International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 7, 2020
ISSN: 1475-7192

Improvement Of Working Stations In Logistic Companies By Using Baseline Risk Identification Of Ergonomic Factors (Brief)

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Abstract *- One of the Logistics company in Bandung is a company engaged in the field of freight forwarding services. Of the various activities carried out by the company, all cutting activities at the retail division are carried out manually. This can pose a risk of MSDs. The method used in this study is the Nordic Body Maps (NBM) which is a questionnaire to identify the risk of injury, and then to follow up on the results of the NBM, the Baseline Risk Identification of Ergonomic Factors (BRIEF) method is used. In the NBM method, it is identified that the workstation that is critically experiencing complaints of muscle fatigue is retail with a score of 69. While the highest score of the MSDs risk of workers on the BRIEF method is the right shoulder at 100%. From these two results, it is then proposed a workstation design in the form of a cutting table that is able to reduce the risk of MSDs. After making improvements following the BRIEF method, the results in the calculation of the MSDs injury risk in the right shoulder decreased from 100% to 25%.*

Keywords *- Musculoskeletal Disorders (MSDs), Nordic Body Maps (NBM), Baseline Risk Identification of Ergonomic Factors (BRIEF), Conseptual Design.*

I. INTRODUCTION

Works that are done manually in a dangerous manner can cause a condition called Musculoskeletal Disorders (MSDs) [1]. Most musculoskeletal do not result in disability but cause disruption of work activity [1]. The inability of a person to perform movements and coordination of limb movements impacts on less efficiency and loss of work time and decreased work productivity [2]. The danger of MSDs is caused by the mechanical loads that must be borne are in excess of the capacity of the components of the musculoskeletal system [3].

MSDs are conditions that interfere with the functioning of the joints, ligaments, muscles, nerves, and tendons. Excessive use of muscles or muscles receiving static repetitive loads over a long period of time, in the packing process for cutting wood is very risky for developing musculoceletal disorders (MSDs) due to unnatural and forced or awkward postures, such as bending, twisting, squating down, or kneeling. This disorder can affect any area in the body, including the neck, shoulders, wrists, back, hips, knees, and feet, if this activity is carried out repeatedly or for a long period of time workers can potentially experience injury and this can be a major cause of disability [4].

In 2006 the Ministry of Health conducted a study of the profile of health problems in Indonesia. The results show the percentage of about 40.5% of illnesses is suffered by workers in carrying out their work. The study was conducted on 9,482 workers in 12 regencies or cities in Indonesia. In general, there are several types of diseases including 16% musculoskeletal, 8% cardiovascular, 6% nerve disorders, respiratory disorders 3% and ENT disorders 1.5%. Unergonomic work position done for a long time will cause muscle injury [5].

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Logistics company has a company profile engaged in shipping services. One of the activities operated is packaging, precisely in the section of cutting wood. Logistics companies certainly have a number of problems identified during the observation activities. The problem that arises is in the activity of packaging, namely cutting wood is quite dangerous because it requires the workers to bend and squat, causing the risk of injury.

Good and correct posture is to maintain the natural curvature of the spine, minimize tension and maintain balance of muscles and skeletal body [6]. Correct posture does not make the body lean forward, backward, left, or right [7]. The level of risk of musculoskeletal injuries at work is high in relation to posture. Rigid postures, lifting, forced lifting, and other manual work at high speed and frequency often cause musculoskeletal disorders [8].

There are 3 types of work postures or body positions when working, namely sitting, standing and sitting-standing. Combined work attitude or sitting-standing work attitude is the most appropriate work attitude towards all types of work which consists of several subdivisions of tasks and jobs which require movement in the work environment [9].

Based on the results of field observations, workers who cut wood often squat and bend to form an angle of ± 90 °, in addition to the position of workers' legs that are slightly bent. This activity is done repeatedly or continuously for a long period of time. So it will cause musculoskeletal disorders around the shoulder and waist [10].

The process of identifying the risk of injury and determining the problem is done using the Nordic Body Maps (NBM) method [11]. In order to measure work posture in more detail, body parts that have not been measured, duration, and frequency of work is measured using the Baseline Risk Identification of Ergonomic Factors BRIEF method [12]. This reduction in risk of injury uses a workstation design that is designed using measurements obtained from the anthropometric method [13].

