WORK POSTURE ANALYSIS USING APPROACH METHOD OF RAPID UPPER LIMB ASSESSMENT (RULA) AT FABRIC CUTTER WORKERS TO REDUCE MUSCULOSKELETAL DISORDERS (MSDS)(RANGGANESVI HOME INDUSTRY CASE STUDY)

Oleh
Nur Ayu Irmawati[1], Widhy Wahyani[2]
[1,2]National Institute of Technology Malang, Indonesia
Email: [1]nayu1876@gmail.com, [2]widhy_wahyani@lecturer.itn.ac.id

Article History:
Received: 23-07-2024
Revised: 12-08-2024
Accepted: 27-08-2024

Keywords:
Musculoskeletal Disorders (MSDs), Nordic Body Map (NBM), Rapid Upper Limb Assessment (RULA)

Abstract: *Home Industry Convection Bag "Rangganesvi" is a Home Industry that produces various types of bags. Workers carry out the production process manually using makeshift work facilities that are not good because these workers sit hunched on the floor without a base for 8 hours of work. This problem is related to work postures that are not ergonomic. This can lead to complaints of Musculoskeletal Disorders (MSDs) which consist of bones and skeletal muscles that are conscious muscles. With these complaints, a Nordic Body Map (NBM) Questionnaire was filled out for 11 workers to know the body parts of the workers who felt sick while doing work at the work station. It was found that the most dominant body part of the risk of Musculoskeletal Disorders (MSDs) is the back. This is analyzed using the Rapid Upper Limb Assessment (RULA) method. The final score obtained for the cloth cutting process activity with the posture of sitting on the floor and doing cloth cutting manually gets a score = 6 and is at a risk level of 3 which indicates that further investigation is needed and changes are needed as soon as possible by using a Cloth Cutting Machine which gets a score = 3 and is at risk level 2. Thus it can reduce the risk of Musculoskeletal Disorders (MSDs)*

PENDAHULUAN

Being able to provide innovative creativity to small businesses in the industrial sector is now a very good opportunity for Indonesia because it can improve the economy, especially for business actors and the surrounding community. With the right qualifications, the industry can create various job opportunities for the community. There are quite a several industries with different fields, one of which is the *Home Industry* of Bag Convection.

The bag is one object that is in great demand by the public because it has two functions, namely as a fashion companion and carrying necessities. So it is not surprising that bags have become one of the secondary needs of the general public. Bags have various types and models that are produced specifically considering the wishes of consumers and these products feature designs according to the age of the user. So that it opens a very large bag

convection business opportunity. However, establishing this *Home Industry* requires paying attention to all important aspects, namely business management, marketing, production processes, K3, productivity, efficiency and effectiveness as well as ergonomics. All of these aspects are closely related.

Humans are the most important and dominating part of an organization, especially in the production process of sustainable manual products. Human resources (HR) in *Home Industry* carry out work using simple facilities and properties that are adjusted to their respective divisions. A high degree of flexibility can be achieved by using humans as skilled workers in confined spaces. Besides that, the use of the workplace, namely an open environment, will greatly affect the type of work, especially the facilities used to support the implementation of work operations. Workplaces that are not strategic and ergonomic will form work postures that cause complaints and even injuries, including squatting, sitting cross-legged, bending, looking down, lifting, transporting, and always standing for a long time. This can lead to complaints of *Musculoskeletal Disorders (MSDs). The Musculoskeletal Disorders System (MSDs)* consists of bones and skeletal muscles that are conscious muscles. The main function of the muscular-skeletal system is to support and protect body parts and maintain posture.

Musculoskeletal Disorders (MSDs) are injuries or disorders that can affect the movement of the human body or the *Musculoskeletal Disorders system (MSDs)* such as muscles, ligaments, and others (Ergonomics Plus, n.d.). The main complaint of *Musculoskeletal Disorders (MSDs)* or skeletal muscle disease is damage to muscles, nerves, tendons, ligaments, joints, cartilage, and intervertebral discs. Muscle damage can manifest as muscle tension, inflammation, and degeneration. Although the damage to the bone can be bruising microscopic factors, fractures, or distortion.

Home Industry Convection Bags "Rangganesvi" is a *Home Industry* that produces various types of bags including camera bags, school bags, tote bags, wallets, souvenirs, and others. There are problems related to workstations that result in non-ergonomic work postures. This *Home Industry* was founded by Karlina and her husband Agus in 1995 on Jl. Ontoseno Baru I No.9 RT.10 RW.02, Kel. Polehan, Kec. Blimbing, Malang City, East Java. Karlina has decided to open this *Home Industry* because she has quit her job in one of the *Department Stores* in Malang. Then he got an offer from one of his friends to study sewing in the bag convection field, to earn an income, and considering finding a job was very difficult, he finally agreed.

In the *Home Industry* Convection Bag "Rangganesvi" production process is carried out continuously but with different products adjusted to the number and model of consumer orders. Workers carry out the production process manually using makeshift work facilities so that the production process will also adjust to the workers. This *Home Industry* has work activities divided into 11 stages, namely, selection of raw materials, *fabric spreading*, *cutting, pattern making, pattern cutting*, *embroidery* or screen printing, *sewing*, *prefinishing* (installation of accessories), *quality control* (checking), *packing* (packaging), and *distribution* (shipping). Working hours every Monday to Saturday are 8 hours, but if there are many orders, the working hours will be 12 hours. Workers are given one day, which is Sunday, to take a day off from work. The target market that is reached and carried out by marketing

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

from the city of Malang and outside the city of Malang includes hospitals (tote bags), both private and public campuses (tote bags), kindergarten, elementary, middle, and high school/vocational schools (backpacks), gold shops (wallet) and others.

There is a management division which is held by the owner of the *Home Industry* himself, he enforces a minimum product order of 50 pcs with payment of half the total price. Then discuss the embroidery or screen printing design and the determination of the fabric to be used, usually, a sample of the appropriate product is given to provide an overview to the *customer*. Product design can be done by the *customer* himself or by the management, as well as the fabric to be used. Before carrying out the production process, the management buys the materials and accessories that will be used.

