

# Factors Affecting Risk of Musculoskeletal Disorders (MSDs) Complaints in Spring Production Workers

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## Abstract

**Introduction :** Musculoskeletal Disorders (MSDs) are one of the occupational diseases with complaints that felt in the skeletal muscle. Musculoskeletal complaints can occur in any sector of work. one of the sector is in informal sector workers. The aim of this research was to analyze the relation between individual factors with occupational factors on musculoskeletal complaints in spring production workers.

**Methods :** This research was an observational research with cross sectional approach. The sample in this research was 23 respondents in the production unit. Sampling in this research was conducted by total population. Data of respondent characteristics musculoskeletal complaints were obtained through interviews conducted to respondents by filling out standardized questionnaires. Work posture data were analyzed using Rapid Entire Body Assessment (REBA) and musculoskeletal complaints data were analyzed using the Nordic Body Map (NBM) method. Statistical tests were analyzed using the Contingency Coefficient test.

**Results :** The results of the research to 23 respondents showed that the majority of respondents as many as 15 respondents (65.21%) had MSDs complaints in the high pain severity category. Risk factors related to Musculoskeletal Disorders complaints were age. smoking habit. sex. nutritional status. works duration. work posture and physical workload. The data obtained were analyzed using the Contingency Coefficient test.

**Conclusion :** Factors causing Musculoskeletal Disorders that had the strongest relationship were odd or non-ergonomic work posture of workers ( $r = 0.632$ ) with positive relation direction. meaning that the higher the risk of work posture. the higher the risk for experiencing MSDs complaints.

**Keywords :** *Musculoskeletal Disorders (MSDs). Individual Factors. Occupational Factors*

## Introduction

Workers are resource that plays important role in carrying out its work. so workers are required to get attention and protection from their workplaces. Occupational health efforts for workers need to be

carried out in every workplace. especially for companies or industries that are risky of having health hazards. Given that workers is one of the valuable assets for a company or industry. Occupational Safety and Health (OHS) is a form of protection for workers in creating a safe workplace.

The impact of the less optimal efforts to implement Occupational Safety and Health (OHS) is the occurring of Musculoskeletal Disorders (MSDs) complaints. Continental Union of European Union Member. 27 countries of them states that in 2004 MSDs are the most common occupational diseases as much as 59% of all Occupational Diseases (OD). Based on data released by the World Health Organization (WHO) in 2009 MSDs

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accounted for more than 10% which caused disability<sup>1</sup>.

The Health and Safety Authority (HSA) on 2015 explains that the number of Occupational Diseases (OD) that occurred on 2012 struck 27.1 of 1000 workers<sup>2</sup>. The high number of workplace accidents that occur at work has continued to increase since 2012. From those number of reported cases, it is known that around 32% are musculoskeletal injuries resulting from work activities such as lifting weights (43%). The occurrence of musculoskeletal complaints can be worsen if the work position or posture of the workers when carrying out the work activities is not ergonomic or odd.

One of OHS implementations is the ergonomics implementations in the workplace. Ergonomics is a science, art and technology application to harmonize humans in their activities with the facilities used to achieve a better quality of life<sup>3</sup>. Ergonomics is one of the problems that can appear in every company, this is due to the need for harmony between workers and their jobs. The ergonomics implementation is a must for every workplace so that discomfort and other complaints can be minimized<sup>3</sup>. If there is a mismatch between the work stations and the workers, it can result in complaints or disorders in the musculoskeletal system which include joints and muscles because the body is not ergonomic. This position can cause complaints that are commonly called Musculoskeletal Disorder (MSDs).

Musculoskeletal Disorder Disorders (MSDs) are one of the disorders that are caused by non-ergonomic work postures. Musculoskeletal Disorder (MSDs) complaints are complaints that felt in parts of skeletal muscle ranging from very mild to extreme pain complaints caused by muscles receiving repetitive static loads and for long time duration during work and can cause damage to joints, ligaments and tendons. Studies on Musculoskeletal Disorder (MSDs) showed that the parts of muscle that often complained of are the muscles of the neck, shoulders, arms, hands, fingers, back, waist and lower muscles<sup>4</sup>.

