Analysis of MSDs and Work Posture Assessment in Denim Workers Surabaya

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Abstrak

Faktor risiko Musculoskeletal Disorders (MSDs) disebabkan oleh aktivitas kerja manusia seperti posisi canggung, gerakan berulang dan penanganan manual terutama pada industri fashion di bidang penjahit. Keluhan otot diawali dengan rasa panas, tegang dan kaku pada bagian tubuh tertentu akibat durasi yang terlalu lama atau pembebanan yang berlebihan. Penelitian ini bertujuan untuk menganalisis keluhan subjektif MSDs menggunakan kuesioner Nordic Body Map (NBM) dan postur kerja menggunakan lembar kerja Rapid Entire Body Assessment (REBA). Penelitian ini merupakan penelitian cross sectional dengan menggunakan 6 responden di bagian produksi Denim Works. Hasil penelitian menunjukkan bahwa sebagian besar pekerja memiliki MSDs sedang (66,7%), sedangkan sisanya memiliki MSDs rendah (33,3%). Keluhan yang paling sering dirasakan adalah leher bagian atas, kedua bahu, punggung, pinggang, bokong atas dan bawah serta kaki kanan. Semua pekerja di bagian produksi memiliki tingkat risiko postur kerja sedang (100%). Sebagian besar responden memiliki keluhan kelelahan subjektif MSDs sedang dan semuanya memiliki risiko postur kerja sedang, sehingga perlu perbaikan postur kerja. Saran yang dapat diberikan adalah pengadaan kursi yang memiliki sandaran yang dapat diubah ketinggiannya, program peregangan dan perubahan meja kerja.

***Kata kunci**: MSDs; Postur; NBM; REBA; Tailor*

Abstract

The risk factors for Musculoskeletal Disorders (MSDs) are caused by human work activities such as awkward positions, repetitive motions and manual handling, especially in the fashion industry in the tailor field. Muscle complaints begin with a feeling of heat, tension and stiffness in certain body parts due to too long duration or excessive loading. This study aims to analyze the subjective complaints of MSDs using a Nordic Body Map (NBM) questionnaire and work posture using the Rapid Entire Body Assessment (REBA) worksheet. This research is a cross sectional study using 6 respondents in the production department of Denim Works. The results showed that the majority of workers had moderate MSDs (66.7%), while the rest had low MSDs (33.3%). The complaints most often felt were the upper neck, both shoulders, back, waist, upper and lower buttocks and right leg. All workers in the production department have a moderate level of risk of working posture (100%). Most of the respondents had moderate MSDs subjective fatigue complaints and all of them had a moderate risk of working posture, so they needed to improve their work posture. Suggestions that can be given are the procurement of seats that have backrests that can be changed in height, stretch programs and changes to work tables.

***Keywords**: MSDs; Posture; NBM; REBA; Tailor*

1. INTRODUCTION

Today, the use of human labor in carrying out work or activities related to materials and materials around the work area is still quite high in Indonesia. Even though some industries have been modernized, it cannot be denied that manual material handling (MMH) is still often carried out. Efforts to protect work safety in accordance with Law No. 1 of 1970 by providing legal protection to workers who work so that production sites and equipment are always in a safe condition (Indonesia, Republic, 1970). As for the incompatibility between humans, work stations and machines, this is what causes health problems in the field of ergonomics in the workforce, namely Musculoskeletal Disorders (MSDs) (NIOSH. (1997). Manual handling-related injuries continue to account for about one-third of all non-fatal injuries reported to the HSA (33%) (Health and Safety Authority, 2015). The Bureau of Labor Statistics of the Department of Labor defines MSDs as musculoskeletal system and connective tissue diseases and disorders when the event or exposure leading to the case is bodily reaction (e.g., bending, climbing, crawling, reaching, twisting), overexertion, or repetitive motion. (CDC, 2022).