To ensure the quality of a product, raw materials are a very important consideration. In the *Home Industry*, the raw materials used vary widely and depend on the demands and budgets of consumers. The raw materials used for the manufacture of these bags are polyester, nylon, canvas, cotton, and white. The raw materials for each type of bag are different because the structure of the bag is adjusted to the composition of the type of fabric. Although the raw materials used in each type of bag are different, the quality of the products in the *Home Industry* can be guaranteed to satisfy consumers.

In the pattern-making section, it is done by drawing cloth using cardboard and pencils on the floor, after being drawn according to the required number of frames, the cloth is cut out one by one manually using scissors. Cut the fabric into several parts according to the size of the pattern to be made. So that the fabric will not be lacking and wasted due to excess. This is one of the jobs that take too much time, in one day cutting a maximum of 300 fabrics. In addition, the work facilities obtained are also not good, because these workers sit hunched on the floor without a base for 8 hours of work. In these circumstances the work method provided by *Home Industry* is not good, the posture that is formed will make workers easily tired and uncomfortable while working so workers often complain while working. Complaints that often occur are fatigue in the workers' body parts including the back of the neck, back, waist, hands, and palms. If this continues, it will cause injury, where an injury is not only a problem for workers but also for the *Home Industry*, due to a decrease in morale and maybe even loss of focus, so that the result of these actions will make work chaotic and production failure.

These problems are often encountered in various *Home Industries* that apply for continuous work. This step is necessary to establish the effects of *Musculoskeletal Disorders (MSDs).* One solution to deal with risk is to improve the design of workstation facilities in the form of ergonomic tools to form an appropriate body posture.

The improvement of the work system that will be carried out requires a technique that is most relevant and has great potential to increase productivity. Improvements that will be made to the *Home Industry*, namely by innovating a machine that aims to reduce the level of fatigue and streamline the time used. This machine is called a *Cloth Cutting Machine*, it is used in the process of cutting fabrics in large quantities semi-automatically.

The manufacturer of this *Cloth Cutting Machine* uses the *Rapid Upper Limb Assessment (RULA)* method, this is to determine the design of the tool where the method is an accurate research method to analyze body shape and movements related to obstacles in the *upper limbs*, namely the neck, back and upper arms. Where a working system must be adapted to

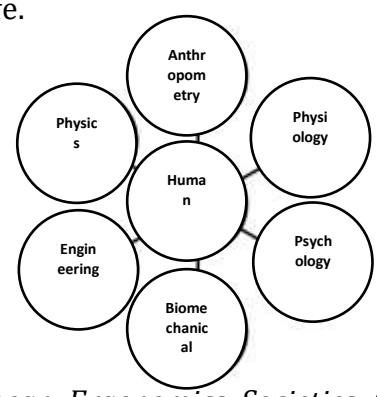
the roles and functions of the components involved such as humans and the physical work environment. In designing the machine, it is necessary to pay attention to an ergonomic body posture according to fabric cutting workers, ensuring strength, comfort, safety, and health for long periods of use, and selection of raw materials by the conditions of use to be appropriate. In addition, the results of an ergonomic body posture will form the compatibility of the machine with the humans who use it, can affect changing the position and work comfortably, and affect the production time of materials and output for finishing cutting.

THEORETICAL BASIS

Ergonomics

Definition of Ergonomics

The term ergonomics refers to the combination of the terms *ergo* (work) and *nomos* (law) in Greek, and can therefore be used to refer to laws or theories of work. *The International Ergonomics Association* defines ergonomics as the study of human interaction with machine components in a system so that it will present various theories and methods to optimize human performance and productivity. In simple terms, ergonomics is the amalgamation of all knowledge i.e. science and technology that underlies the design of any workstation, component, or tool and can help users make informed choices about tools, methods, and appropriate actions. So that humans can live and work in a good system without difficulty and can achieve the goals set by using work processes that are effective, efficient, ethical, and not harmful. Ergonomics is useful for improving the quality of human life by providing optimal health and well-being conditions for everyday life.



The Federation of European Ergonomics Societies (FEES) 2009 categorizes ergonomics into three groups. The categorization is intended to be used as a guide in assessing risk factors and their impact on workers in the work environment. These categories include:

1. Physical ergonomics focuses on human anatomy, anthropometry, physiology, and related biomechanical characteristics of physical activity. Problems related to this focus are work posture, material handling, repetitive movements, Musculoskeletal Disorders (MSDs) due to work, workplace design, safety, and health.
2. Cognitive ergonomics focuses on human thought processes such as perception, memory, and motor responses. Topics related to cognitive ergonomics are workload, decision making, skills, stress, and training.
3. Organizational ergonomics focuses on optimizing sociotechnical systems such as

organizational structures, policies, and processes. Topics related to this include communication, HR management, work shift arrangements, teamwork, production, and quality management (McCauley-Bush, 2012).

In any field of work, ergonomics plays an important role in task performance, work processes, and productivity. Each work area uses ergonomic principles to some extent. Ergonomics principles are applied in the workplace so that employees can carry out their duties effectively and comfortably and make work more enjoyable for employees. With pleasant taste, productivity can be increased & improved. The study of ergonomics in the world of work discusses the following: how people do their jobs, what positions a worker takes, and what tools he uses.

Ergonomics Purpose

The main purpose of ergonomics is to improve the health and productivity of workers (Sulianta, 2010). Ergonomics is the study of workplace locations, methods, and work environment according to the physical and psychological constraints of workers, this will make the level of efficiency and effectiveness in work more visible. There are several goals to be achieved when applying ergonomics, including:

1. Physical and mental health is improved by preventing work-related illnesses, decreasing physical and mental workload, and seeking promotion and job satisfaction.
2. Social welfare will increase by improving the quality of social contacts and good work coordination, to increase social security both during productive age and after being unproductive.
3. There is a rational balance between the technical, economic, and also anthropological aspects of each work system that is carried out to create a high quality of work and quality of life.