II. LITERATURE REVIEW

Ergonomics is a study that teaches about work law. Ergonomics is designed to match work with each individual, not adjustment between workers and their jobs. Ergonomics is intended to develop knowledge that is able to adapt and is efficient in every work method that affects the individual's physiological and psychological characteristics [14]. In ergonomics there is a study of body posture. This posture is defined as the position or physical attitude of the body, such as sitting, lying down, and standing. Body posture is said to be true if the body is able to maintain the curvature of the spine naturally, minimize tension, and maintain the balance of muscles as well as the body's framework [15].

There are several methods that are often used in several studies. Some examples of methods that are often used as in this study [11], the Nordic Body Maps method is used to identify the risk of MSDs health problems on 27 parts of the muscle. NBM calculations performed by [16], the body parts that have the most complaints about subjective rates of Musculoseletal Disorders (MSDs) injuries are 80% left shoulder, 80% back, 80% wrist. This disruption of MSDs is caused by the accumulation of injuries or the occurrence of problems in the musculosketal system due to repetitive activity causing considerable pain [17].

In addition, another method that is often used is the BRIEF method. BRIEF is used to determine nine body parts including left hand and wrist, left elbow, left shoulder, right hand and wrist, right elbow, right shoulder, neck, back and legs at risk for MSDS through 4 factors: posture, body weight, frequency and duration [12]. Seeing the results of research conducted by [18], the BRIEF method is able to identify the risk of injury to each operator, namely the risk of MSDs. For example, the results obtained from the BRIEF calculation is a high potential level of injury risk to the neck by 100%.

To reduce this risk there are methods that can be used such as anthropometry. Anthropometry is a branch of human science that deals with body measurements: especially with body size, shape, strength and work capacity [13]. Some of the results that can be taken from several studies such as those conducted by [19], re-create a workstation design in the form of tools to improve work productivity in which work activities include filling, weighing and packing. The research

conducted by [20], made a worktable design that is able to make the operator's work position to stand up and reduce the squatting position which puts pressure on the lower leg of the body. Research conducted by [21], produced a recommendation that is to create a new workstation. This new workstation is in the form of a worktable design and also chairs that have been adjusted to the size of the workers and in accordance with the movements of the workers.

III. METHODOLOGY

This research was conducted at the Logistics Company by taking data using the NBM and BRIEF methods. Data collection on this research was carried out on 4 workers and in different departments. Among them were the retail department, HR, POM coordinator, and Spv. Each department made a grouping with problematic activities using the NBM and the BRIEF Checklist. After making a grouping and getting the highest problem, then the improvement suggestion was given.

Collection of NBM data was carried out after the collection of 4 questionnaires that had been distributed and filled out by one of the workers in the four divisions. The NBM data are pain levels scores at 28 points of the seceletal muscles show as in the Nordic Bodi Maps questionnaire, where the scoring for the level of pain and muscle pain felt by the workers while performing each activity is in the range of 1-4. If the score obtained is 1, then it is categorized as not sick, if a score of 2 is obtained then categorized as somewhat sick, if a score of 3 is obtained then categorized as sick, and if a score of 4 is obtained it is categorized as very sick.

After the collection of the NBM data, BRIEF data were then be collected by filling out the BRIEF Survey available, in accordance with the woodcutter's working posture and the length of time the worker is in a particular position. Then the risk rating on certain body parts, among others, low, medium, and high would be known. If the results obtained have a score of 0 or 1 then the level of risk is categorized as low, if it has a score of 2 then the level of risk is categorized as medium, and if it has a score of 3 or 4 then it is categorized as high and needs immediate improvement.

The second result of this data was then used as a reference for designing a new station. This new station was designed according to the operator's work posture. The proposed improvement was a drawing in the form of a table and cutting machine using AutoCAD. The dimensions of this workbench were obtained from the results of anthropometric calculations.

IV. DATA COLLECTION

a.*Nordic Body Maps* (NBM)

Based on the recapitulation of NBM questionnaire data distributed as shown in Table 1, it can be seen that the highest score is found in the retail division, which means that according to the clarification terms of the subjectivity level of skeletal muscle risk, the score of the results of these respondents can be categorized into a high level of risk so immediate corrective action is needed.

