

# **Ergonomic Risks Associated with Musculoskeletal Disorders in Ikat Weaving Workers in Letmafo Induk Village, Insana Tengah District, Timor Tengah Utara Regency**

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## **Abstract**

Musculoskeletal Disorders (MSDs) are complaints of parts of the skeletal muscles that are felt by weaving workers ranging from very mild complaints to very painful. This study aims to determine the ergonomic risk factors associated with age, body mass index, years of service, education, work attitude, workload, working hours, and temperature on complaints of MSDs in weaving workers in LetmafoInduk Village, Insana Tengah District, Timor Tengah Utara Regency. The study used descriptive analytic study with a cross sectional design. The population in this study is all active weavers in LetmafoInduk Village, Insana Tengah District, Timor Tengah Utara Regency. The sampling technique in this study used a total sampling method of 47 people. The data analysis used is Chi-Square analysis. The results showed that there is a relationship between work attitudes with MSDs, there is a relationship between workload and MSDs, and there is a relationship between working hours and MSDs with the p-value of  $< \alpha$  (0.05). There is no relationship between temperature and MSDs with the p-value of  $> \alpha$  (0.05).

## **Keywords**

Ergonomic Risk, Weaving Workers, Musculoskeletal Disorders

## **1. Introduction**

Based on the research done by Indonesian Ministry of Health, the dominance of joint disease on workers is in East Nusa Tenggara (33.1%), seconded by West Java (32.1%), and then Bali (30%), (*BalitbangKemenkes RI 2013*, in Rahman 2017). World Health Organization (WHO) predicts that the second most killer disease is severe fatigue. The Japanese Ministry of Manpower studied 12 thousand companies with approximately 16 thousand randomly selected workers, as the subject of the study, with the results showing that 65% of them complained of physical fatigue, 28% complained of mental fatigue, and around 7% of workers complained of severe stress.

International Labor Organization (ILO) states that informal employment is all types of work that provide income, both independent work and paid work, which are not recognized, regulated and protected by existing laws and regulations. Health services for workers in the informal sector is not in the equal level with the workload, resulting vulnerability of experiencing certain health problems such as Musculoskeletal Diseases (MSDs), especially for workers who still use the traditional work system (Rinaldi et al. 2015).

Ergonomics studies ways of adjusting work, work tools, and work environment with humans, by paying attention to the capabilities and limitations of the human concerned so that a harmony is achieved between humans and their work which will increase work comfort and productivity. Work tools and physical environment that are not in accordance with the natural abilities of the workforce will cause a less optimal work results, and even have the potential to cause health complaints and occupational diseases (Anies 2014 in Utari et al. 2015).

This research was conducted in a village in main Letmafo village, where generally every adult woman in main Lemafo village has weaving skills. Moreover, nearly the entire adult women, married or not, dropped out of school or not, are weaving. Weaving workers work in a sitting position for a long time and are repeated every day with the requirement of having high accuracy at work. These workers have a high risk of developing MSDs by working in such a position.

The initial survey conducted on 15 weaving workers in main Letmafo village using the Nordic Body Map questionnaire gave results in the form of 9 workers experiencing severe risk, and 6 workers experiencing moderate risk. Muscle pain, stiffness around the neck, shoulders, and tingling sensation in the arms, are complaints that workers often experience after weaving activities.

According to Anies (2014) in Utari et al. (2015), certain postures and activities related with work tools potentially causing health problems and/or diseases. The wrong posture when working can also cause health problems, such as pain, fatigue, and even work accidents. In addition, a static work attitude, be it a sitting posture or standing posture for long periods of time, can also cause these problems. These negative impacts will occur in both the short and long term. Workloads that exceed the ability limit can cause fatigue or injury, while workloads that are too light can cause boredom. The workload given to workers should be a workload that is balanced with the abilities of the workers. If the workload given is not balanced, it can have an adverse impact on both workers and the company (Mutia 2014).

Workhours determine the health, efficiency, effectiveness and productivity of the worker concerned. Excessive extension of worktime combined with less optimal work efficiency and productivity often requires workers to work more than their limited ability. As a result, a noticeably decreased working quality would arise. Moreover, a tendency of work fatigue, health problems, accidents, and dissatisfaction, would appear (Suma'mur 2014 in Bilondatu 2018).