Ergonomic Benefits

The benefits of ergonomics are for work to be completed quickly, with a smaller risk of accidents, time-efficient, and so on. The various benefits derived from ergonomics are as follows:

1. Reduce costs

   The application of ergonomics in the workplace can prevent *Musculoskeletal Disorders (MSDs)* which may require expensive treatment costs. By preventing this disruption, companies and their workers can make significant savings in health costs as well as in the costs of training and education on occupational health and safety.
2. Increase work productivity

   Work ergonomics can also be the best solution for increasing work productivity. The application of ergonomics in the workplace allows workers to get a more conducive and efficient work environment or workplace. Increased work productivity for example speed, accuracy, and safety as well as reducing energy when working.
3. Improve the quality of work

   When work is too physically demanding for workers, they can be more prone to making mistakes and not being able to produce work to the prescribed standards. The application of ergonomics in the workplace can help its workers improve the quality of their work without a hitch so that it will increase time efficiency so that it is not wasted.
4. Increase employee engagement

Work ergonomics can maintain the fitness and health of employees so that they do not quickly experience fatigue or distraction while working. In addition, employees will be more optimal to develop work skills and become more comfortable while working.

Ergonomics Principle

The most important ergonomic principle is to ensure that the work is performed according to the desired result. Ergonomics provides work areas, workspaces, and work equipment that are ergonomically designed to meet their needs. In other words, a well-designed work location can create a safe and effective work environment to increase employee productivity. Work actions must be carried out consistently to ensure optimal health to minimize hazards to health, which depend on an unhealthy working environment. In general, the principles of ergonomics are divided into 5 parts, namely:

1. Usability (*Utility*)

The principle of usability is that each product produced has benefits for someone in supporting activities or needs to the maximum without experiencing difficulties/problems in their use. For example, the principle of ergonomics is a shirt that is buttoned to make it easier to put on and take off the bag.

2. Security (*Safety*)

The principle of safety means that each product produced has a useful function without risking safety and harm to users. For example, the pocket on the bag is given a lid and buttons so that something that is inserted does not fall easily.

3. Comfort (*Comfortability*)

The principle of convenience means that the resulting product has a purpose that is aligned or in other words, does not interfere with activities. For example, the fabric is selected from soft, cool, and breathable fibers so that the user is comfortable.

4. Flexibility

The principle of flexibility means that ergonomics can be used for needs in multiple conditions or functions. For example, clothes are given a small space so that they can store small objects.

5. Strength (Durability)

The principle of strength means that it must be durable, durable and also not easily damaged when used. For example, the bag material is durable and sewn strong.

Musculoskeletal Disorders (MSDs)

Definition of *Musculoskeletal Disorders (MSDs)*

Musculoskeletal Disorders (MSDs) are complaints in the parts of the skeletal muscles (skeletal) that are felt by a person ranging from very mild complaints to very painful. Complaints in the form of damage to joints, ligaments, and tendons will occur if the muscles receive static loads repeatedly and for a long time, usually termed MSDs or injuries to the *Musculoskeletal Disorders (MSDs)* system. Musculoskeletal Disorders (MSDs) are a collection of symptoms or disorders related to muscle tissue, tendons, ligaments, cartilage, nervous system, bone structure, and blood vessels. MSDs initially cause aches, pains, numbness, tingling, swelling, stiffness, shaking, sleep disturbances, and burning (OSHA, 2000). *Musculoskeletal Disorders (MSDs)* are disorders that are

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

caused when a person performs significant work and work activities that affect the normal function of smooth tissues in the musculoskeletal system which includes nerves, tendons, and muscles (WHO, 2003).

Musculoskeletal Disorders (MSDs) are disorders of the skeletal muscles caused by the muscles receiving static loads repeatedly and continuously over a long time and will cause complaints in the form of damage to joints, ligaments, and tendons (Rizka, 2012). Skeletal muscle complaints generally occur due to excessive muscle contractions due to giving a workload that is too heavy with a long duration of loading. On the other hand, muscle complaints may not occur if muscle contractions are only around 15% – 20% of maximum muscle strength. However, if the muscle contraction exceeds 20%, then the blood circulation to the muscle decreases according to the level of contraction which is influenced by the amount of force required. The oxygen supply to the muscles decreases, the carbohydrate metabolism process is inhibited and as a result, there is an accumulation of lactic acid which causes muscle pain (Suma'mur, 1982; Grandjean, 1993).

Factors Affecting Musculoskeletal Disorders (MSDs)

Several factors influence the occurrence of Musculoskeletal Disorders (MSDs), including the following:

1. Environmental Factors

- Microclimate

Microclimate that is not controlled properly will affect the level of comfort and health problems for workers.

- Noise

Noise can cause communication disturbances with speech, it may even lead to errors or accidents, especially in the use of labor due to misunderstandings and misunderstandings.

- Lighting

If the level of illumination in a workplace can not meet the requirements, it can cause the neck posture to flex forward (down) and the body posture to *flexion* (bend) are at risk.

2. Individual Factor

- Age

In general, complaints of musculoskeletal disorders begin to be felt at the working-age of 25-26 years. The first complaint is usually felt at the age of 35 years and the level of complaints will continue to increase with age. This is because, in middle age, muscle strength and endurance begin to decrease so that the risk of muscle complaints increases. (Chaffin and Guo in Tarwaka, 2015)

- Gender

Physiologically, women's muscle strength is lower than men's, only about two-thirds of men's muscle strength, so men's muscle endurance is higher than women's. Meanwhile, the results of Johanson's research (1994), stated that the muscle complaints of men and women were 3:1. (Tarwaka, 2015)

- Smoking habit

The longer and higher the frequency of smoking, the higher the level of muscle complaints felt. (Tarwaka, 2015) Smoking habits will be able to reduce lung capacity so that the ability to consume oxygen decreases and as a result, the level of body freshness decreases.

