

Identification of Musculoskeletal Disorders in Garment Workers using the Nordic Body Map (NBM)

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Abstract: The textile industry is one of the industrial activities that is carried out repeatedly with static positions and has non-ergonomic rules, causing musculoskeletal disorders such as stiff neck, back pain, muscle pain in the shoulder and calf areas. These complaints can reduce work productivity in garment workers. This study aims to determine the musculoskeletal disorders experienced by garment workers x. This study was conducted through direct observation, interviews, and filling out the Nordic Body Map (NBM) questionnaire to measure musculoskeletal disorders. The results showed that the most complaints of pain were in the waist, upper neck, and the back. For the classification of risk levels based on the Nordic Body Map score, 17 respondents (85%) experienced a risk level of MSDS disorders with the "low" category, 3 respondents (15%) with the "medium" category, and there were no respondents with the "high" category. To prevent more serious health problems in the future, it is important for garment workers to always apply ergonomic principles in their work. So that workers can maintain their health and work productivity in the long term.

Keywords: musculoskeletal disorders, garment, NBM

INTRODUCTION

Garment is one of the industrial sectors that produces apparel, such as shirts, jackets, pants, t-shirts, work clothes, and sportswear, where the science of occupational safety and health aims to improve and maintain the highest level of physical health, mental, and social well-being of workers in various types of work; the implementation of occupational safety and health includes efforts to create a safe workplace, avoid environmental pollution, and reduce work accidents and occupational diseases.

Every job has risks that have the potential to cause harm. Occupational diseases and accidents are two examples of such risks. Hazards that arise are usually caused by the interaction between workers and their work processes. There are various types of hazards that can arise, such as chemical, physical, biological, psychosocial, and ergonomic hazards, all of which can negatively affect the health of workers. Therefore, occupational health must be implemented in the work environment, not only for oneself, but also for all of workers in the place (Kurniawan & Muzakir, n.d.)

Workers with unergonomic work postures can cause fatigue, complaints in several parts of the body, and other disorders that can hinder the work process. Risky work postures can be overcome through modification of work tools, additional rest periods, and various other steps. If the worker's work posture is correct, the results produced will be satisfactory. Conversely, if the posture applied by workers is not optimal or even bad, the resulting output will not meet expectations (Sulaiman & Sari, 2016 in (Hernantya & Azzahra, 2024). According to the Labor Force Survey (LFS) released by the Health and Safety Executive, by 2023/24 around 543,000 workers will experience musculoskeletal disorders due to work activities. In addition, these disorders caused the loss of approximately 7.8 million working days. The majority of work-related musculoskeletal disorders affect the upper limbs or neck (37%) and back (43%), while the remaining 20% affect the lower limbs (Health Safety and Executive, 2021). Meanwhile, based on data from (Risksdas, 2018), it was recorded that as many as 713,783 Indonesians suffered from joint disorders.

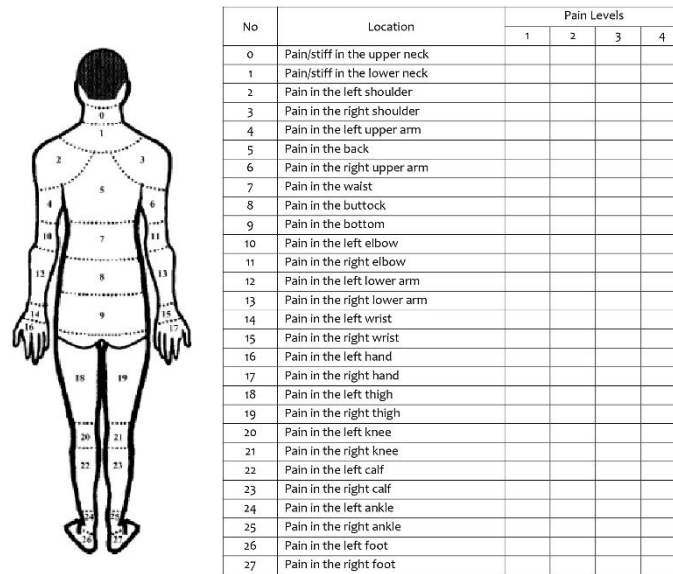
Work in the textile industry is one of the activities that has a high risk of causing musculoskeletal complaints due to physical demands such as repetitive muscle use and non-ergonomic work positions for a long time, for example when sewing, ironing, or cutting fabrics (Ajhara et al., 2022). These activities can continuously trigger disorders in various parts of the body. The results of the study (Erniyani & Astutik, 2023) show that the body parts that most often experience complaints include the upper and lower neck, both shoulders, back, waist, buttocks, and left and right calves. Complaints in the form of 'slight pain' were mostly felt on the left shoulder at 14%, while 'pain' in