## **1.1 Objectives**

In accordance with the description above, the authors conducted research on weaving workers to find out the relationship between work attitudes, workload, temperature, and working hours, on MSDs in weaving workers in LetmafoInduk Village, Insana Tengah District, Timor Tengah Utara Regency. In this study, work attitude, workload, temperature, and working hours act as independent variables, while MSDs act as dependent variables.

## **2. Literature Review**

### **2.1 Ergonomic Risk Factor**

Ergonomic risk is a risk that causes work-related injuries, including the following (Kuswana 2017): (1) Use of force or force (lifting, pushing, pulling, etc.), (2) repetition; perform the same type of activity of a job using muscles or limbs repeatedly, (3) body flexibility (bending, turning, upper reach, etc.), (4) static work; stationary in one position for a certain period of time, (5) vibration of machines, (6) stress contact; when obtaining a sharp object surface from a tool or workpiece against the part or body. In general, there are three types of bodily injuries, namely, Cumulative Trauma Disorders, Repetitive Strain Injuries, and Musculoskeletal Disorders (MSDs).

### **2.2 Musculoskeletal Disorders (MSDs)**

MSDs are a group of symptoms or disorders related to muscle tissue, tendons, ligaments, cartilage, nervous system, bone structure, and blood vessels. MSDs initially cause pain, tenderness, numbness, tingling, swelling, stiffness, shaking, sleep disturbances, and burning (OSHA 2009). The causes of MSDs are difficult to explain with certainty, but there are certain risk factors that are always present and associated or play a role in causing MSDs.

#### **2.2.1 MSDs Risk Factor**

The causes of MSDs are difficult to explain with certainty, but there are certain risk factors that are always present and associated or play a role in causing MSDs. These risk factors can be classified into three categories, namely individual, occupational, and environmental. (Rahman 2017)

1. Individual Factor (age, years of service, gender, Body Mass Index)
2. Occupational Factor
  - a. Body Posture

An unnatural posture is a work posture that positioned certain body parts uncomfortably from their initial natural position; for examples raising arms too high, bending the back for too long, and so on. The risk of skeletal muscle complaints would be higher as the farther the position of certain body parts from the body's center of gravity. Due to the demanding tasks, work tools, and workstations that exceed the limitations of workers, an unnatural posture would form (Tarwaka 2014). The tool used in this measurement is called the Rapid Entire Body Assessment (REBA) form. REBA is a specialty method used in ergonomics to rapidly assess the posture of a worker's neck, back, arms, wrists and feet (Firdaus 2011). The evaluator will assess every part of the body in the REBA form, namely the wrists, forearms, upper arms, shoulders, neck, torso, back, thighs and knees. After data has been collected from each section, a table on the form is used to compile the risk factor variables and generate a score that describes the risk level of MSDs.

#### b. Workload

Workload is a load of physical, mental, and social activities, which must be completed within a certain time in accordance with the physical abilities and limitations of the workers who accept the load. Workload must be completed by workers before the deadline given under normal circumstances. Work or movement that uses excessive energy will put heavy loads on workers' muscles, tendons, ligaments and joints. Heavy loads would result in having irritation, inflammation, muscle fatigue, and/or damaging tendons and other tissues (Manuaba 2008).

#### c. Workhour

In a day, the normal workhour for a worker is approximately 8-10 hours. The other hours left would be used for family and community life. It would be better to spend some hours for having a rest or recreational activities. Excessive extension of worktime combined with less optimal work efficiency and productivity often requires workers to work more than their limited ability. As a result, a noticeably decreased working quality would arise. Moreover, a tendency of work fatigue, health problems, accidents, and dissatisfaction, would appear. Within a week, an appropriate working hour should be around 40-50 hours. Exceeding 50 workhours in a week would come up with disadvantages for the workers and the work itself. The number of workhours is in parallel with the number of unwanted things to occur. The number of 40-50 workhours in a week, which can be made as five or four working days, is the prevailing regulation and is increasingly being applied everywhere (Suma'mur 2014).