- Physical fitness

In every work activity, every workforce is required to have good physical fitness so that they do not feel tired quickly and work performance remains stable for a long time (Tarwaka, 2015).

- Body mass index

Body Mass Index (BMI) or Body Mass Index (BMI) is a simple tool or method to monitor the nutritional status of adults, especially those related to underweight and overweight (Depkes RI, n.d).

- Working mass

The longer a person's working period, the longer they are exposed to it in the workplace, so the higher the risk of occupational diseases. A worker who has worked for more than 5 years can be categorized as a worker with a relatively long working period, while it is said to be a new worker if his tenure is below or equal to 5 years (Saputra, 2012). The maximum additional working time that is still efficient is 30 minutes. Meanwhile, between working hours must be provided with a break which amounts to 15-30% of the total working time. If the working hours exceed these provisions, things such as a decrease in work speed, health problems, and the number of absenteeism due to illness will increase, which can result in a low level of work productivity (Tarwaka, 2015).

3. Job factor

- Work attitude

Natural work attitude or normal posture is an attitude or posture in the work process that is following the anatomy of the body so that there is no shift or emphasis on important parts of the body such as organs, nerves, tendons, and bones so that the situation becomes relaxed, while attitudes and work positions that are not Ergonomics can cause several health problems, including muscle fatigue, pain, and vascularization disorders (Baird in Hasrianti, 2016).

- Workload

Justified physical loading is loading that does not exceed 30-40% of the maximum working capacity of the workforce in 8 hours a day by observing the applicable working hours regulations. The heavier the load, the shorter the work time (Suma'mur, 2009).

- Repetitive activities

Repetitive activities are jobs that are carried out continuously such as hoeing, splitting large logs, lifting and carrying, and so on. If the muscles receive static loads repeatedly and for a long time, it can cause complaints in the form of damage to joints, ligaments, and tendons

- Force/load

Force is the amount of physical effort used to perform work such as lifting heavy objects. The amount of labor depends on the type of grip used, the weight of the object, the duration of the activity, the work attitude, and the type of activity.

- Length of working

The length of time a person works in a day is 6-8 hours. The rest (16-18 hours) is used for family or community life, rest, sleep, and others. Extending working time more than this ability is usually not accompanied by high efficiency there is usually a decrease in productivity and a tendency to fatigue, illness, and accidents (Suma'mur in Septiawan 2012).

Measurement of Musculoskeletal Disorders (MSDs) complaints

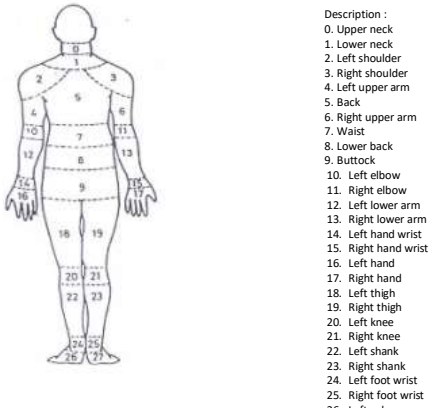
The Nordic Body Map (NBM) method is a very subjective assessment method,

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

meaning that the success of the application of this method really depends on the conditions and situations experienced by the workers at the time of the research and also on the expertise and experience of the observer concerned. This Nordic Body Map (NBM) questionnaire has been widely used by ergonomics experts to assess the severity of disorders of the Musculoskeletal Disorders (MSDs) system and has sufficient validity and reliability (Tarwaka, 2011). The Nordic Body Map (NBM) questionnaire includes 28 parts of the muscles in the musculoskeletal system on both right and left sides of the body, starting from the upper limbs, namely the neck muscles, to the lowest part, namely the leg muscles. Through the Nordic Body Map (NBM) questionnaire, it will be able to know which parts of the muscles are experiencing pain disorders or complaints from low level (no complaints or injuries) to high-level complaints (very sick complaints) (Tarwaka, 2015). This Nordic Body Map (NBM) questionnaire aims to determine the body parts of workers who feel pain before and after doing work at the work station. This questionnaire uses images of the human body which have been divided into 9 main sections, namely;

- Neck
- Shoulder
- Upper back
- Elbow
- Lower back
- Right/left wrist
- Waist or buttocks
- Knee
- Heel or foot

The division of body parts and descriptions of the data body parts are shown in the following figure:



Nordic Body Map (NBM) uses a scoring research design. If a Likert scale scoring is used, then each score has a clear operational definition and is easy to understand by respondents, namely as follows:

Score	Description	Category
0	No complaints/ pain in the muscles or no pain at all felt by workers while doung work (no pain)	Painless

1	Feeling hurts, there is a complaint or pain in the muscles and it has interfered with work (slightly hurts)	Little bit hurts
2	The respondent feels a complaint/pain in the muscles and has disturbed the worker, but the pain immediately disappears after taking a break form work (hurts)	Hurts
3	Respondents feel very sick or very painful in the muscles and the pain does not go awas immediately even though they have rested for a long time or even muscle pain relievers are needed	Painfull

Furthermore, after completing the interview and filling out the questionnaire, the next step is to calculate the total individual score of the entire musculoskeletal system (28 parts of the muscle). In this 4 Likert scale design, the lowest individual score is 0 and the highest score is 84. The following is the classification of the risk level for Musculoskeletal Disorders (MSDs):

Total score of individual complaints	Level of risk	Type of risk	Corrective action
0 - 20	0	Low	No correction action is needed
21 - 41	1	Moderate	Action may be required at a later day
42 - 62	2	High	Urgent action needed
63 - 84	3	Very high	Comprehensive action is needed as soon as possible

Body position that deviates significantly from the normal position while performing work can cause local mechanical stress on muscles, ligaments, and joints. This results in injuries to the neck, spine, shoulders, wrists, and others. (Grandjen, 1993 in Hasrianti, 2016).

