muscle and back pain which can be related to productivity of production process.
2. The NBM questionnaires before improvements were distributed to 10 furniture workers, and the result was showed that all of the furniture workers were getting muscle disorders, from painful to very painful complaints. The parts of the body are complained of being neck, shoulders, hands, back, and legs.
3. The RULA result was known that 2 processes were classified as high-risk categories, 2 processes were classified as moderate-risk categories, and 3 processes were classified as small-risk categories. The improvements were focused on the positions which have high-risk and it was must be fixed soon. From RULA analyzing, the improvement recommendations by using a chair can minimize squatting position and minimize the bent of back and neck position. Beside of that, the table can also be recommended to arrange the material for decreasing workload which is supported by upper and lower arms, and the wrist movements.
4. For improvements analyzing by using OWAS, it got score combinations such as 1-1-2-1 were upright body, both of hands under the shoulders, standing on 2 feet and the load was not more than 10 kg. These scores were referred to in the manual engraving process. Its position was classified as a small-risk category so that it didn't cause musculoskeletal disorder.
5. From the result of the NBM questionnaire was showed that there were 7 out of 10 the workers were still having muscle pain in their back and neck. These numbers were decreasing from the previous numbers. The decreasing of these complaints was inverse with the time of production process.

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