#### 3. Environmental Factor

A good temperature in the workplace, which can support high work productivity, is at a temperature of 24°C - 27°C. The effect of temperature levels on the human body while working is different (Wingjosoebroto 2008). The difference between environmental temperature and body temperature is too large, causing some of the energy in the body to be utilized by the body to adapt to that environment. If this is not balanced with an adequate supply of energy, there will be a lack of energy supply to the muscles. As a result, blood circulation becomes less smooth, oxygen supply to muscles decreases, carbohydrate metabolism processes are inhibited, and lactic acid accumulation occurs which can cause muscle pain (Tarwaka 2014). At temperatures below 39.20°F (40°C), the effects of cold evaporation can occur and exacerbate the risk factors for other MSDs (DiBerardinis 1999)

### 3. Methods

The research used descriptive analytical research with a cross sectional study design to see the relationship between the independent variable and the dependent variable. Research began with an approach, observation, and continued with data collection. The sampling technique in this study used the simple random sampling technique. The research sample was 47 female weavers.

### 4. Data Collection

Data collection was carried out by interview, observation, documentation, and measurement of work attitudes. Data analysis was using Chi-Square analysis. The independent variables include work attitudes, workload, temperature and working hours, while the dependent variable is the MSDs.

### 5. Results and Discussion

#### 5.1 The Relationship between Work Attitudes and MSDs in Ikat Weaving Workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

Based on figure 1, there are weaving workers with a non-risk work attitude variable, with details of 7 (14.9%) workers experiencing MSDs without risk and 4 (8.5%) workers experiencing MSDs at risk. As for the risky work attitude variable, there were 9 (19.1%) workers experiencing MSDs without risk and 27 (57.5%) workers experiencing MSDs at risk. The results of statistical tests with the Chi-Square test obtained  $p \text{ value} = 0.029 < \alpha (0.05)$  so that it can be concluded that there is a significant relationship between work attitudes and MSDs in weaving workers in LetmafoInduk village, Insana Tengah District, Timor Tengah Utara Regency. Work attitude is an assessment of the suitability of the work tools used by workers with the anthropometric measurements of workers with predetermined sizes. At work, it is very important to note that the work attitude must be in a balanced state in order to work comfortably and last a long time. Working in a sitting position has the advantage of minimal loading on the legs so that the need for blood circulation can be reduced. The sitting position has a high degree of body stability, which can reduce fatigue and subjective complaints when working more than 2 hours. In addition, workers can also control their legs and feet to perform movements. On the other hand, if you work in a sitting position for too long, it can cause decreased abdominal muscle tone and a curved spine that can cause workers to tire easily and develop muscle complaints.

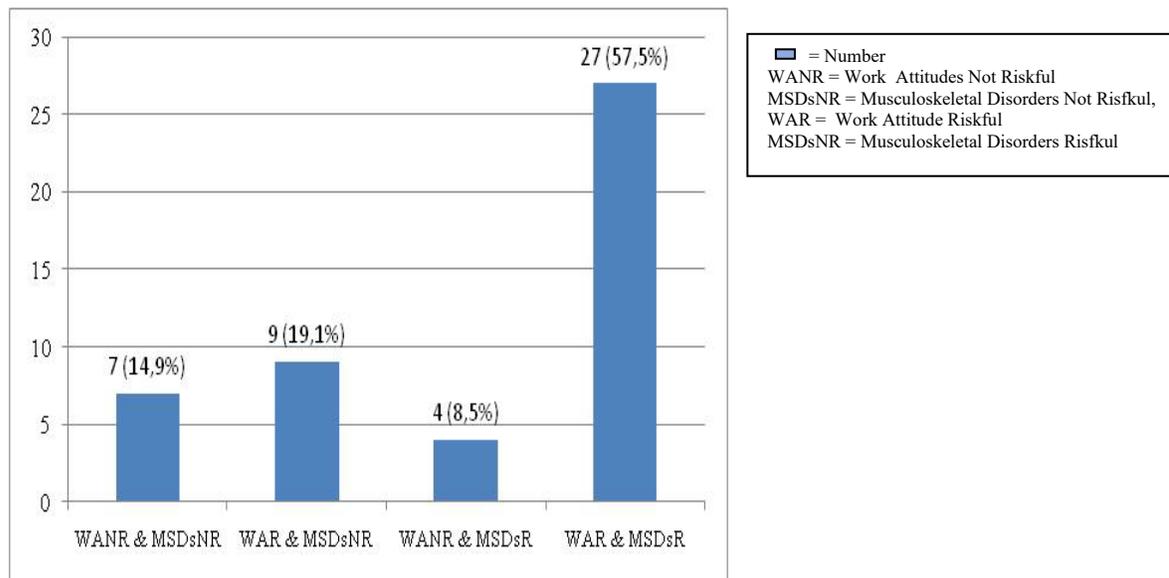


Figure 1. Distribution of relationship between work attitudes and MSDs in ikat weaving workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