Rapid Upper Limb Assessment (RULA)

Definition of Rapid Upper Limb Assessment (RULA)

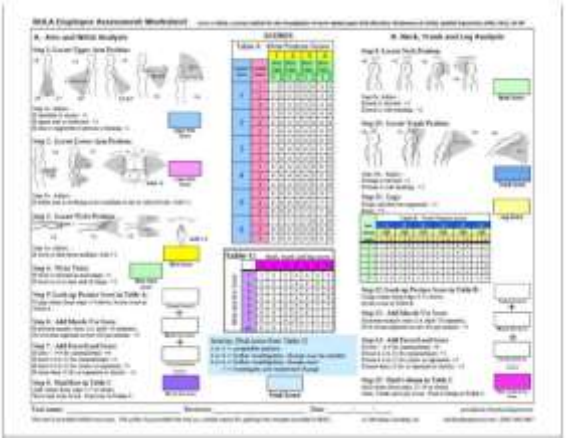
Rapid Upper Limb Assessment (RULA) is a method for assessing posture, style, and movement of a work activity related to the use of the *upper limb*. This method was developed to investigate the risk of abnormalities that will be experienced by a worker in carrying out work activities that utilize the *upper limb* (Andrian, 2013).

RULA is a method to assess body posture or work activities related to the upper limbs *(Upper Limb).* This method was developed to investigate the risk of abnormalities that will be experienced by a worker when carrying out work activities, and the person utilizes the upper limb *(Upper Limb).* (Ratna Purwaningsing: 68). RULA was developed by Dr.Lynn MC Attamney and Dr. Nigel Corlett who is an ergonomist from the University of Nottingham (University's Nottingham Institute of Occupational

Ergonomics). The journal form was first described in the application of ergonomics in 1993 (Lueder, 1996, in Bintang and Dewi, 2017). RULA is used and used in the field of ergonomics with a very wide scope (McAtamney, 1993, in Bintang and Dewi 2017).

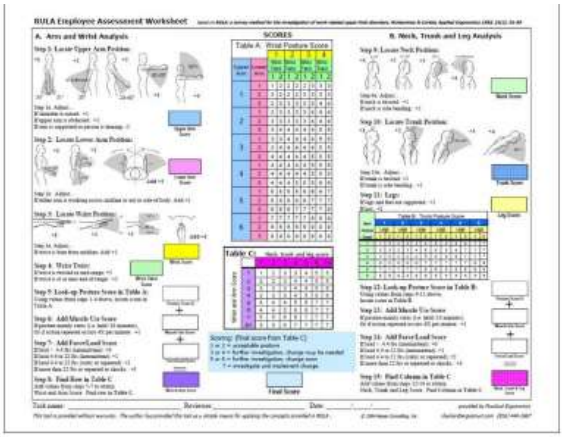
Ergonomics is applied to evaluate and identify the results of the approach in the form of a risk score of one to seven, seven indicating the highest score, the level that constitutes a hazardous risk to perform the job. This does not mean that the lowest score can guarantee that work is free from *ergonomic hazards.* So that the RULA method was developed which is useful for detecting work postures that cause risks and repairs are needed as soon as possible (Lueder, 1996). The RULA method is used to deal with cases that can pose a risk of Musculoskeletal Disorders (MSDs) when workers are active. The RULA method provides an objective risk value on the strengths, attitudes, and activities of workers. In recent years, the international community has assessed risk using the RULA method associated with Work-Related Upper Disorders (WRULD). This method uses posture diagrams and assessment tables to provide an evaluation of the risk factors that will be experienced by workers. The risk factors investigated in this method are those that have been described by McPhee as external load factors which include: the amount of movement, static muscle work, force, work posture determined by equipment and furnishings, and working time without rest. To assess the first four external load factors mentioned above (amount of movement, static muscle work, force, and posture), the Rapid Upper Limb Assessment (RULA) was developed to:

1. Provide a method of rapid screening of the working population, to determine the possible risk of injury from work related to the upper limb.
2. Recognize muscle effort related to work posture, use of force and doing static or repetitive work, and things that can cause muscle fatigue.
3. Provide results that can be combined in a broader ergonomic assessment covering epidemiological, physical, mental, environmental, and organizational factors.



RESEARCH METHOD

RULA is a method to assess body posture or work activities related to the upper limbs (*Upper Limb*). This method was developed to investigate the risk of abnormalities that will be experienced by a worker when carrying out work activities, and the person utilizes the upper limb (*Upper Limb*). (Ratna Purwaningsing: 68). [Purwaningsih Ratna, 2007 "Teaching Book of Industrial Ergonomics", UPT PUSTAKA, Diponegoro University.Semarang].



Research Location and Time

Location is the main thing to consider in setting up a company. In determining the success of a business, the selection of a strategic location is an important factor because the location will have an impact on the success of the business itself. Location Home Industry Rangganesvi is located on Jl. Ontoseno Baru I No.9 RT.10 RW.02, Kel. Polehan, Kec. Blimbing, Malang City, East Java. The location is quite strategic because it is in the middle of the city and near residential areas so it is close to raw materials and the availability of labor.

The research implementation time starts from the beginning of the survey on October 1, 2021 which will continue in November to carry out data collection and December to carry out data processing.

Required data

Data sources can be divided into two parts, namely primary data sources and secondary data sources:

1. Primary Data, Data taken with this method is data on body complaints that cause *Musculoskeletal Disorders (MSDs)*, data on the process of working old tools, data on measuring angles on the body, data for taking documentation of body postures, and data for parts of making the necessary tools. .
2. Secondary Data Is data obtained from other sources outside the object of research, including theories related to research problems.

3. Population sample

The population studied at *Home Industry* Rangganesvi and the samples taken were 15 samples from workers who carried out the production process, especially for workers in the fabric cutting division.