Based on the publication of the Occupational Safety Consultation Institute in the UK, on 2016 to 2017 there are 507.000 cases related to MSDs due to work with a total of 1.299.000 cases of Occupational Diseases or 39% of total Occupational Diseases. The average value of MSDs complaints reaches 1.550 cases out of 100.000

workers who have Occupational Diseases<sup>5</sup>.

MSDs are complaints or disorders that are felt by someone ranging from mild to very painful complaints in the parts of musculoskeletal which include the joints, nerves, muscles and spine due to unnatural work<sup>4</sup>. If the muscles are experiencing disorders, then daily activities such as working can be disrupted because muscle strength is one of the most important parts of human organs so the body can move. The appearance of pain in the muscles can result in decreased person's work productivity. While muscle strength itself would be determined by the number of fibers that are actively wrinkled in the human body in a certain period of time<sup>6</sup>. In addition, excessive muscle contraction coupled with too much weight lifting in a long time duration would certainly increase a risk to MSDs complaints.

Other theories state that unnatural work positions such as backs too bent, hand raised movements and so on can increase the occurrence of MSDs complaints. The farther the body part position from the center of body gravity, the higher the risk of skeletal muscle complaints. This unnatural work position is generally due to the characteristics of job demands, work tools and work stations that are not in accordance with the abilities and limitations of workers<sup>3</sup>.

Researches related to MSDs complaints themselves have been conducted in various companies and industries. Such as research conducted by Aulia Tjahayuningtyas (2019) the research results to 38 respondents shows the work period ( $p = 0.019$ ) and workload ( $p = 0.000$ ) has a relation with MSDs complaints on workers in the informal sector<sup>7</sup>. The MSDs complaints themselves are mostly felt by the informal workers on the right wrist (86%) and right foot (68%). Meanwhile, research conducted by Elza (2012) shows that the informal sector of traditional songket craftsmen in West Sumatra has a high ergonomic risk based on an assessment using the RULA method<sup>8</sup>. The results shows the most frequent complaints experienced by workers were on the back by 80%, then complaints on the right shoulder by 74% and the last complaints on the waist by 72%.

Previous research conducted by Alfiani & Basri (2016), as much as 46.9% workers such as porters are at risk of experiencing complaints of low back pain due to too much heavy load lifted and carried out continuously<sup>9</sup>.

Although the informal sector has contributed a lot to both the economy and employment providers, it cannot be denied that the health conditions of the workers are still worrying.

The impact resulting from the appearance of Musculoskeletal Disorders complaints according to Bird and Germain (2005), are loss of work time, reduce alertness, increase the risk of accidents, if the complaint has reached the final stage then requires high costs for recovery<sup>10</sup>. Musculoskeletal Disorders complaints require sufficient time and various stages for pain to appear in certain body parts.

Musculoskeletal Disorders complaints can occur in both the formal and informal sectors. The spring production industry which was my research place is one of the informal sector businesses. According to Alma (2001) explains that the informal sector is a manifestation of small-scale employment with the aim of earning income without profit<sup>11</sup>. Business in the informal sector is one type of business that has a very high health risk. The workforce on 2000 with total 95.650.691 people, which 70-80% of them are in the informal business sector. Workers in the informal sector are populations that lack of getting health services especially occupational health<sup>12</sup>.

The explanation above, became the background of researcher conducting research related to risk factors affecting the occurrence of Musculoskeletal Disorders complaints in production unit workers in the spring industry. It was expected that after conducting this research, researcher could study the factors related with the occurrence of Musculoskeletal Disorders complaints in workers. Thus, the ergonomics implementation in the workplace needed to be pursued directly because it would affect complaints both fatigue and other health problems.

## **Materials and Methods**

Based on the type, this research was observational because it did not provide treatment to respondents with analytical research methods. Meanwhile, the design of this research used a cross-sectional research  $\rightarrow$  because the variables were researched and observed at the same time to describe the level of Musculoskeletal Disorders (MSDs) complaints in respondents.

The population used in this research was the spring production industry workers in Menganti District, Gresik. The sample in this research were all workers who worked in the production process and were willing to be respondents in this research with a total of 23 workers. Research was conducted in December 2019 until February 2020.

The variables used include age, smoking habit, sex, nutritional status, works duration, work posture and physical workload on Musculoskeletal Disorders complaints felt by workers after carrying out work activities.

Data obtained through observation, interviews, and questionnaires. Workers were observed to watch work postures and physical workload obtained while working on Musculoskeletal Disorders complaints. Work posture was observed by adjusting the REBA (Rapid Entire Body Assessment) observation assessment sheet, then the assessment of physical workload was obtained based on measurements using a calorimeter to calculate the calorie needs assessment when carrying out work activities. Then, continued to fill in the Nordic Body Map (NBM) assessment sheet after the workers completed their works. The completion of this assessment sheet aimed to find out which parts of the body experiencing complaints and the level of complaints felt by each individual.

Data and information that obtained through observation, interviews and questionnaires processed and analyzed in the form of tables, pictures, and narratives to ease the delivery of information and results obtained in research. To find out the results, an analysis using contingency coefficient test was conducted. If the results of the analysis approach 0 then the relation gets weaker, if it approaches 1 then the relation gets stronger. This research obtained ethical approval from the Health Research Ethics Commission of the Faculty of Dentistry, Universitas Airlangga (No:001/HRECC.FODM/1/2020).

## **Results and Discussion**

The work carried out in the spring production industry was work that requires considerable effort and energy of the workers. The production process of this industry used a lot of repetitive activities in a standing

position continuously and movements such as taking and arranging repeatedly. This work activities will certainly cause injury to the muscles. joints. ligaments and tendons<sup>4</sup>. Such disorders are commonly referred to as MSDs complaints or complaints that appear in the musculoskeletal system which is a condition with discomfort or pain can appear.

Based on the results of research that had done. it was known that all workers in the production unit or 23 respondents stated experiencing MSDs complaints in part of their bodies after carrying out their work activities. Parts of the body that often experience complaints such as the hands. feet. back. waist due to the work using repetitive hand movement activities and carried out on

standing and bent position in the daily work.

**Respondent Characteristics**

The respondents were as many as 23 people. based on Table 1 showed that the majority of respondents were in the Late Adult category aged 36-45 years as many as 9 respondents (39.1%). most of them had a smoking habit in Moderate Smoker category as many as 9 respondents (39.1% ) and the majority were male respondents as many as 20 respondents (86.95%). Most respondents had normal nutritional status category as many as 16 respondents (69.6%) and as many as 15 respondents (65.2%) had works duration ≥ 8 hours/day.

**Table I. Distribution of Respondent Characteristics in Spring Production Industry on 2019**

Variable	Category	Frequency	Percentage (%)
Age	Early Teenager	4	17.4
	Early Adult	3	13.1
	Late Adult	9	39.1
	Early Elderly	6	26.1
	Late Elderly	1	4.3
Total		23	100
Smoking Habit	Non Smoker	6	26.1
	Light Smoker	5	21.7
	Moderate Smoker	9	39.1
	Heavy Smoker	3	13.04
Total		23	100
Sex	Male	20	86.95
	Female	3	13.05
Total		23	100
Nutritional Status	Thin	5	21.7
	Normal	16	69.6
	Fat	2	8.7
Total		23	100
Works duration	≤ 8 hours/day	8	34.8
	≥ 8 hours/day	15	65.2
Total		23	100

**Work Posture**

Respondents work postures were assessed using the REBA (Rapid Entire Body Assessment) observation questionnaire sheet by measuring angles and then continuing with scoring for each group. This scoring assessment aimed to determine the risk categories received which consisted of acceptable risk, low risk, moderate risk, high risk and very high risk. Based on research that had done on 23 respondents.

Group A score consisted of assessments on the body, neck and legs and addition of force scores. The scoring results were then entered into the group A REBA score table. Group B score consisted of assessments of the upper arm, forearm and wrist and the addition of a grip

type score. The score results were then entered into the group B REBA score table. Assessment of group C score was a combination of score A and score B. The results of the next assessment entered into the group C REBA score table. Furthermore, the total C score was added to the increase of muscle activities score. The results of the assessment were final result which could determined a risk category.

Table 2 could be seen the final results of the work posture assessment that from a total of 23 respondents as many as 14 respondents (60.7%) had work postures with moderate risk category, as many as 7 respondents (30.4%) had work postures with low risk category and as many as 2 respondents (8.7%) had a work posture with a high risk category.

**Table II. Distribution of Work Posture Assessment Final Results in Spring Production Industry on 2019**

Category	Frequency	Percentage (%)
Low Risk	7	30.4
Moderate Risk	14	60.7
High Risk	2	8.7
Total	23	100

**Physical Workload**

Physical workload was measured using a calorimeter. This tool was installed when the respondents work for 8 hours while working in one work shift using a calorie needs assessment technique. This measurement aimed to determine the physical workload categories received which consisted of mild, moderate and heavy.

Table 3 could be seen the final results of the physical workload measurement that from a total of 23 respondents as many as 18 respondents (78.26%) included in the category of moderate physical workload and as many as 5 respondents (21.73%) included in the category of heavy physical workload.

**Table III. Distribution of Physical Workload Measurement Results in Spring Production Industry on 2019**

Category	Frequency	Percentage (%)
Moderate	18	78.26
Heavy	5	21.73
Total	23	100

**Musculoskeletal Disorders Complaints**

Musculoskeletal Disorders (MSDs) complaints were measured using the Nordic Body Map (NBM) assessment sheet. Measurement steps carried out through observation and interviews respondents about which parts of the body experiencing pain by pointing directly to the picture on the questionnaire sheet. The assessment sheet then carried out a checklist based on the complaint levels of pain experienced by the respondents

This measurement aimed to determine the severity pain categories received which consisted of low, moderate, high and very high.

Table 4 could be seen the final results from the complaints measurement felt that from a total of 23 respondents as many as 8 respondents (34.78%) had complaints in the moderate pain severity category and as many as 15 respondents (65.21%) had complaints in the high pain severity category.

**Table IV. Distribution of Musculoskeletal Disorders Complaints Measurement Results in Spring Production Industry on 2019**

Category	Frequency	Percentage (%)
Moderate	8	34.78
High	15	65.21
Total	23	100

**Results of Relation Analysis Between Respodent Characteristics with MSDs Complaints in Informal Workers**

Based on the results of the research in Table 1 related Respondent Characteristics showed the respondents as many as 23 people. most of the respondents were in the Late Adult category as many as 9 respondents (39.1%). most of them had smoking habits in Moderate Smoker category as many as 9 respondents (39.1%) and the majority were male respondents as many as 20 respondents (86.95%). Most respondents had a normal nutritional status category as many as 16 respondents (69.9%) and as many as 15 respondents (65.2%) had works duration ≥ 8 hours/day.

**Table V. Results of Relation Analysis Between Variables with MSDs Complaints in Spring Production Industry on 2019**

Variable	MSDs Complaints				Total		Coeff	Expl.
	Moderate		High		N	%		
	n	%	n	%				
<b>Age</b>								
Early Teenager	1	25	3	75	4	100	0.512	Strong
Early Adult	1	33.3	2	66.7	3	100		
Late Adult	6	66.7	3	33.3	9	100		
Early Elderly	0	0	6	100	6	100		
Late Elderly	0	0	1	100	1	100		
Total	8	125	15	375	23	100		
<b>Smoking Habit</b>								
Non Smoker	2	33.3	4	66.7	6	100	0.273	Moderate
Light Smoker	1	25	4	75	5	100		
Moderate Smoker	5	55.5	4	44.4	9	100		
Heavy Smoker	0	0	3	100	3	100		
Total	8	113.8	15	286.1	23	100		

**Cont... Table V. Results of Relation Analysis Between Variables with MSDs Complaints in Spring Production Industry on 2019**

Sex								
Male	8	40	12	60	20	100	0.255	Moderate
Female	0	0	3	100	3	100		
Total	8	40	15	160	23	100		
Nutritional Status								
Thin	0	0	5	100	5	100	0.611	Strong
Normal	8	50	8	50	16	100		
Fat	0	0	2	100	2	100		
Total	8	50	15	250	23	100		
Works duration								
≤ 8 hours	2	25	6	75	8	100	0.374	Moderate
≥ 8 hours	6	40	9	60	15	100		
Total	8	65	15	135	23	100		
Work Posture								
Low	4	57.2	3	42.8	7	100	0.632	Strong
Moderate	4	28.6	10	71.4	14	100		
High	0	0	2	100	2	100		
Total	8	34.8	15	65.2	23	100		
Physical Workload								
Moderate	0	0	5	100	5	100	0.559	Strong
Heavy	8	44.4	10	55.6	18	100		
Total	8	34.8	15	65.2	23	100		

The results of the research analysis in Table 5 obtained the coefficient correlation value of 0.512 which meant that the strength of the relation between age and MSDs complaints had a strong category relation strength. the results of the relation analysis between smoking habits with MSDs obtained correlation coefficient value of 0.273 which meant it had a moderate category relation strength. the results of relation analysis between sex with MSDs complaints obtained coefficient correlation value of 0.255 which meant it had a moderate category relation strength. The results of research analysis related to the relationship of nutritional status with complaints of MSDs obtained coefficient correlation value of 0.611. which meant that the strength of the relation between nutritional status with MSDs complaints in strong category and the results of relation analysis between works duration with MSDs complaints obtained coefficient correlation value of 0.374. which meant that

strength of relation in the moderate category.

**Results of Relation Analysis Between Work Posture with MSDs Complaints in Informal Workers**

Based on the results of the research in Table 1 related to the final results of the work posture assessment that from a total of 23 respondents as many as 14 respondents (60.7%) had work posture with moderate risk category. as many as 7 respondents (30.4%) had work posture with low risk category and as many as 2 respondents (8.7%) had work posture with a high risk category.

The results of the research analysis in Table 5 obtained the coefficient correlation value of 0.632 which meant that the strength of the relation between work posture with MSDs complaints had strong category relation strength.

One of the factors causing Musculoskeletal Disorders complaints is an unnatural or ergonomic work posture. An unnatural work posture is a work posture that causes the position of body parts to move from the natural position. for example the movements of hands raised. backs too bent. head raised. and so on. The farther the body part position from the center of body gravity of the body. the higher the risk of skeletal muscle complaints. This unnatural work posture is generally due to the characteristics of job demands. work tools and work stations that are not in accordance with the abilities and limitations of workers <sup>13</sup>.

The work posture assessment was carried out using the REBA assessment sheet. REBA was developed to assess the risk of work postures on non-ergonomic work postures. The final REBA score obtained will be a reference to provide a reference of the level of risk and action that must be taken. The final result of the assessment that had done showed the highest level of work posture risk was in the moderate category of 60.7% with a total of 14 workers. low risk category of 30.4% with a total of 7 workers and high risk category of 8.7% with a total of 2 workers.

Results of the analysis showed that work posture had a strong correlation with musculoskeletal complaints. This could occur because each respondent had a different work posture. for example respondents who worked to make a dough of sumpia skin that used a lot of hand strength would subsequently at risk of experiencing complaints on the wrist and hand muscles. Another research conducted by Bukhori (2010) on gold miners transporters in Cilograng District. Lebak Regency <sup>14</sup>. In his research showed work posture had a significant relation with musculoskeletal complaints.

Other research showed that work position risk would be closely related to the occurrence of MSDs complaints. In addition. according to Diana (2012). there was a relation between standing work posture with musculoskeletal complaints in the weaving unit workers conducted at PT. Delta Merlin Textile Kebakkramat Karanganyar <sup>15</sup>. It also said. that the higher the assessment of work postures. the higher the received musculoskeletal complaints.

Results of Relation Analysis Between Physical Workload with MSDs Complaints in Informal Workers

Based on the results of the research in Table 1 related to the final results of the physical workload measurement that from a total of 23 respondents as many as 18 respondents (78.26%) included in the category of moderate physical workload and as many as 5 respondents (21.73%) included in the category of heavy physical workload.

The results of the research analysis in Table 5 obtained the coefficient correlation value of 0.559 which meant that the strength of the relation between physical workload with MSDs complaints had a strong category relation strength.

Workload is every job that requires muscle strength and thought of the subject. The workload given to workers must be adjusted to the physical and psychological abilities of their workers so that they cannot affect the worker's health condition <sup>16</sup>. Effort to reduce the workload of workers can be done by planning and designing a tool that can minimize complaints due to inappropriate workload <sup>17</sup>.

The physical workload measurement is based on calorie needs assessment according to energy expenditure. Based on observations. it was known that the results of the physical workload measurement showed from the total 23 respondents as many as 18 respondents (78.26%) were included in the category of moderate physical workload and as many as 5 respondents (21.73%) were included in the category of heavy physical workload. The results of this research were in line with the theory which stated that an increase in workload will be followed by an increase in musculoskeletal complaints that occur <sup>18</sup>.

According to Tarwaka (2015). the human body has been created to be able to do daily work activities <sup>4</sup>. Muscle mass that weighs almost more than half of body weight allows humans to be able to move the body and do work. Work is a life goal that has an important meaning for progress and improvement in achievement so that it can reach a productive life. On the other hand. it means that the body will receive loads from outside the body. Means that each worker is a load for those concerned both in the form of physical and mental load.

The theory was in line with Tarwaka (2015) that stated each person's work ability is highly dependent on

the level of skill. physical fitness. nutritional status. sex. body size and age of the worker concerned<sup>4</sup>. Generally, age is related to person's work period. when the work period increases automatically the age of the worker will increase and applied the other way around. then the increasing age and work period of a person results in decreasing muscle strength and endurance so that the risk of muscle complaints occurs. This was one of the causes related to the results obtained where respondents who had a heavy workload were experiencing high risk level musculoskeletal complaints.

Another research conducted by Bobaya (2017) about the relation between physical workload with musculoskeletal complaints on loading and unloading porters in Manado Harbor to one hundred respondents<sup>19</sup>. This research showed there was a relationship between physical workload with musculoskeletal complaints on loading and unloading porters. this happened because musculoskeletal complaints will often appear if the muscles receive excessive workload pressure.

The results of this research were also in line with research by Utami. et al (2017) that stated there was a significant relationship between workload with musculoskeletal complaints on farmers in Ahuhu Village. Meluhu District. Konawe Regency<sup>20</sup>.

### Conclusion

Based on the results of research that conducted on factors affecting *Musculoskeletal Disorders* complaints in workers in informal sector. namely workers in the spring production industry in Menganti Gresik District. it was known that age. smoking habit. sex. nutritional status. works duration. work posture and physical workload had a relation with *Musculoskeletal Disorders* complaints felt by workers.

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