Data from the Central Statistics Agency (BPS) in August 2020, Population Development of Male and Female Gender Aged 15 and Over by Type of Activity shows that around 138.2 million people are in the type of work force activity (ILO, 2020). The results of the report from the implementation of occupational health of the Ministry of Health of the Republic of Indonesia in 2013 stated that as many as 428,844 cases of occupational diseases occurred in Indonesia (Kementrian Kesehatan, 2014). Based on data from the ILO (International Labor Organization) in 2013 it was found that every year 2.34 million people died due to work accidents and occupational diseases. The ILO in 2013 also reported that MSDs occur in various parts of the world. As happened in Argentina in 2010, around 22,013 cases of CAD were found, with MSDs dominating the incidence of CAD (ILO, 2013). According to data from the National Research Council and the Institute of Medicine, musculoskeletal disorders account for nearly 70 million physician office visits in the United States each year, and an estimated 130 million total health care encounters including outpatient, hospital, and emergency room visits (CDC, 2022).

Denim Works is a home industry in the tailor sector based on Jl. Srikana No. 44 Airlangga Kec. Gubeng, Surabaya which produces tops and bottoms such as pants and

jackets depending on the demand from consumers with an average incoming order of 40 pants orders with a total production team of 6 people with details of 1 person as a pattern breaker, 4 people as tailors and 1 people as finishing. The work station for the pattern breaker is located at 1 fixed point with a static condition and the majority are standing and moving upper body parts. As for tailors, the position of their work station varies depending on the stage and machine being used. The Finishing stage is in 1 static work station and the majority are in a sitting condition.

The general purpose of this study was to assess the level of risk of MSDs subjective complaints that arise and to analyze the work posture of production workers at Denim Works Surabaya and make recommendations for their control. This study has specific objectives, namely identifying the location of complaints and the level of subjective complaints of MSDs for production workers at Denim Works Surabaya using the Nordic Body Map (NBM), evaluating and analyzing work postures for production workers at Denim Works Surabaya using Rapid Entire Body Assessment (REBA). and provide control recommendations based on the results of the analysis.

2. MATERIAL AND METHOD

This research is a cross sectional research type, with an observational approach. This research was conducted at Tailor Denim Works, Gubeng District, Surabaya Regency. The subjects of this study were all production workers at Denim Works, namely 6 respondents. The variables used in this study consisted of occupational factors, namely the level of ergonomic risk using the REBA assessment sheet. The Rapid Entire Body Assessment (REBA) is a tool used to evaluate the risk of musculoskeletal disorders (MSDs) associated with specific tasks within a job. It is a whole-body screening tool that follows a systematic procedure to assess biomechanical and postural loading on the body. The benefits of this tool are that it is simple, quick, and requires minimal equipment (pen and paper) making it easy to complete multiple assessments per task or per job. The REBA evaluates the whole body and it can be used to assess any task. (Hignett, S., & McAtamney, L, 2000). The subjective complaints of MSDs by filling out the NBM questionnaire. Through the Nordic body map, it can be seen parts of the muscles that experience pain with the level of pain ranging from discomfort (rather pain) to very sick (Corlett E. N. and Clark T. S., 2003).

The data used are primary data and secondary data. Primary data was obtained from the Nordic Body Map (NBM) worksheet which was given to all production workers at denim works and observations were made to directly observe the worker's body posture during production activities (cutting patterns, sewing and finishing) using the Rapid Body method. Entire Assessment (REBA). Secondary data in this study were obtained from companies and documentaries and can be obtained from related companies such as a general description of the company, business activities and the identity of each production worker at denim works.

The data that has been obtained is then analyzed using the crosstabs or cross tabulation method and is presented in the form of tables and texts or narratives that know the workers' body postures and the subjective complaints of MSDs in production workers at Denim Works.

3. RESULT AND DISCUSSION

Denim Works is an UMKM that is engaged in tailoring so that it is able to provide top and bottom clothing according to the wishes and sizes of consumers. The main materials provided are raw denim or raw jeans for smart casual needs and cotton twill which is more formal in nature and the selection of threads that can be chosen to give the best accent to the outfit. The production process at Denim Work consists of making patterns, sewing and finishing.

In this study, researchers conducted observations in workshops Denim Works with a research focus, namely the identification of work positions against subjective complaints of MSDs. Respondents in this study were all workers production in the Denim Works workshop as many as 6 people with details 1 pattern breaker, 4 tailors and 1 finishing worker which are all workers has never been studied before regarding work posture. Based on observation data The initial work carried out in May 2021 the six workers stated felt subjective complaints of MSDs in the form of back pain and pain in wrist. Research respondents are male and the average age of the respondents is 29 years, with an average tenure of 3 years. The work is in progress for 12 hours a day. All respondents stated that they did not have the disease participants in carrying out their work related to complaints subjective MSDs.

Based on interviews and research on respondents using the NBM questionnaire, data obtained that from the 6 respondents studied, 4 respondents (66.66%) were found

to be included in the moderate risk level for MSDs subjective complaints. The score ranges from 47-58 with an average risk level score of 51. This means that the majority of respondents or 4 people experienced a moderate level of MSDs subjective complaints and 2 others had low risk MSDs subjective complaints. The following are the results of the questionnaires that have been conducted and differentiated by each respondent:

Table 1. Distribution of MSDs Subjective Complaints Level among Production Workers in Denim Works

No	Skor Nordic Body Map (NBM)	Sewing	Pattern making	Finishing	Total
		n	n	n	%
1	28 – 49 (Low	1	0	1	33,33
2	50-70 (Medium)	3	1	0	66,67
3	71-91 (High)	0	0	0	0
4	92-112 (Very high)	0	0	0	0
Total		4	1	1	100

Table 2. Score of NBM Results on Production Workers in Denim Works

No	Body Position	Pain level							
		Painless		Medium pain		Hurt		Very Sick	
		n	%	n	%	n	%	n	%
0	Pain/stiffness in the upper neck	0	0	5	83,3	0	0		16,7
1	Pain in the lower neck	5	83,3	0	0	0	0	1	16,7
2	Pain in the left shoulder	2	33,3	4	66,7	0	0	0	0
3	Pain in the right shoulder	0	0	6	100	0	0	0	0
4	Pain above the left arm	3	50	1	16,7	2	33,3	0	0
5	Pain in the back	0	0	0	0	5	83,3	1	16,7
6	Pain in the right upper arm	0	0	2	33,3	4	66,7	0	0
7	Pain in the waist	0	0	0	0	5	83,3	1	16,7
8	Pain in the buttocks	1	16,7	0	0	5	83,3	0	0
9	Pain in the lower part of the buttocks	1	16,7	0	0	5	83,3	0	0
10	Pain in the left elbow	5	83,3	1	16,7	0	0	0	0
11	Pain in the right elbow	4	66,7	0	0	2	33,3	0	0
12	Pain in the left forearm	5	83,3	1	16,7	0	0	0	0
13	Pain in the right forearm	5	83,3	1	16,7	0	0	0	0
14	Pain in the left wrist	4	66,7	2	33,3	0	0	0	0
15	Pain in the right wrist	1	16,7	3	50	2	33,3	0	0
16	Pain in the left hand	5	83,3	1	16,7	0	0	0	0
17	Pain in the right hand	2	33,3	4	66,7	0	0	0	0
18	Pain in the left thigh	6	100	0	0	0	0	0	0
19	Pain in the right thigh	5	83,3	1	16,7	0	0	0	0
20	Pain in the left knee	6	100	0	0	0	0	0	0
21	Pain in the right knee	4	83,3	2	16,7	0	0	0	0
22	Pain in the left calf	3	50	1	16,7	2	33,3	0	0
23	Pain in the right calf	0	0	1	16,7	5	83,3	0	0

No	Body Position	Pain level							
		Painless		Medium pain		Hurt		Very Sick	
		n	%	n	%	n	%	n	%
24	Pain in the left ankle	4	66,7	2	33,3	0	0	0	0
25	Pain in the right ankle	0	0	2	33,3	4	66,7	0	0
26	Pain in the left leg	6	100	0	0	0	0	0	0
27	Pain in the right leg	1	16,7	5	83,3	0	0	0	0

In table 2, it can be seen that the majority of workers in the production division experience complaints of moderate pain in the body dimensions of the lower neck, left shoulder, right shoulder, right wrist, right leg and complaints of pain in the body dimensions of the back number, right upper arm, waist, buttocks, buttocks. bottom, right calf, right ankle and even some workers complained of extreme pain in the neck and back areas. It is known that these complaints are caused by a static position, repetitive motion and static electricity in the sewing machine pedal area to be one of the factors of MSDs subjective complaints that can arise. Map of body parts which in Nordic body map data can be described as follows:

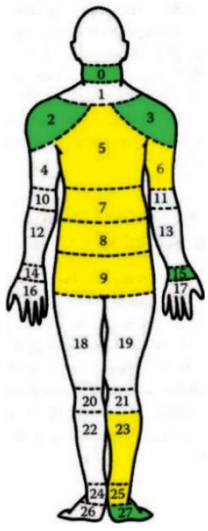

Figure 1. Nordic body map MSDs Subjective Complaints to Production Workers at Denim Works

After observing and measuring all respondents with a total of 6 people using the REBA worksheet from https://industrial.ergo-plus.com/ergoplus/home/eplus, the distribution of REBA scores has a relatively stagnant value, namely at number 6 with an index risk is 1.5 from the standard standard, namely 1. The following are the steps for identifying work postures and elaborating the results of measuring work postures for each respondent using the REBA worksheet which has been collected (Ergoplus, 2021; Kong et al, 2018). The following is an illustration of the work posture of 6 respondents:

Figure 2. First Responder Work Posture When Sewing

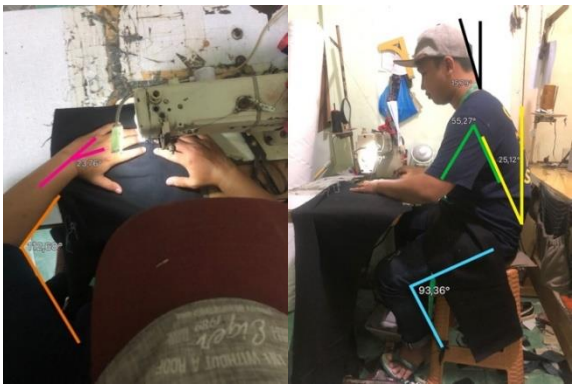

figure 3. Second Respondent Work Posture When Sewing, 2021

Figure 4. Third Respondent Work Posture, 2021

Figure 5. Fourth Respondent Work Posture While Sewing, 2021

Figure 6. Fifth Respondent's Work Posture When Finishing, 2021

Figure 7. Fourth Respondent's Work Posture When Making Pattern, 2021

From the work posture data of all respondents who have been observed while doing their work, the REBA risk level scores are all in the moderate risk level with a working length of 50 minutes/hour and a total duration of 12 hours of work in a day. The working position is 90% done in a static position and does not do too many variations of movement. The results of the calculation of work posture risk analysis using the REBA worksheet from each respondent can be categorized into several levels of risk as shown in the following table 3:

Table 3. REBA score and MSDs risk level

Respondent	REBA Score	Risk Category	Action
Respondent 1	6	Medium risk	Further investigation, change soon
Respondent 2	8	High risk	Investigate and implement change
Respondent 3	6	Medium risk	Further investigation, change soon
Respondent 4	6	Medium risk	Further investigation, change soon
Respondent 5	6	Medium risk	Further investigation, change soon
Respondent 6	6	Medium risk	Further investigation, change soon

Based on Table 3, it can be seen that there are 1 respondent who has a high risk level of MSDs and 5 respondents in the moderate risk category. For the moderate MSDs

risk category, the company, in this case Denim Works, is expected to make changes to the work system or work tools/work facilities in the future. For the category of high risk level of MSDs, the company must make changes to the work system or work tools / work facilities as soon as possible. Changes to the work system, work tools or work facilities are carried out so that the risk of MSDs can be minimized immediately (Ncube et al, 2019).

The World Health Organization (WHO) states that Musculoskeletal Disorders (MSD) "can appear suddenly and are short-lived, such as fractures, sprains and strains, but can pose a lifelong risk of conditions associated with ongoing pain and disability". This disorder occurs in people of all ages and in all parts of the world. This disease has important economic consequences and implies a decrease in performance, in addition to affecting the health of the people who suffer from them (WHO, 2020). The methods used for evaluating musculoskeletal disorders vary depending on the country, the companies carrying them out and the working environment, etc. For this reason, it is possible to classify them as direct, semi-direct or indirect methods (Gutiérrez M.H. et al, 2020).

Nordic Body Map or NBM is a method or tool in ergonomics as a structured way to find out discomfort and assess subjective complaints of MSDs that involve workers directly by distributing questionnaires (Kuorinka, et al., 1987). Symptoms that arise are directly related to the normal function of smooth tissues such as muscles, tendons, ligaments, cartilage, nervous system, bone structure and blood vessels and supporting tissues such as intervertebral discs (OSHA, 2002).

Based on the results of research conducted on production workers at Denim Works, it was found that 2 respondents (33.3%) were included in the subjective complaint of low MSDs and 4 respondents (66.7%) were included in the subjective complaint of moderate MSDs. The body dimensions that most complained about were the upper neck, both shoulders, back, waist, upper buttocks, lower buttocks and right leg area. This is in line with research by (Sihombing, A. P., et al., 2015) which used tailors as research subjects that 31 respondents felt MSDs complaints with 22 respondents feeling moderate MSDs complaints and the rest, 9 respondents, felt high level MSDs complaints. The results of this study are in line with the results of research on assessment of work posture using the REBA method conducted by Betty Andriani, et al (2020) on 75 tailors who stated that work as a tailor has a high potential risk (42.7%) and moderate risk (57, 3%) on the prevalence of MSDs.

Complaints of Musculoskeletal Disorders (MSDs) are a factor that is quite influential on posture when workers do their jobs (Rumangu, et al., 2021). Respondents have a risk level score between 5-6, which means they are at a moderate risk level with a risk index between 1.25-1.5 from the standard, namely 1. Research on tailors at the Menteng Small Industry Center Medan revealed a significant relationship between work attitudes with Musculoskeletal Disorders (MSDs) (Sihombing, et al., 2015).

The work steps carried out in the production department of Denim Works are closely related to repetitive motion or repeated movements of more than 4 times in 1 minute. In the upper body, especially the upper and lower arms, the upper body members do the most movement. The lower limbs are in a static condition or often do not move within 1 minute. Denim Works has a fairly solid work rhythm with a light workload, so there has not been significant attention to overcome this. Further measures need to be taken to reduce the symptoms of MSDs which gradually arise with a severity from low to moderate. Some suggestions that can be given by researchers to all respondents when doing sewing, making pattern or finishing activities are: Changes in work posture This change in work posture applies to all respondents where if there are symptoms of fatigue or heat in a certain body member, further review is needed because it may be included in awkward positions such as bending, squatting and looking up. For example when sewing, a safe position when working in a static lower body position is that the neck is not more than 20° from the axis of the human body so as not to cause pain in the shoulders and upper back due to the neck being pulled too far away from the body axis, the position of the legs at an angle more than 90° is changed to form a 90° fit angle so that the support on the lower body is evenly distributed and the bent wrist is changed so that it is aligned with the straight axis of the forearm.

Work Tool Change : The most urgent change in work tools is a chair that can be adjusted to the height of the seat and is able to hold the waist up to the worker's body. In their work activities, the majority of work is done in a sitting condition for a long time. For this reason, it is necessary to provide a chair as a place to rest for a while after doing work in a standing condition so that the lower body part does not cause symptoms of stiffness or numbness. (Muhyidin, 2022). The chair design that was originally not ergonomic can be replaced with a more ergonomic chair as shown in the following figure (figure 2).

Figure 2a. Office Chair

Figure 2b. Tailor's work posture using an ergonomic chair (https://222.osha.gov/etools/sewing/station-design)

Work table for the finishing section to facilitate the differentiation of finished and unfinished goods. with the following form (Figure 3).

Figure 3. Finishing section working table

The use of a work table as shown in Figure 3 is very helpful for workers to place their stitches according to their type/category. Arrangement of work items that are well organized will make it easier for workers to take the stitches according to customer orders. The table design can reduce fatigue on workers' backs, because workers no longer have to bend more than 30° when picking up the stitches. Then the update on the sewing machine table that is adjusted to the dimensions of the machine, dynamo and foot pedal as follows :

Figure 4. Sewing section working table

The use of a table design to place a sewing machine as shown in Figure 4 can reduce fatigue in the legs, calves and ankles because the legs of the table have foot rests. After replacing work facilities and infrastructure, another thing that workers need to do is do stretching exercises.

When finished working for two hours, the muscles in the body will experience fatigue and pain. One effort to reduce these complaints is stretching. Stretching properly after a workout will not dissipate the pain but will definitely minimize it to a large extent. On the other hand, if your muscles remain tight after a workout, it increases your risk of muscle injury. (Nilamsari, et al. 2017) Stretching can actually minimize and reduce your predisposition to injuries. (Luik, et al, 2021). The function of stretching itself is to accelerate the body's metabolism, which is balanced by resting for 5 minutes. A suitable stretching schedule is carried out before work, after 2 hours of work and after doing work. Stretching or stretching muscles is an activity carried out to keep the muscles of the body flexible, strong and healthy. Stretching movements that are mostly done are dynamic active movements for about 3 minutes. This is in line with the amanat UU No. 36 tahun 2009 about Health, namely that occupational health efforts must be carried out at every workplace so that they can work in a healthy manner and do not cause disease for themselves and the surrounding community. (Putri, 2021). Examples of stretching movements are as follows:

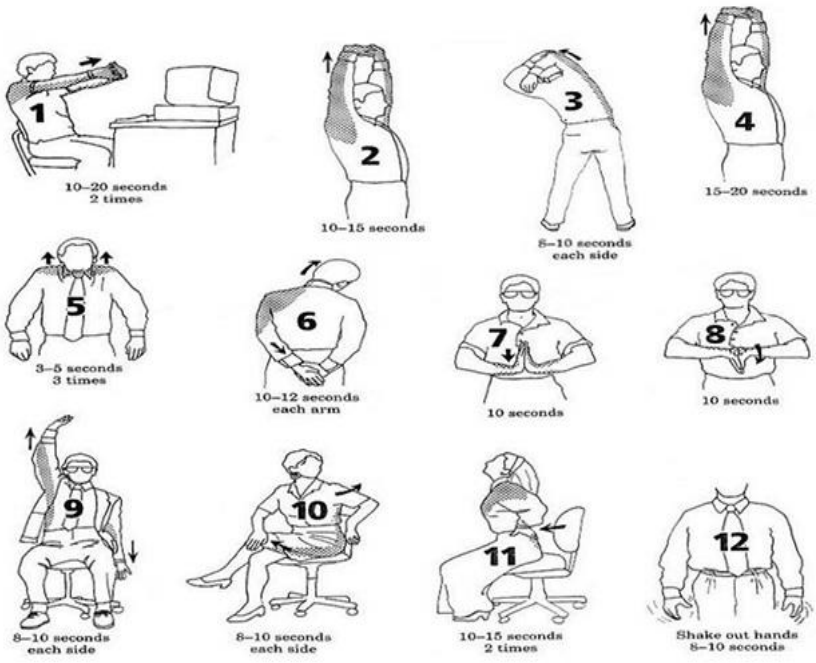

Figure 5. Stretching movements to reduce subjective complaints of MSDs, (MLDSPOT, 2015)

4. CONCLUSION

The conclusion of this study is presented briefly in a single paragraph at the end of the discussion, without using a separate subtitle. Based on the research conducted on six production workers at Denim Works regarding the analysis of work postures and subjective complaints of Musculoskeletal Disorders (MSDs), it can be concluded that the majority of respondents (66.7%) experienced moderate levels of subjective complaints related to MSDs, while the remaining 33.3% experienced mild levels of complaints. The most frequently reported areas of discomfort include the upper neck, both shoulders, back, waist, upper and lower buttocks, and the right leg. In terms of work posture risk, an assessment using the REBA worksheet showed that all respondents (100%) were categorized at a moderate risk level, except for one respondent who was classified at a high-risk level. To address these findings, it is recommended that the company provide chairs with backrests, implement regular stretching programs, and modify work desks to improve ergonomics and reduce the risk of MSDs.

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