Data Collection Stage

Interview

Interviews are conducting questions and answers and direct discussions with the owner of *Home Industry* Rangganesvi as well as the workers and related parties regarding matters related to the research topic, to support the discussion of the problem. Data obtained:

- Company history..
- *Standard Operational Production (SOP)*
- Production process

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

Observation

Observation is to make direct observations by participating in the bag production process. Data obtained:

- Tools and materials used in the production process
- Human Resources (HR) facilities and complaints **Documentation**

Documentation is collecting data by recording existing data and conducting documentation on the Home Industry Rangganesvi related to the research conducted.

Data Processing and Analysis Stage

After collecting the required data, the next step is to process the data according to the *Nordic Body Map (NBM) and Rapid Upper Limb Assessment (RULA)* methods, which are methods that will be applied in solving existing problems. Stages of RULA method analysis:

Group A scores: wrist, upper arm, lower arm, and wrist twist.

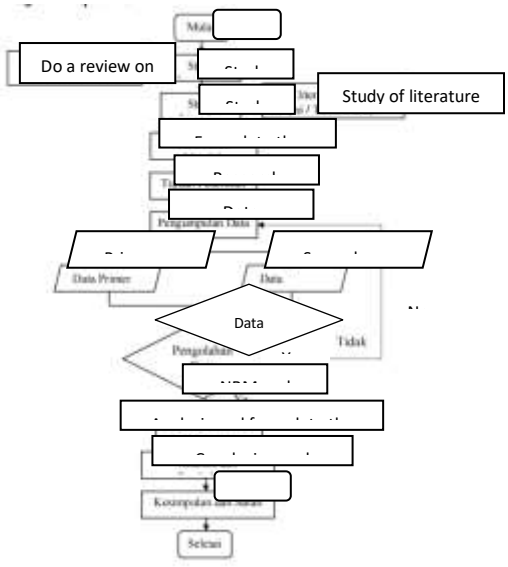
Group B scores: trunk, neck, and legs Enter group A posture. Determine the value of each work posture using the RULA method

into scores A and B. Determine the grand score by combining scores A and B

Conclusion stage

Analysis and interpretation of the results of the study was carried out by analyzing the results of work postures through the *Nordic Body Map (NBM) and Rapid Upper Limb Assessment (RULA)* methods. Comparing the current work posture and the results of the RULA analyzed to find out which work postures are considered risky as in the results of the *Nordic Body Map (NBM)* questionnaire. In the final stage of this research, conclusions are drawn based on the results of data processing and analysis carried out in the previous stage. Furthermore, suggestions that are considered important and possible to be followed up for the benefit of practitioners, *the Home Industry* and for the improvement of the next research section will be given.

Research flowchart



Data Collection and Processing

Characteristics of Work Environment

Home Industry Rangganesvi is an industry that is engaged in convection products and

services for souvenirs, packaging, bags, and so on. *Home Industry* Rangganesvi is located on Jl. Ontoseno Baru IV No.9 RT.10 RW.02, Kel. Polehan, Kec. Blimbing, Malang City, East Java. Rangganesvi is a *Home Industry* that was established in early March 1998, located in Malang City. In addition to producing bags, wallets, and various souvenirs, this business also provides sewing and screen printing services for a minimum of 50 pcs. This business is still called the *Home Industry* because from the survey results that have been carried out the scope of the place of production seems to be relatively small and the employees are still less than 20 people. This is because the design of the building where the product is still within the same scope as the owner's residence, is only given a wall partition for the production process section, so it still looks narrow.

Coupled with the presence of materials, both raw materials, semi-finished products, waste generated, and the use of several sewing machines, the space is getting narrower. In addition, the level of lighting in the production site is also greatly reduced, this is due to the lack of ventilation. The amount of ventilation available is not proportional to the number of workers and the heat generated by the machine makes the safety and comfort of workers disturbed. The lack of light makes workers always bend down to see the object of their work, this can have an impact on the health of workers, namely getting tired quickly. Besides that, the facilities provided to the workers are still minimal, and there is no ergonomic value. Especially for workers in the fabric cutting division who have to sit flat on the floor without a mat and bend over during working hours. However, the demand for the product is quite large, because the quality of the product produced is very good. In addition, the satisfactory level of service and the accuracy of product orders make consumers trust the products at the *Home Industry* Rangganesvi.

Overview of Work Process

Pattern Cutting Process

After making the pattern and imitating the sample pattern on the cloth, the next step is cutting the pattern that was made earlier. The pattern cutting process can be done automatically or manually. At Home Industry Rangganesvi the cutting process is still done manually using tools such as scissors and cutters, so you have to be careful in cutting them. In cutting the pattern, add a few inches so that during the sewing

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

process the fabric does not cut the predetermined pattern size. After the pattern is cut, bundling techniques are carried out and numbering techniques are carried out on the components of the bag to make it easier to distinguish the component pieces and sizes and to determine the number of bag components so that the sewing process becomes easier.

Nordic Body Map* Questionnaire Data *(NBM)

Questionnaire data is data obtained from distributing questionnaires to workers in Home Industry Rangganesvi. From this questionnaire, several questions were asked regarding disturbances or complaints suffered by workers in the form of illness, pain, or soreness. In the bag production process, several jobs are carried out by workers, where each worker does not always do one part but also helps each other do other jobs such as positions in pattern making and cloth cutting. Nordic Body Map (NBM) data on 11 workers are as follows:

No.	Name	Age (years)	Gender	Length of work (years)
1.	Erni Kurniawati	41	Female	10
2.	Dewi Nur Handayani	46	Female	8
3.	Karlina Soebandi	55	Female	25
4.	Sumanto	41	Male	15
5.	Sahwi	39	Male	20
6.	Bambang Setiawan	18	Male	5
7.	Sutaman	40	Male	15
8.	Hidayatullah	41	Male	1
9.	Darto	40	Male	3
10.	M. Judi	50	Male	23
11.	Agus Susanto	55	Male	25