Table 1

Processing of NBM Questionnaire Data

No	Location of Complaints	Respondent Score				Total Score
		Retail	Spv	POM	HR	
0	Upper Neck Pain	2	1	3	2	8
1	Lower Neck Pain	1	1	1	2	5
2	Left Shoulder Pain	2	2	2	3	9
3	Right Shoulder Pain	3	2	3	3	11
4	Upper Left Arm Pain	3	2	2	2	9
5	Back Pain	4	4	3	3	14

6	Upper Right Arm Pain	2	4	3	1	10
7	Low Back Pain	3	4	3	2	12
8	Waist Down pain	3	4	2	2	11
9	Rear Pain	4	1	1	1	7
10	Left Elbow Pain	2	1	1	2	6
11	Right Elbow Pain	2	1	1	2	6
12	Left Forearm Pain	1	2	2	3	8
13	Right Forearm Pain	1	2	3	3	9
14	Left Wrist Pain	3	3	2	3	11
15	Right Wrist Pain	3	3	3	3	12
16	Left Hand Pain	2	3	2	3	10
17	Right Hand Pain	2	3	3	2	10
18	Left Thigh Pain	3	1	1	3	8
19	Right Thigh Pain	3	1	1	3	8
20	Left Knee Pain	2	1	2	2	7
21	Right Knee Pain	2	1	3	2	8
22	Left Calf Pain	2	1	1	2	6
23	Right Calf Pain	2	1	1	2	6
24	Left Ankle Pain	3	1	1	3	8
25	Right Ankle Pain	3	1	1	3	8
26	Left Foot Pain	3	1	1	2	7
27	Right Foot Pain	3	1	1	2	7
Total Score		69	53	53	66	8.61
Average Individual Score		60.25				

b. Baseline Risk Identification of Ergonomic Factors (BRIEF)

This BRIEF analysis used the BRIEF Checklist, the division to be analyzed was the retail division that has a cutting station in the form of a wood cutting process as shown in Figure 1.

Figure 1. Cutting Station

Figure 1 shows the position that is often complained of by workers, namely when cutting wood. To find out the work risks shown in Figure 3, a risk rating calculation was performed using the BRIEF method.

V. DATA PROCESSING

a.*Nordic Body Maps* (NBM)

NBM calculation results obtained were then used as a basis for determining which divisions have the highest risk of injury and can reduce worker's productivity. In Table 1 it can be determined that the division that has the highest risk is in the retail division.

Figure 2 shows the results of the NBM calculations of all workers in each division. From 28 data produced in all divisions, there are 12 body parts that exceed the average limit and can result in injury to each worker. The 12 body parts consist of the left shoulder, right shoulder, upper left arm, back, upper right arm, waist, lower waist, right forearm, left wrist, right wrist, left hand, and right hand.

	Hand and Wrist		Elbow		Shoulder		Neck	Back	Foot
	Left	Right	Left	Right	Left	Right			
Posture	0	1	0	1	0	1	1	1	1
Strength	0	1	0	1	0	1	0	0	1
Duration	0	1	0	1	0	1	1	1	1
Frequency	0	0	0	0	0	1	1	1	1
Score	0	3	0	3	0	4	3	3	4
Risk Level	Low	High	Low	High	Low	High	High	High	High

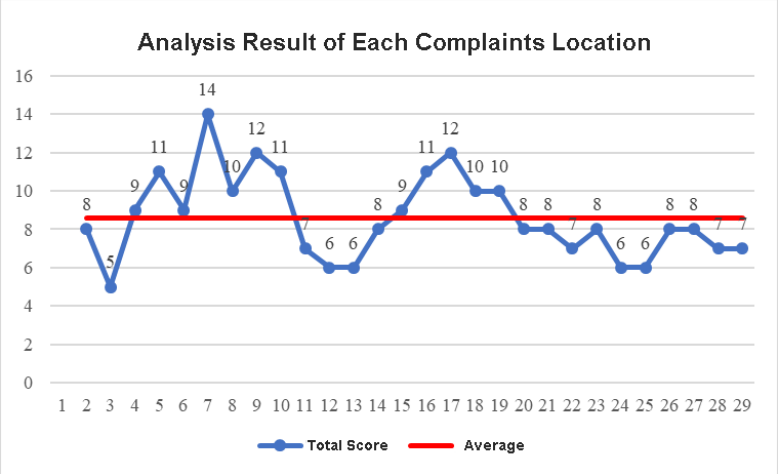

Figure 2. Total Skeletal Muscle Score

b. Baseline Risk Identification of Ergonomic Factors (BRIEF)

This BRIEF analysis used the BRIEF Checklist, the division analyzed was the retail division located at the cutting station in the form of a wood cutting process, the results of which can be seen in Table 2.

Table 2

BRIEF Calculation Results

Table 2 above shows the recapiculation results from the calculation of the BRIEF method. These results indicate that the right side of the work operator's body is the part with the highest risk of MSDs. From these results the scores obtained are 3 and 4 which then categorized in the high risk category and need immediate improvement.

c. Anthropometry

This percentile calculation was used as a basis for the dimensions of the tool made by considering the operator's body size which can be seen in Table 3. All specifications use P5 because workers who are small or with short body size will find it very difficult to use the design if the dimensions are made too large, wide, and tall . However, large-sized workers still feel comfortable, even though the dimensions of the design are too small. Besides, this P5 was selected because it is in accordance with the body of the worker concerned.

Table 3

Anthropometric Measurement Results

No	Spesification	Required Body Parts	Percentile	Score
1	Cutting table width	The length of the hand grip to the front	P5	78
2	Cutting table length	The length of the hand grip to the side	P5	171, 06
3	Cutting table height	Hip height	P5	94

VI. RESULT AND DISCUSSION

The problem that is often become an issue of workers is the presence of health problems on the part of the body. Health problems that are usually complained about are related to muscolusketal disorders caused by the use of MMH continuously for a long time. To reduce the risk of injury to workers, in this study there are several analyzes that can be used as a reference for both workers and the company. This research uses two approaches that have a relationship with workers' issues, namely using the NBM method and the BRIEF method.

The number of studies that have been done using the NBM method and the BRIEF method make reference in this study. The results of the research can be in the form of a workload risk analysis as well as the design of equipment and workstations for each employee concerned.

The results of the recaptulation of the NBM contained in Table 1 shows that the highest total score is retail which does the work of cutting wood. This leads to Figure 2, which is the skeletal back muscles are at high risk. It seems to be a major problem caused by poor body posture. This is in accordance with [22], where the positive relationship between heavy work and back is interrelated.

The relationship of back pain to wood cutting work can be complex: workers will experience interference at work and be unproductive due to back pain [22]. The working posture of the back shows the body bending more than 20 °. This value is far from a neutral angle because the position of the body is very bent when cutting wood [23] and the risk is higher if done for a long time and cause serious problems in muscles and joints [24].

The results are followed by an assessment using the BRIEF method, it shows that the activities can have a high risk if done for a long time. Strange posture causes frequent fatigue [25]. Table 4 shows the results of the BRIEF score, from the calculation it is found that operators who carry out manual cutting activities are at high risk of MSDs injuries. Based on the research conducted by [12], the calculation results of this brief data scoring if converted into the percentage of injury rates it is categorized as dangerous. From the results of these studies, the percentage calculation of some body parts that produce a high risk is done. Some of these high-risk body parts are found in the right hand and wrist by 75%, right elbow

by 75%, right shoulder by 100%, back by 75%, and legs by 75%. To reduce the risk of injury, the researchers made repairs to the workstation by making new tools and designs for the operator to carry out their cutting activities.

The proposed improvement in this research is to design a working station that is specifically designed so that the working operator works in a normal condition and does not bend. The proposal made should be able to reduce the MSD risk experienced by the operator. Of all the activities carried out, there are several results that appear on the results of the BRIEF calculations which are categorized as having high risk. From these results it is used as a reference as work design data that can reduce the risk of MSDs.

Based on some data obtained from the results, the improvement made is to make an automatic cutting tool design that is placed in the middle of the desk. In addition, the design of the work desk itself is obtained from the anthropometric calculation results of workers and from the results of the BRIEF calculation method.

Figure 3 shows the results of the design of tools that can be used for 2 activities, which is to cut wood and can also be used as a worktable that can be adjusted to the posture of workers so that they do not have to bend. The design of this tool is shaped like a table that has a special wood cutting machine.

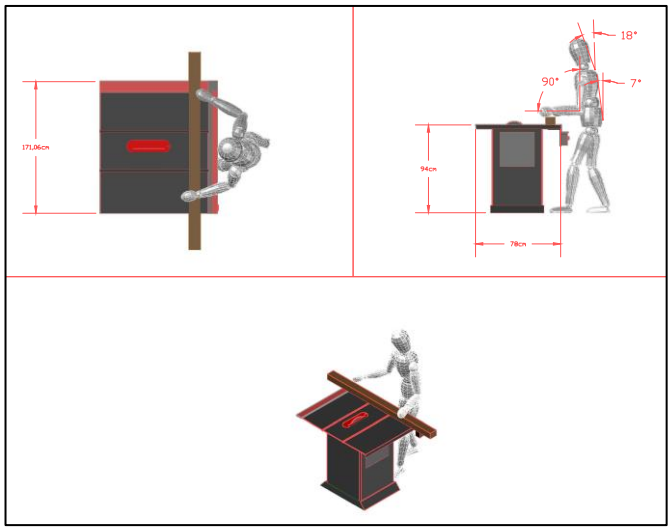

Figure 3. Proposed Critical Workstation ImprovementAfter the improvements shown in Figure 3, the BRIEF analysis was performed again. The purpose of this calculation was intended to find out whether the design of the newly designed workstation could have a good or bad effect on the woodcutting operator. The workstation design was adjusted to be more ergonomic and more in line with the work posture. The existence of this automatic wood cutting machine made it easier for workers to do cutting, but also the comfort when doing better work. For example, the previous position before the reparation, workers had to cut woods by bending, but after the repairs were done workers could do it by standing.

In addition, the level of work accidents risk prior to repairs is quite high, such as an injured hand due to the use of the Material Handling Manual. Work accidents are accidents that hit the operator when in contact at work [26]. Every job that involves Manual material handling (MMH) increases the risk of having an accident that is related to work and caused by MMH [27].

Table 4

	Hand and Wrist		Elbow		Shoulder		Neck	Back	Foot
	Left	Right	Left	Right	Left	Right			
Posture	1	1	1	1	1	1	1	0	0
Strength	1	1	0	0	0	0	0	0	0

Duration	0	0	0	0	0	0	0	0	0
Frequency	0	0	0	0	0	0	0	0	0
Score	2	2	1	1	1	1	1	0	0
Risk Level	Low	High	Low	Low	Low	Low	Low	Low	Low

BRIEF Calculation Results

From the calculation results shown in Table 4, it can be concluded that after an improvement in the work station gets a positive result because it can reduce the risk of existing MSDs. For example, the right wrist that initially had a percentage risk of 75%, after repairs was reduced to 25%.

The benefits of this new design are:

1. Reducing the risk of injury
2. Reducing workload received by workers
3. Increasing workers' productivity
4. Speeding up the time needed when cutting
5. Make operators comfortable doing work
6. Reducing costs for accidents

VII. CONCLUSION

Based on the results of the study, the issue of muscular colletal disorder (MSDs) in wood cutting operators is identified. The results were carried out using the Nordic Body Maps (NBM) questionnaire. There are 14 muscle parts found at high risk with an average individual score of 60.25. The BRIEF method supports the results of questionnaires from NBM. Furthermore, based on the research conducted, the results of a worksheet using BRIEF shows that one of the activities in packaging namely cutting wood has a high work risk.

It is said that the work risk is high because the worksheets resulrs using BRIEF produce a percentage calculation of some parts of the body namely, on the right hand and wrist by 75%, right elbow by 75%, right shoulder by 100%, back by 75%, and legs by 75%. The results of these calculations are at high risk of injury to MSDs. From these results the researchers designed a cutting table with wood cutting tools to improve working posture for the better.

After making improvements to the BRIEF method one of score on the body part which is the right shoulder gets a positive result from 100% to 25%. In addition, the conceptual design allows the operator of wood cutting to work in neutral posture and the usage of muscles in the waist and upper limb can be reduced.

Implementing ergonomic interventions and the conceptual design of this cutting table can improve work posture and increase worker comfort, but also reduce MSD risk and potentially increase productivity.

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