The results of the analysis of the relationship between work attitude and MSDs complaints showed that there was a relationship between work attitudes and MSDs complaints on weaving workers in LetmafoInduk village, Insana Tengah district, with a  $p \text{ value} (0.027) < \alpha (0.05)$ . A tense or stiff sitting posture will make your blood circulation unbalanced. The monotonous position in carrying out this weaving activity will increase muscle complaints in weavers. This can be proven because they feel complaints in the neck, shoulders, wrists and feet, as well as in their thighs. This condition will be more severe if allowed to continue. Therefore, urgent action is needed. The work attitude of weavers has a high risk of experiencing MSDs. As early as possible precautionary measures should focus on improving the health of the weavers or by conducting studies and assessments of the work tools used so that the work risks of the weavers can be reduced. This research is in line with that conducted by Sogar (2017) which states that there is a relationship between work attitudes and MSDs in cloth weaving workers in Naioni Village.

## 5.2 The Relationship between Workload and MSDs in Ikat Weaving Workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

Based on figure 2, there are weaving workers with a non-risk workload variable with details of 14 (29.8%) workers experiencing MSDs without risk and 12 (25.5%) workers experiencing MSDs at risk. For risky workloads, 2 (4.3%) workers experienced MSDs without risk and 19 (40.4%) workers experienced MSDs at risk. The results of statistical tests obtained  $p$  value = 0.004  $<$   $\alpha$  (0.05) so that it can be concluded that there is a significant relationship between workload and MSDs on ikatweaving workers in Main LetmafoVillage, Insana Tengah District.

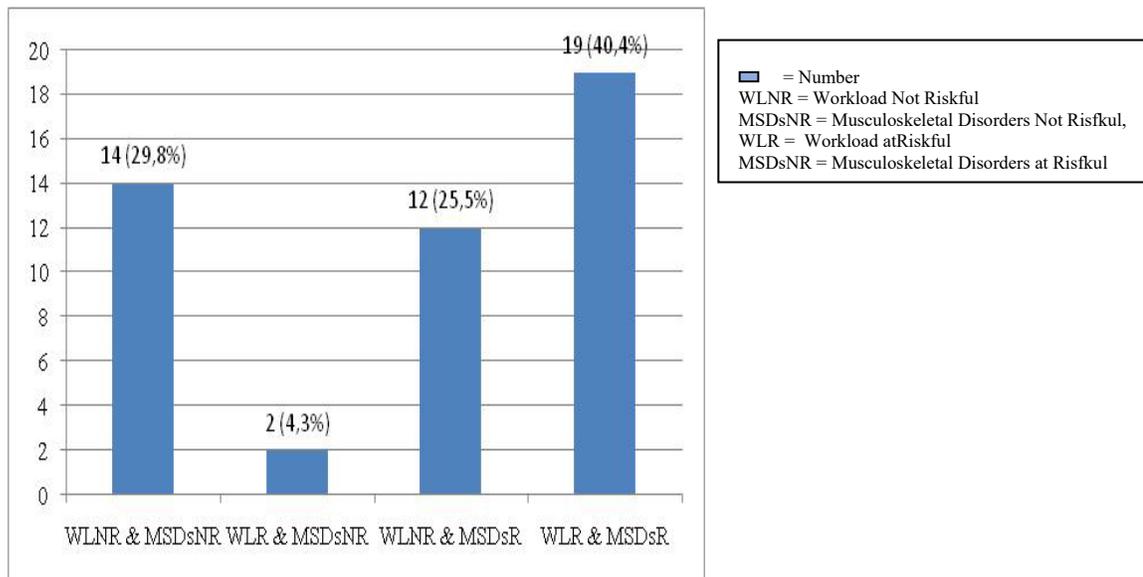


Figure 2. Distribution of relationship between workload and MSDs in ikat weaving workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

Workload is any work that requires physical and psychological abilities from the worker. Workload should adjust workers' physical and psychological abilities in hope of avoiding disadvantageous health condition of the workers (Setyawati 2010). Inappropriate workloads could be minimized by planning and/or designing a tool (Notoatmodjo 2018). Therefore, it is necessary to strive for an optimum level of intensity of loading that exists between the two extreme limits, which differ from one individual to another.

The relationship between workload and complaints in the muscles experienced by workers is an illustration that workload affects workers when they do work. The high level of workload is caused by workers having to finish the weaving according to the target, within a certain period of time, so that workers can sell their weaving directly to meet the economic needs of their families. This research is in line with Aulia (2019) where there is a relationship between workload and MSDs in informal workers.

### 5.3 The Relationship between Working Hour and MSDs in Ikat Weaving Workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

Based on figure 3, in weaving workers with working hours that are not at risk, it was found that 12 (25.5%) workers experiencing MSDs without risk and 8 (17.1%) workers experiencing MSDs at risk. Meanwhile, in weaving workers with risky working hours, it was found that 4 (8.5%) workers experiencing MSDs without risk and 23 (48.9%) workers experiencing MSDs at risk. The results of the statistical test obtained  $p$  value = 0.003  $<$   $\alpha$  (0.05), so it can be concluded that there is a significant relationship between working hours and MSDs on weaving workers in LetmafoInduk Village, Insana Tengah District.

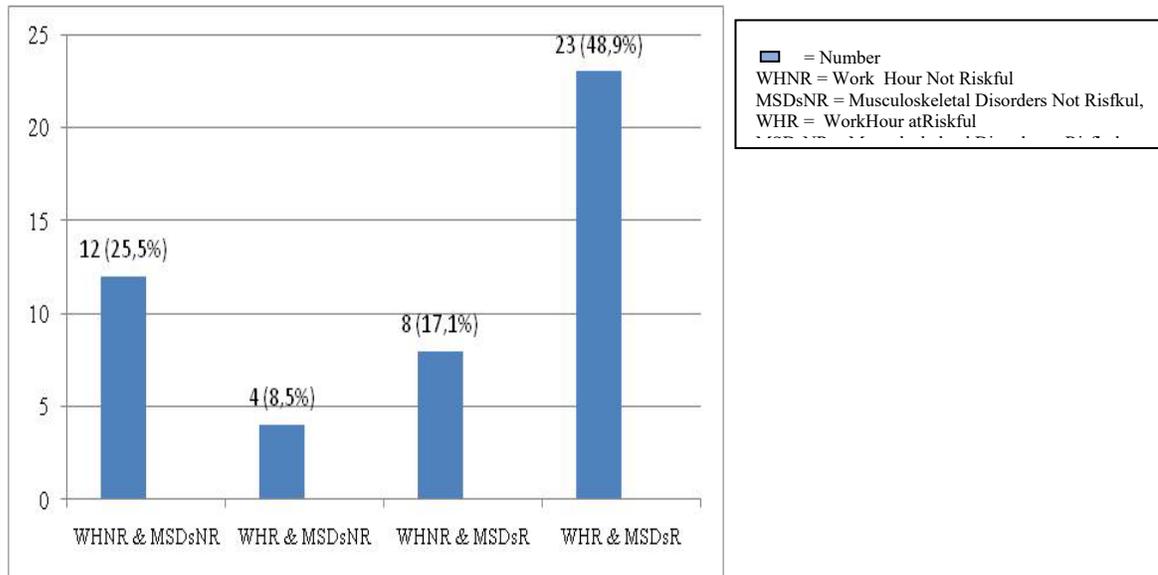


Figure 3. Distribution of relationship between working hour and MSDs in ikat weaving workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

In a day, the normal workhour for a worker is approximately 8-10 hours. The other hours left would be used for family and community life. It would be better to spend some hours for having a rest or recreational activities. Excessive extension of worktime combined with less optimal work efficiency and productivity often requires workers to work more than their limited ability. Even worse, there would be noticeable deterioration in the quality and output of work. Extreme workhours create a tendency for fatigue, health problems, accidents, and dissatisfaction. Within a week, an appropriate working hour should be around 40-50 hours. (Suma'mur, 2014).

The duration of work that occurs in weaving workers is of a risky duration (more than 8 hours a day). This condition is done because they are chasing targets so that workers experience MSDs and work fatigue. Working conditions for more than 8 hours a day make workers feel complaints in the waist and neck, and this has become a habit that is done continuously every day. This research is in line with Tania (2019) where there is a relationship between length of work and MSDs in laundry workers in Sleman Yogyakarta.

#### 5.4 The Relationship between Temperature and MSDs in Ikat Weaving Workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

Based on figure 4, in weaving workers with temperature that are not at risk, it was found that 11 (23.4%) workers experiencing MSDs without risk and 21 (44.7%) workers experiencing MSDs at risk. Meanwhile, at risky temperatures, there are 5 (10.6%) workers experiencing MSDs without risk and 10 (21.3%) workers experiencing MSDs at risk. The results of statistical tests obtained  $p \text{ value} = 1,000 > \alpha (0.05)$  so it can be concluded that there is no relationship between temperature and MSDs in weaving workers in LetmafoInduk Village, Insana Tengah District.

Advances in technology and production processes, with a variety of tools such as air conditioning, have created a work environment that has a certain climate, which can be in the form of a hot working climate and a cold working climate. One of the conditions caused by a working climate that is too hot is what is known as heat stress. Heat or cold stress is the overall heat and cold load received by the body, which is a combination of physical work, environmental factors (air temperature, water vapor pressure, air movement, changes in radiation heat, etc.), and the type of clothing.

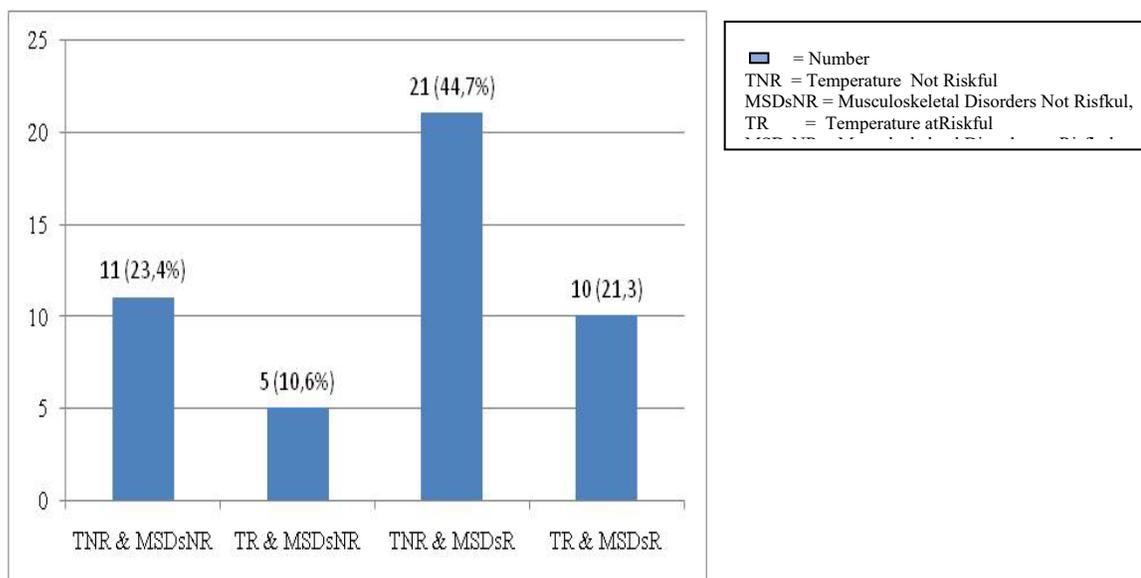


Figure 4. Distribution of relationship between temperature and MSDs in ikat weaving workers in Main Letmafo Village, Insana Tengah District, North Timor Tengah Regency

The results showed that the weaving workers had a risk of experiencing MSDs. The results of the observations made showed that the temperature at the weavers' workplace was at an average temperature of 27.8°C, which falls into the normal category. Workers look for comfortable work conditions so they can avoid too hot or cold temperatures. This situation provides good support for workers in carrying out weaving activities until the completion stage. This research is in line with that conducted by Viki (2018) where there is a relationship between heat stress and MSDs on the upper body of workers in the jipang cake factory in Ambarawa District, Semarang Regency, Central Java.

## 6. Conclusion

Based on the research results, there is a relationship between work attitudes and MSDs, there is a relationship between workload and MSDs, there is no relationship between temperature and MSDs, and there is a relationship between working hours and MSDs for weaving workers in Main Letmafo Village, Insana Tengah District.

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