Nordic Body Map Questionnaire Data Processing (NBM)

The assessment of the questionnaire using the Nordic Body Map (NBM) weighting can be categorized as follows:

1. The weight for the painless scale is denoted by the number 1
2. The weight for the somewhat sick scale is denoted by the number 2
3. The weight for the sick scale is denoted by the number 3
4. The weight for the very sick scale is denoted by the number 4

The workers filled out the Nordic Body Map (NBM) questionnaire according to the complaints they felt. Each worker feels different complaints, so the weights obtained also vary. The results of the questionnaire are shown in the table below:

No.	Skeletal muscle	Worker scoring											Mean
		1	2	3	4	5	6	7	8	9	10	11	
0.	Neck	3	1	2	3	2	2	2	2	3	1	2	3
1.	Nape	3	1	1	2	2	2	2	2	3	1	2	2
2.	Left shoulder	3	2	3	2	3	1	1	2	1	2	3	3
3.	Right shoulder	3	2	3	2	3	1	1	2	1	2	3	3
4.	Upper left arm	1	1	1	2	3	1	2	1	2	1	3	2
5.	Back	4	3	1	3	3	2	3	4	4	4	3	4

6.	Upper right arm	1	1	1	2	3	1	2	1	2	2	3	2
7.	Waist	1	2	3	3	1	2	3	4	4	4	3	3
8.	Hip	1	2	3	3	3	2	3	4	4	4	3	3
9.	Buttocks	3	1	3	3	3	2	3	4	4	4	3	3
10.	Left elbow	1	1	1	1	1	1	1	1	1	2	1	2
11.	Right elbow	1	1	1	1	1	1	2	3	1	2	1	2
12.	Lower left arm	1	2	3	2	3	1	2	3	1	2	3	2
13.	Lower right arm	1	2	3	2	3	1	1	1	1	2	3	2
14.	Left wrist	3	1	3	1	1	1	1	1	1	2	3	2
15.	Right wrist	3	1	3	1	1	1	1	1	1	2	3	2
16.	Left hand	1	2	1	2	1	1	1	2	1	2	1	2
17.	Right hand	1	2	1	2	1	1	1	2	1	2	1	2
18.	Left thigh	3	2	1	3	3	2	2	3	2	3	1	3
19.	Right thigh	3	2	1	3	3	2	2	2	1	3	1	3
20.	Left knee	3	2	1	3	3	2	2	2	1	1	1	2
21.	Right knee	3	2	1	3	3	2	2	2	1	1	1	2
22.	Left shank	1	2	1	3	2	1	2	3	1	1	2	2
23.	Right shank	1	2	1	3	2	1	2	2	1	1	2	2
24.	Left ankle	1	2	1	2	3	1	1	1	1	1	1	2
25.	Right ankle	1	2	1	2	3	1	1	1	1	1	1	2
26.	Left foot	1	2	1	2	3	1	1	1	1	1	1	2
27.	Right foot	1	2	1	2	3	1	1	1	1	1	1	2
Total		53	48	47	63	66	38	46	54	47	55	56	66

After the scores for each part of the *Musculoskeletal Disorders (MSDs)* muscles are obtained, then they are summed as a whole, to show more clearly the level of risk for each worker. Besides that, the average calculation for each part of the body of the whole work is also carried out. It aims to determine the parts of the body that experience *Musculoskeletal Disorders (MSDs).* So that it can be known whether corrective action is needed or not. After that, a different mark is given according to the provisions in the following table:

Range Score	Level of risk	Type of risk	Type of color	Corrective action
0 - 20	0	Low	Blue	No correction action is needed
21 - 41	1	Moderate	Green	Action may be required at a later day
42 - 62	2	High	Yellow	Urgent action needed
63 - 84	3	Very high	Red	Comprehensive action is needed as soon as possible

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

The table above explains that blue is a low-risk level with a *score range* of 0 to 20, green is a moderate risk level with a *score range* of 21 to 41, yellow is a high-risk level with a score range of 42 to 62, while red is the color of a risk level. very high with a score range of 63 to 84.

Work Posture Data

Rapid User Limb Assessment (RULA) data processing is obtained from calculations obtained by calculating the angles of body posture carried out by workers in carrying out their activities. These angles are obtained from photo data that has been taken. The first stage is to conduct an *assessment* of the worker's body posture on the workstation and analyze the photos from the observations. The following is a photo of a worker in the manual fabric cutting process:

Upper arm	Lower arm	Wrist							
		1		2		3		4	
		PP		PP		PP		PP	
		1	2	1	2	1	2	1	2
1	1	1	2	2	2	2	3	3	3
	2	2	2	2	2	3	3	3	3
	3	2	3	2	3	3	3	4	4
2	1	2	3	3	3	3	4	4	4
	2	2	3	3	3	3	4	4	4
	3	3	4	4	4	4	4	5	5
3	1	3	3	4	4	4	4	4	5
	2	3	4	4	4	4	4	5	5
	3	4	4	4	4	4	5	5	5
4	1	4	4	4	4	4	5	5	5
	2	4	4	4	4	4	5	5	5
	3	4	4	4	5	5	5	6	6
5	1	5	5	5	5	5	6	6	7
	2	5	6	6	6	6	6	7	7
	3	6	6	6	7	7	7	7	8
6	1	7	7	7	7	7	8	8	9
	2	8	8	8	8	8	9	9	9
	3	9	9	9	9	9	9	9	9

From the picture above, it can be seen that the worker is doing the cutting of cloth with the right leg straightened and the left leg bent. This forms a bent posture. In the process of cutting cloth, the position of the worker's spine forms an angle of 23°, the position of the worker's neck forms an angle of 40°, the position of the worker's body sits on the worker's buttocks, while the right upper arm forms an angle of 30°, as well as the left upper arm posture, has a high score. The position of the right forearm posture forms an angle of 145° and vice versa for the left forearm posture forms the same angle, then the position of the worker's body posture on the right wrist forms an angle of 15°, while for the left wrist it forms an angle of 15°. the angle of 0°.

Assessment of Work Posture in the Manual Fabric Cutting Process based on the Rapid Upper Limb Assessment (RULA) Method

Posture Group A (Arm and Wrist Analysis)

- Upper Arm Posture (upper arm)

The upper arm forms an angle of 30°. Where the position is at an angle of 30 ° - 45°. Then given a score = 2.

- Lower arm posture

The lower arm forms an angle of 145°. Where the position is at an angle of >100°. Then given

a score = 2.
- Wrist (wrist)
The wrist forms a 15° angle. Where the position is at an angle of 0° - 15°. Then given a score = 2.
- Wrist loop
The wrist is at the end of the spin range. Then given a score = 2.
- Group A's work posture score based on the table above is = 3
- Activity score
The activity is repeated more than 4 times/minute with a score = of 1
- Load score
Occasional loading or force less than 2kg and hold = 0
- Total score obtained for group A (Arm and Wrist Analysis), 3 + 1 + 0 = 4

Group B Posture (Neck, Trunk, and Leg Analysis)
- Neck Posture
The neck forms an angle of 40°. Where the position is at an angle > 20°. Then given a score = 3.
- Posture of the torso (Back)
Back in work looks slightly bent at an angle of 23°. Where the position is at an angle of 20° - 60°. Then given a score = 3.
- Legs Posture
The legs are unbalanced when sitting because the right leg is straightened and the left leg is bent so that the body weight is not spread evenly. Then given a score = of 2

Leher	Punggung											
	1		2		3		4		5		6	
	kaki		kaki		kaki		kaki		kaki		kaki	
	1	2	1	2	1	2	1	2	1	2	1	2
1	1	3	2	3	3	4	5	5	6	6	7	7
2	2	3	2	3	3	4	5	5	6	7	7	7
3	3	3	3	4	4	5	5	6	6	7	7	7
4	5	5		6	6	7	7	7	7	7	8	8
5	7	7	7	7	7	8	8	8	8	8	8	8
6	8	8	8	8	8	8	8	9	9	9	9	9

- Group B's work posture score based on the table above is = 5
- Activity score
The activity is repeated more than 4 times/minute with a score = of 1
- Load score
Occasional loading or force less than 2kg and hold = 0
- The total score obtained for group B, 5 + 1 + 0 = 6
- After obtaining Group A and Group B scores, the final scores for both groups are required. C score = A score + muscle use score + loading score for group A = 4 D score = B score + muscle use score + loading score for group B = 6
This final score can be determined using the table to calculate the final score, here are the final scores for Group C and Group D.

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

Grand Score							
Skor C*	Skor D = Skor B + Otot + Tenaga						
	1	2	3	4	5	6	7+
1	1	2	3	3	4	5	5
2	2	2	3	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	4	5	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8+	5	5	6	7	7	7	7

The final score based on the table above is = 6. Based on this score, the activity or work undertaken by the worker is at risk level 3.

1. Result and Discussion

Nordic Body Map (NBM) Questionnaire Results

The following are the results of the overall total score for each worker:

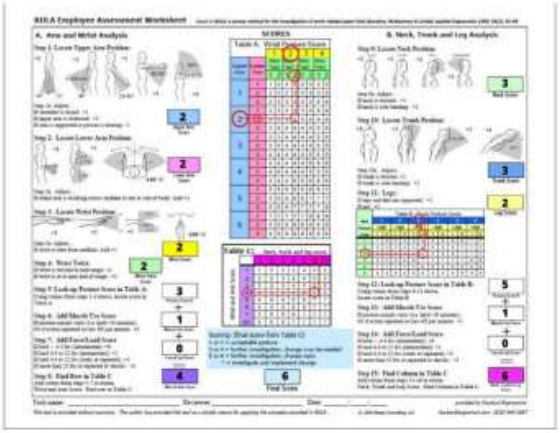
No.	Name	Score	Level of risk
1.	Erni Kurniawati	53	High
2.	Dewi Nur Handayani	46	High
3.	Karlina Soebandi	47	High
4.	Sumanto	63	Very high
5.	Sahwi	66	Very high
6.	Bambang Setiawan	38	Moderate
7.	Sutaman	46	High
8.	Hidayatullah	54	High
9.	Darto	47	High
10.	M. Judi	55	High
11.	Agus Susanto	56	High

From the table above, it can be seen that all workers experience *Musculoskeletal Disorders (MSDs)* with an average high-risk category. In addition, from the results of the *Nordic Body Map (NBM)* questionnaire where workers do the work of cutting cloth, an average assessment is also carried out for each body part, and it can be seen that several body parts have a high scale weight symbolized by the number 3 and even the number 4 which means sick and very sick. The body parts that are felt to have *Musculoskeletal Disorders (MSDs)* by 11 workers at Home Industry Rangganesvi in a sitting position include the following:

No.	Otot Skeletal	Skor
1	Leher	3
2	Bahu Kiri	3
3	Bahu Kanan	3
4	Punggung	4
5	Pinggang	3
6	Pinggul	3
7	Pantat	3
8	Paha Kiri	3
9	Paha Kanan	3

The table above shows the complaints of 11 workers in the fabric cutting process. This explains that the most dominant complaint felt by workers in the back.

Results of Work Posture Assessment in the Manual Fabric Cutting Process based on the Rapid Upper Limb Assessment (RULA) Method



The final score for the fabric cutting process activity at Home Industry Rangganesvi with sitting posture based on the table above is = 6. Based on this score, the activity or work undertaken by the worker is at risk level 3 which indicates that further investigation is needed and changes are needed as soon as possible. Where to improve the work posture by using the help of work facilities such as Cloth Cutting Machine.

Assessment of Work Posture in the Fabric Cutting Process using a Cloth Cutting Machine based on the Rapid Upper Limb Assessment (RULA) