

The Relationship Between Work Posture, Workload, and Sex with Musculoskeletal Disorder (MSDs) Complaints in Workers at Tofu Factories in Piyungan District

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ABSTRACT

Background: Musculoskeletal Disorder is a disease or complaint that occurs in parts of the skeletal muscles that are felt by a person ranging from very mild complaints to very severe complaints. MSDs complaints can be caused by several factors such as work posture, workload, gender, age, body size, and so on. Therefore, this study aims to determine the relationship between gender, workload, and work posture to MSDs complaints felt by workers in tofu factories in the Piyungan District area.

Methods: This study used a quantitative method. observational analysis of *cross sectional design design*. *Cross sectional design* is a research design by measuring or observing at the same time exposure to variables, with a case study design of workers in sections. This study used the REBA method, SNI 7269:2009 standard measurement, and *Nordic Body Map questionnaire* to see worker complaints

Results: There was a significant relationship between work posture and complaints of *Musculoskeletal Disorder* in tofu manufacturing workers in Piyungan District with a *p-value* of 0.050 (*p-value*<0.05). There was a significant relationship between workload and complaints of *Musculoskeletal Disorder* in tofu manufacturing workers in the Piyungan District area with a *p-value* of 0.041 (*p-value*<0.05). There was a significant relationship between sex and complaints of *Musculoskeletal Disorder* in tofu manufacturing workers in the Piyungan District area with a *p-value* of 0.050 (*p-value*<0.05).

Conclusion: This study shows a significant relationship between work posture, workload, and gender and complaints of *Musculoskeletal Disorder* in tofu making in Piyungan District.



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1. Introduction

Based on data from the Ministry of Health of the Republic of Indonesia, it shows that diseases *musculoskeletal* Or also known as muscle pain, the most experienced by informal sector workers such as laborers, fishermen and farmers, which is 31.2%. Parts of the body that often experience complaints *musculoskeletal* or muscle pain is 100% in the back, 95.2% in the waist and 47.6% in the buttocks (1). *Musculoskeletal Disorders* (MSDs) are the most frequently reported work-related health problems (2).

One of the informal sectors, namely the Tofu Factory in Piyungan Regency, is a tofu manufacturing industry which in the manufacturing process comes from soybeans. Based on an interview with the owner of one of the factories in Piyungan Regency, this tofu factory has a total of 12 workers with an age range of 23 years to 56 years. This factory has 1 work shift, which is from 07.00 -15.00 WIB a day and operates every Monday to Sunday, but the duration of working hours may change or increase according to consumer demand which makes workers work longer than the specified time.

2. Research Methods

This study uses a quantitative method The *cross sectional* design is a research design by measuring or observing at the same time exposure to the variables, with a case study design of workers in parts. This study uses the REBA method, SNI 7269:2009 standard measurement, and Nordic *Body Map* questionnaire to see worker complaints. The sample in this study is all workers in the tofu processing area at the tofu factory in the Piyungan Regency area. The number of samples was 31 people.

3. Research Results

3.1. Tofu Manufacturing Condition

Kapanewon or also known as Piyungan sub-district has several industries engaged in the production or manufacture of tofu, in this piyungan sub-district there are 5 tofu producers, usually a business that is developed by the family itself or can also be called a family business. These 5 tofu producers are found in several villages in Piyungan sub-district such as Madugondo, Krasaan, Mandungan, Sandean, and Bintaran Kulon villages. In total, out of 5 tofu producers in the Piyungan District area, there are 31 workers in total.

3.1.1. Sex relationship with complaints of Musculoskeletal Disorder

Table 1. The results of the relationship between sex and Msds complaints.

Gender	MSDs Complaints				Total	P-Value	OR	
	No MSDs Complaints		MSDs Complaints					
	N	%	N	%				N
Man	9	29	15	48	24	77	0,035	0,667
Woman	2	6	5	16	7	23		
Total	11	35	20	65	31	100		

Table 1. showed the results of the Chi Square test regarding the relationship between sex and complaints of Musculoskeletal Disorder (MSDs) in tofu manufacturing workers in the Piyungan District area. Of the total 31 respondents, there were 24 men and 7 women. Of the 24 men, 15 (48%) reported complaints of MSDs, while 9 (29%) had no complaints. Among the 7 women, 5 (16%) experienced MSDs complaints, while 2 people (6%) did not experience such complaints. The results of the Chi Square test showed a p-value of 0.035, which is smaller than 0.05, indicating a significant relationship between sex and MSDs. The Odds Ratio (OR) of 0.667 indicates that men have a lower likelihood of

experiencing MSDs complaints than women. This data comes from primary data collected in 2024. These results showed that gender affected the risk of MSDs complaints among tofu workers, with women showing a higher vulnerability to complaints.

This study also examines the impact of gender on Musculoskeletal Disorders (MSDs) complaints felt by workers. Of the 31 respondents involved in this study, the majority were men, as many as 24 people, while the rest were women, namely 7 people. Of all the respondents, 15 men and 5 women reported experiencing MSDs complaints.

The results of the statistical test using Pearson Chi-Square showed a p-value of 0.035, which is smaller than the significant limit of 0.05. This indicates that there is a significant relationship between gender and MSDs complaints in workers. The odds ratio obtained was 0.667, showing that men have a lower likelihood of experiencing MSDs complaints than women who work in tofu manufacturing in the Piyungan District area. In other words, these results suggest that gender plays a role as a risk factor in MSDs complaints, with women having a higher vulnerability than men.

According to research conducted by Berek and Agus (2020), it is explained that the ability of male muscles is stronger than the ability of female muscles. Female muscles are smaller in size and their strength is only about 60% of the strength of men's muscles, especially in the arm, back and leg muscles. Such a natural condition makes women more susceptible to musculoskeletal disorders. The ratio of muscle complaints between women and men is 3 to 1, meaning that women experience complaints 3 times more often than men. The results showed that out of a total of 38 female operators, 22 people (57.9%) were at risk of musculoskeletal disease. Meanwhile, of the 31 male operators, only 7 people (22.6%) are at risk (3).

Similarly, the research that has been conducted by Muzakir, Ajhara, and Novianus found the same results if one of the The risk factor that affects the occurrence of musculoskeletal disorders complaints is gender, which physiologically women are much more susceptible to musculoskeletal disorders complaints than men (4).

This condition is also found in the field, female workers who work in tofu manufacturing have the same workload as male workers. When the data was collected, it was found that female workers were carrying out activities such as printing tofu, coloring finished tofu, filtering tofu dregs, cooking soybeans. Perhaps that could be one of the factors why women who work in tofu manufacturing complain more about MSDs.

This research is also in line with the research conducted by (5). Where gender and workload factors also have the potential to experience MSDs complaints. This relationship is because in his research it was found that at least 78.6% of workers reported at least one MSDs complaint once a year. The most common parts of the body that experience pain complaints are in the lower back, neck, and shoulders. In addition, MSDs complaints also occur as a result of a less supportive work environment.

Another factor that can affect the emergence of MSDs complaints felt by tofu manufacturing workers in the Piyungan District area itself is inseparable from the habits of workers in doing work. However, worker characteristics such as gender, workload, and work posture that workers feel. The stages carried out by tofu making workers include soybean milling, cooking, filtering, clumping of tofu pulp, printing, cutting, and frying. In line with the research conducted by (6) Regarding MSDs complaints felt by workers in the motorcycle repair shop sector, it shows that one of the factors that can cause MSDs complaints is that the wrong daily work posture factor can affect the incidence of MSDs to workers in the motorcycle repair shop sector.

3.1.2. workload relationship with complaints of Musculoskeletal Disorder

Table 2. The results of the relationship between workload and Msds complaints.

Workload	MSDs Complaints				Total	P-Value	OR
	No MSDs Complaints		MSDs Complaints				
	N	%	N	%			
Light	3	10	3	10	6	20	

Workload	MSDs Complaints				Total	P-Value	OR	
	No MSDs Complaints		MSDs Complaints					
Heavy	8	25	17	55	25	80	0,041	2,125
Total	11	35	20	65	31	100		

Table 2. showed the results of the Chi Square test regarding the relationship between workload and complaints of Musculoskeletal Disorder (MSDs) in tofu manufacturing workers in the Piyungan District area. Of the total 31 respondents, 25 people had a heavy workload, while 6 people had a light workload. Of the 25 respondents with heavy workloads, 17 people (55%) reported complaints about MSDs, while 8 people (25%) did not experience complaints. Among the 6 respondents with a light workload, 3 people (10%) experienced MSDs complaints and 3 people (10%) did not experience complaints. The results of the Chi Square test showed a p-value of 0.041, which is less than 0.05, indicating a significant relationship between workload and MSDs complaints. An odds ratio (OR) of 2.125 indicates that workers with heavy workloads are more than twice as likely to experience MSDs complaints compared to workers with light workloads. This data comes from primary data collected in 2024. These results show that heavy workloads significantly increase the risk of MSDs complaints among tofu manufacturing workers, indicating the need for actions to manage the workload to reduce health risks.

Workload is the number of tasks that must be completed by the workforce, both physical and mental, and is their responsibility. Every job is a challenge for those who do it, and each workforce has a different ability to handle that workload, which can be a physical, mental, or social workload. Excessive physical workload can be a risk factor for MSDs complaints because it can cause excessive muscle stretching at risk of causing pain in the spine. Work such as manual handling in its work activities requires the use of large amounts of energy so that it often exceeds the optimal strength of the muscles, resulting in excessive muscle stretching. Muscle tension can cause disturbances in blood circulation which then leads to tingling or muscle soreness (7).

Workload according to Parashaki and Putriawati (2020) can be defined as a difference between the capacity or ability of workers and the job demands that must be faced. Considering that human work is mental and physical, each has a different level of burden (8).

According to Sari (2021), workload is defined as the difference between workers' abilities and workers' demands. If the worker's ability is higher than the demands of the job, there will be a feeling of boredom (9).

The workload that can cause musculoskeletal disorder is usually related to certain ergonomic factors and working conditions such as, performing the same movement repeatedly over a long period of time, working in awkward positions or tensing muscles for a long time, lifting, pushing or pulling heavy loads continuously it can increase the risk of MSDs.

This study measures the workload, the assessment of this workload is assessed based on the level of calorie needs according to the energy expenditure experienced by tofu manufacturing workers in the Piyungan District area using the SNI 7269:200 standard. The results obtained Of the 31 respondents, 25 had a heavy workload and 6 had a light workload. 17 respondents with heavy workloads and 3 respondents with light workloads experienced MSDs. The p-value of Pearson Chi-Square was 0.041, indicating a significant relationship between workloads and MSDs. The odds ratio was 2.125, indicating that respondents with heavy workloads were 2,125 times more likely to experience MSDs compared to light workloads tofu making workers in the Piyungan District area [10].

This is supported by field conditions that workers know are required to lift and move heavy loads such as buckets filled with soybeans or water, or tofu piles. This can lead to injuries to muscles and joints. Workers perform the same tasks throughout the day, which can lead to overpressure on certain parts of the body. Long working hours can lead to fatigue and increase the risk of MSDs.

This is in line with the research that has been carried out by (11) The results of the study showed that there was a relationship between workload and MSDs complaints with workers in industrial centers. In his research, the impact of physical workload on complaints

Musculoskeletal Disorders (MSDs) are categorized into 2 types, namely heavy workload (125-150) as much as 26.9% and light workload (75-100) as much as 11.1%. Based on the results of the analysis, it was concluded that there was a relationship between physical workload and complaints of *Musculoskeletal Disorders* (MSDs).

Similar to the research that has been conducted by Primalia Sukma Putri in her research on "The Relationship between Physical Workload and *Musculoskeletal Disorders* Complaints in Workers at Shoe Factories in Nganjuk", the study stated that testing the relationship between physical workload and MSDs complaints obtained significant results. Physical tasks related to spatial planning, working conditions, and workload can affect a person's fatigue, the accumulation of this workload can cause muscles to contract more and can result in MSDs complaints (12).

Workload is an interaction that arises between the demands of tasks and the work environment. Complaints *musculoskeletal* This often occurs as a result of muscles receiving excessive physical workload pressure. Physical work is work that requires physical energy in human muscles that will function as a source of energy. Every human being has their own workload, for men a maximum of 40kg of weight that can be lifted and for women half of the men's workload which is 20kg, if the use of muscles lasts for more than 1 hour it will accelerate the onset of complaints *musculoskeletal* (13)

3.1.3. the relationship between work posture and complaints of *Musculoskeletal Disorder*

Table 3. Results of the relationship between work posture and Msds complaints.

Work Posture	MSDs Complaints				Total	P-Value	OR
	No MSDs Complaints		MSDs Complaints				
	N	%	N	%			
Low risk	7	23	6	19	13	42	0,050 0,245
High risk	4	13	14	45	18	58	
Total	20	65	11	35	31	100	

Table 3. showed the results of the Chi Square test regarding the relationship between work posture and complaints of *Musculoskeletal Disorder* (MSDs) in tofu manufacturing workers in the Piyungan District area. Of the total 31 respondents, 13 people had a low-risk work posture, while 18 people had a high-risk work posture. Of the 13 respondents with low-risk work postures, 6 people (19%) reported complaints of MSDs, while 7 people (23%) did not experience complaints. Among the 18 respondents with high-risk work postures, 14 people (45%) experienced MSDs complaints and 4 people (13%) did not experience complaints. The results of the Chi Square test showed a p-value of 0.050, which is smaller than 0.05, indicating a significant relationship between work posture and MSDs complaints. The Odds Ratio (OR) of 0.245 indicates that workers with low-risk work postures are less likely to experience MSDs complaints than workers with high-risk work postures. This data comes from primary data collected in 2024. These results showed that high-risk work postures significantly increased the likelihood of MSDs complaints among tofu manufacturing workers, emphasizing the need for improvements in ergonomics and good work posture training to reduce health risks.

Work is carried out in an unnatural body position or by exerting too much force, fatigue and discomfort will appear [14]. The tofu manufacturing process often involves unergonomic working postures such as bending over, standing for long periods of time, or lifting heavy weights. These positions can cause overpressure on the musculoskeletal system. Many stages in making tofu involve repetitive movements, such as stirring, printing, or cutting tofu. These repetitive movements can lead to muscle fatigue and increase the risk of MSDs.

Reactive movements are actions that are performed repeatedly over a certain period of time, can be in the form of the same movements that are performed continuously during a work shift, such as lifting, typing or using certain tools. According to Barbe and Barr (2006) repetitive movements can lead to muscle fatigue through several mechanisms such as Repetitive movements can cause changes in muscle metabolism, including the buildup of lactic acid and metabolites. Long-term exposure to repetitive movements can lead to changes in the way the nervous system controls these muscles can result in inefficient muscle activation patterns, increasing the risk of fatigue (15).

This condition can be seen by researchers when taking data in the field directly. Tofu workers often have to lift and move heavy loads such as buckets filled with soybeans or water, or tofu piles repeatedly and for a long time of approximately 15-30 minutes. This can lead to injuries to muscles and joints. Workers also often carry out repetitive movements such as when printing tofu, filtering tofu pulp, and cutting tofu. The tofu manufacturing work area is also wet and slippery, which can increase the risk of slipping or falling, as well as forcing workers to maintain a certain posture to maintain balance. This can increase the risk of developing MSDs.

The assessment of work posture in this study uses a REBA worksheet where the assessment assesses 9 parts of the body including the neck, waist, legs which results in a score of A and the upper arms, forearms, fingers which will produce a score of B. The scores obtained are a score of A and a score of B will result in a score of C. If the result of the C score has been found, there will be an additional value of the activity that will produce the value of the activity score so that the final REBA score will be obtained from a score of C plus the activity value, out of 31 respondents, 13 respondents have a low-risk work posture and 18 have a high-risk work posture. 6 respondents with a low-risk work posture and 14 respondents with a high-risk work posture have MSDs complaints. The p-value of Pearson Chi-Square is 0.017, indicating a significant relationship between work posture and MSDs complaints. Odds Ratio is 0.245, showed that respondents with low-risk work postures had a lower likelihood of experiencing MSDs compared to high-risk work postures.

It was explained that at the time of measuring REBA, respondents were doing different activities in the tofu making stage, which affected the REBA assessment. This is in line with research conducted by [16]. The results of the study showed that there was a significant relationship between unergonomic work posture and MSDs in various parts of the body. Static and repetitive work postures were found to have a strong correlation with MSDs in the neck, shoulders, and back.

In line with the research conducted (16) showed that there was a relationship between the work posture of cleaning glass in hotel workers in Jakarta and complaints *Musculoskeletal*. The relationship between toilet cleaning posture and complaints *musculoskeletal* and the relationship between floor cleaning posture and complaints *Musculoskeletal*. This is most likely because the respondents' working posture has a moderate and high risk of ergonomics (based on the REBA method). So it can be concluded that musculoskeletal complaints are affected by a person's posture while working.

In line with the research conducted by (17) Where the workload and work posture have an influence on MSDs complaints experienced by farmers in the Marioirawa District area, Soppeng Regency. The REBA method found that most postures at work are very dangerous. Working long hours and monotony at work is the main factor that can cause injuries related to MSDs. Farmers suffer from musculoskeletal disorders in various parts of the body just like workers in tofu manufacturing, they experience complaints in parts (lower back, knees, neck, shoulders, and upper back) because of the positions they do during activities, namely bending over long working hours, repetitive movements, and MMH is an ergonomic risk factor for the development of MSDs.

According to the (18) research shows that there is a very strong relationship between work posture and MSDs complaints. Unergonomic or unnatural work posture can cause the incidence of MSDs complaints. The worse the work posture, the more complaints *musculoskeletal* getting bigger. The company redesigned the layout, one of which was by avoiding multi-storey floors. Conduct routine supervision of activities that are at risk of injury, and hold regular sports activities once a week.

Conclusion

Based on the results of the research on bivariate analysis, it can be concluded:

1. There was a significant relationship between work posture and complaints of *Musculoskeletal Disorder* (MSDs) in tofu manufacturing workers in the Piyungan District area with a *p-value* of 0.050 (*p-value*<0.05).
2. There was a significant relationship between workload and complaints of *Musculoskeletal Disorder* (MSDs) in tofu manufacturing workers in the Piyungan District area with a *p-value* of 0.041 (*p-value*<0.05).
3. There was a significant relationship between sex and complaints of *Musculoskeletal Disorder* (MSDs) in tofu manufacturing workers in the Piyungan District area with a *p-value* of 0.035 (*p-value*<0.05).

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