the lower neck was experienced by 17% of tailors. The body part that experienced 'severe pain' was the back, with a percentage of 20%.

Garment X is an industry engaged in garment, convection, and embroidery, specializing in textile production. In running its business, this industry has a strategic role in supporting various local fashion brands to produce high-quality products. The increased production demands and repetitive physical activities increase the risk of musculoskeletal disorders. To identify these risks, the Nordic Body Map (NBM) method is the most effective instrument for assessment, a questionnaire designed to assess the level of complaints and potential injuries to various parts of the body. The results of filling out this questionnaire make it possible to identify the type and level of complaints, fatigue, and pain felt by workers, based on the analysis of a body map that illustrates the level of discomfort from mild to severe (Rasya, 2024).

METHODS

This research uses a descriptive design with data collection methods through direct observation at the research location and in-depth interviews. This approach allows researchers to make comprehensive observations of work activities and identify potential hazards that can threaten labour safety. Furthermore, in identifying ergonomic problems using NBM (Nordic Body Map).



No	Location	Pain Levels			
		1	2	3	4
0	Pain/stiff in the upper neck				
1	Pain/stiff in the lower neck				
2	Pain in the left shoulder				
3	Pain in the right shoulder				
4	Pain in the left upper arm				
5	Pain in the back				
6	Pain in the right upper arm				
7	Pain in the waist				
8	Pain in the buttock				
9	Pain in the bottom				
10	Pain in the left elbow				
11	Pain in the right elbow				
12	Pain in the left lower arm				
13	Pain in the right lower arm				
14	Pain in the left wrist				
15	Pain in the right wrist				
16	Pain in the left hand				
17	Pain in the right hand				
18	Pain in the left thigh				
19	Pain in the right thigh				
20	Pain in the left knee				
21	Pain in the right knee				
22	Pain in the left calf				
23	Pain in the right calf				
24	Pain in the left ankle				
25	Pain in the right ankle				
26	Pain in the left foot				
27	Pain in the right foot				

Figure 1. Nordic Body Map (NBM) Questionnaire

The Nordic Body Map questionnaire in Figure 1 is a commonly used questionnaire to identify the level of discomfort or complaints of pain in certain parts of the body. Respondents are asked to mark areas of the body that experience interference or pain while working. NBM is widely used because it has been standardized and arranged systematically, making it easier to collect and analysis data related to complaints of musculoskeletal disorders (MSDs). This questionnaire presents a map of the human body divided into several areas, with a scale of complaint levels ranging from 'Not Pain', 'Moderate', 'Pain', to 'Very Pain'. Through analysis of the results of filling out the NBM questionnaire, it is possible to estimate the type, severity of complaints, fatigue, and pain in certain muscles or body parts felt by workers (Dewi, 2020).

The Nordic Body Map (NBM) assessment refers to Figure 1, where each body part has been divided and classified to be assessed separately according to Table 1 (Agustin et al., 2021).

Tabel 1. Classification of Score Nordic Body Map (NBM)

Likert Scale	Total Individual Score	Risk Level	Corrective Action
1	28-49	Low	no need for corrective action
2	50-70	Medium	corrective action is needed later
3	71-90	High	it needs to be improved as soon as possible
4	91-122	Very High	It requires corrective action now

The sampling technique in this study used a sampling method involving half of the total population of workers, namely 20 respondents. After the formulation of the problem is carried out, the data obtained from the NBM questionnaire that has been filled in by the respondents is analysis using a scoring system. Data processing and analysis were carried out through the stages of data reduction, data presentation, and conclusion drawing and verification to obtain a deep understanding of the musculoskeletal complaints experienced by workers.

RESULT AND DISCUSSION

Respondent Characteristics

This study involved 20 respondents who were analyzed based on three variables. The following are the results of the recapitulation of 20 worker respondents at Garment X:

Table 2. Characteristics of respondents based on gender, age, and length of service

Variable	Total Respondents (n=20)	Percentage (%)
Gender		
Men	2	10
Women	18	90
Age		
Adult (18-45 tahun)	12	60
Pre-elderly (45-59 tahun)	7	35
Elderly > 60 tahun	1	5
Working Period		
0-1 year	8	45
1-3 year	9	40
3-5 year	3	15

Based on Table 2, it is known that workers in garment are dominated by women. Of the total 20 respondents, there were 18 female workers (90%) and only 2 male workers (10%). According to the results of a systematic review conducted by (Aprianto et al., 2021), it shows that there are average differences in muscle strength between men and women. This is influenced by various factors, including hormonal differences, genetics, and levels of physical activity. However, individual variation is very large, and many women have the same or even greater physical strength than men. Work in the garment sector that involves repetitive physical activity may increase the risk of musculoskeletal disorders (MSDs). Although women tend to dominate the garment industry in many countries, the risk of MSDs is not only related to gender, but also to other work factors such as ergonomics and workload (Diana, 2024)

In terms of age, the majority are in the adult age group (18-45 years) as many as 12 workers (60%), then there is a pre-elderly age group (45-59 years) as many as 7 people (35%), and only 1 person (5%) who entered the elderly category with an age of more than 60 years. This age distribution illustrates that workers in garment industry X are dominated by workers in the productive age range. There is a significant proportion of workers who have entered pre-elderly age. This has a high potential vulnerability to musculoskeletal complaints. This is in line with research conducted by (Yosineba et al., 2020) which states that there is a decrease in bone elasticity that occurs naturally with age, increasing a person's susceptibility to musculoskeletal disorders.

The length of service is the duration of time a person starts working until now or until he/she stops working in garment activities. The results of the analysis of the characteristics of respondents showed that 45% (9 people) had worked for more than 1 year, as many as 40% (8 people) of workers had worked for more than 3 years and for workers who worked for less than 1 year as many as 15% (3 people). According to research conducted by Ferusgel and Rahmawati, (2018) in (Aprianto et al., 2021) repeated exposure to work risk factors such as repetitive work movements and non-ergonomic work postures, over a long period of time can increase the risk of musculoskeletal disorders. Therefore, it is necessary to identify musculoskeletal disorders in garment workers, especially for workers who have worked for a long time.

The result distribution of Nordic Body Map Instrument

Table 3. The result of Nordic Body Map Instrument by Likert Scale

No	Location	Pain Levels			
		Not Pain	Moderate	Pain	Very Painful
		Totals			
0	Pain/stiff in the upper neck	8	7	4	1
1	Pain/stiff in the lower neck	13	4	3	0
2	Pain in the left shoulder	12	2	5	1
3	Pain in the right shoulder	10	5	5	0
4	Pain in the left upper arm	11	5	4	0
5	Pain in the back	11	2	7	0
6	Pain in the right upper arm	13	4	3	0
7	Pain in the waist	6	8	6	0
8	Pain in the buttock	12	6	2	0
9	Pain in the bottom	19	1	0	0
10	Pain in the left elbow	20	0	0	0
11	Pain in the right elbow	20	0	0	0
12	Pain in the left lower arm	15	4	1	0
13	Pain in the right lower arm	15	4	1	0
14	Pain in the left wrist	17	3	0	0
15	Pain in the right wrist	16	4	0	0
16	Pain in the left hand	14	6	0	0
17	Pain in the right hand	12	7	1	0
18	Pain in the left thigh	17	2	1	0
19	Pain in the right thigh	16	3	1	0
20	Pain in the left knee	17	1	2	0
21	Pain in the right knee	16	2	2	0
22	Pain in the left calf	13	4	3	0
23	Pain in the right calf	12	5	3	0
24	Pain in the left ankle	14	4	2	0
25	Pain in the right ankle	13	5	2	0
26	Pain in the left foot	15	1	4	0
27	Pain in the right foot	14	2	4	0
Total Scores		391	101	66	2

Nordic Body Map (NBP) is an instrument used in the evaluation of muscle and bone pain. This method is used to provide a visual representation of the location and severity of pain experienced by workers (Tarwaka, 2004 in (Diana, 2024). Based on Table 3, it can be seen that the majority of workers experience complaints in certain body parts that are directly related to their work activities. Overall, the highest number of complaints were in the “moderate” category with 101 responses, followed by 66 complaints in the “painful” category, and 2 complaints with “very painful” intensity, while 391 responses indicated that they had no complaints.

The most complained about body part was the waist with a total of 14 people experiencing complaints (8 mildly painful and 6 painful). Followed by the upper neck with 12 complaints, and the right shoulder with 10 complaints. Other complaints were also quite a lot felt on the left upper arm and back, with 9 complaints each. This finding is in line with research conducted by (Ramayanti & Koesyanto, 2021) which shows that the most complaints felt by garment workers are generally at the waist and neck.

The back of body is the part that is complained of because of the sitting work position for a long time. This is in line with research conducted by (Arifianto et al., 2017) which revealed that garment workers mostly experienced low back pain as much as 56.7%. There is a significant relationship between work duration, workload, and work attitude with the incidence of low back pain. Based on the results of the study, the cause of the length of work is at risk of low back pain because the longer a person sits, the muscle tension around the back and the stretching of the ligaments of the back, especially the posterior longitudinal ligament, increases.

Static workloads cause skeletal muscle fatigue. Prolonged static posture is a major factor in modern life, which is the cause of occupational skeletal muscle pain. Working in a sitting position continuously or statically results in rapid muscle contractions becoming static and the load pattern becomes stronger compared to dynamic contractions. Monotonous work, inappropriate size of work facilities and anthropometry can lead to unnatural work attitudes, provide additional workload and can ultimately cause subjective complaints (Tarwaka, 2010 in Widiastuti & Poetryono Dharmosamoedero, 2015)

Work posture that are often done by humans in doing work include standing, sitting, bending, squatting, walking, and others. Work posture are carried out depending on the conditions of the existing work system. If the conditions of the work system are unhealthy, it will cause work accidents, because workers do unsafe work (Sie et al., 2017). Sitting for a long time will cause boredom and fatigue, because when standing upright, the load influenced by gravity acts in a vertical straight line through the centre of the body which is held by the spine and projected by both legs, thus the centre of the body's weight point is in front of the spine, resulting in a moment of force that causes the body to tend to fall forward.

Table 4. The result of assessment Nordic Body Map

Respondent	Gender	Age	Occupation Performed	NBM Score	Risk Level
1	Women	49	Sewing	32	Low
2	Women	55	Sewing	32	Low
3	Women	43	Ironing	50	Medium
4	Women	20	Quality Control	42	Low
5	Women	22	Sewing	38	Low
6	Women	45	Quality Control	41	Low
7	Women	50	Sewing	38	Low
8	Women	61	Sewing	36	Low
9	Women	34	Ironing	36	Low
10	Men	26	Cutting	36	Low
11	Women	19	Cutting	45	Low
12	Women	47	Sewing	42	Low
13	Women	39	Ironing	52	Medium
14	Women	35	Packing	58	Medium
15	Women	53	Sewing	32	Low
16	Women	51	Sewing	32	Low
17	Women	51	Sewing	42	Low
18	Women	53	Sewing	43	Low
19	Women	44	Quality Control	33	Low
20	Men	38	Embroidery	36	Low

Musculoskeletal Disorders (MSDs) are a group of pathological conditions that affect the normal function of the delicate tissues of the musculoskeletal system which includes the nervous system, tendons, muscles and supporting structures such as intervertebral discs (Ramayanti & Koesyanto, 2021). MSDs complaints are one of the complaints that can reduce work productivity, this can have a negative impact on socio-economic activities due to reduced working days. Decreased work productivity can cause the quality of the products produced to decrease. This

can have a negative impact on business actors, because when the quality of goods produced decreases, it can trigger complaints from consumers and lose consumers.

Based on Table 4 of the results of the Nordic Body Map (NBM) questionnaire given to 20 production workers at X garment with the types of work performed ranging from cutting, sewing, quality control, ironing, to packing, it is known that the complaints felt by most production workers have a relatively low level of risk of experiencing musculoskeletal disorders (MSDs). based on the total results of the respondents, 17 people (85%) were at a low risk level, while the remaining 3 people (15%) were at a moderate risk level.

Complaints with a moderate risk level are most commonly found in workers who do ironing work. This job has a repetitive work pattern. Repetitive movements are movements that are performed continuously using the same muscles in one cycle. One cycle has less than 30 seconds. Repetitive motion over a long period of time can lead to excessive tension in the muscles, decreased circulation in the joints, and compression of the nerves and blood vessels. Compression of nerves and blood vessels can result in MSDs complaints such as pain, numbness, and weakening of the extremities (Yosineba et al., 2020). Work activities such as ironing and packing that are carried out for a long time without stretching or taking breaks contribute to the appearance of complaints in certain parts of the body, such as the neck, back, shoulders, and wrists.

Overall, most workers have a low risk of MSDs complaints. However, given the repetitive nature of the work, this risk can increase over time. Therefore, it is important for workers to always pay attention to ergonomic aspects at work. There are several jobs with moderate risk of MSDs complaints, indicating the importance of implementing ergonomic interventions to minimize musculoskeletal complaints. Recommendations for workers, it is necessary to take care of themselves with regular exercise to increase muscle strength and flexibility. In addition, it is important to stretch every 2 hours of work for 10-15 minutes. Recommendations for management are to reorganize the work system and apply ergonomic principles in the work environment to minimize the potential for musculoskeletal disorders in workers. It is important to monitor and prevent work with a moderate risk tendency so that it does not develop into more serious complaints. Management can take preventive measures such as setting a balanced work and rest time and providing ergonomic training on correct work postures.

CONCLUSION

Based on the results of research conducted at garment X on 20 workers with various types of production work such as sewing, ironing, quality control, cutting, embroidery, and packing, it can be concluded that the majority of workers experience musculoskeletal disorders (MSDs) complaints with a relatively low level of risk. However, there are 15% of workers who show a moderate level of risk, especially in ironing work which is characterized by static and repetitive movements. The body parts with the most complaints are the waist, upper neck, and shoulders. Factors such as unergonomic work positions, long work duration, and lack of stretching or rest breaks are the main causes of MSDs complaints. Although the risk level is classified as mild, the potential for the accumulation of long-term injuries remains if preventive efforts are not made. Therefore, the implementation of ergonomic interventions, balanced work-rest time arrangements, and good work posture education are necessary to prevent an increase in the risk of MSDs in the future.

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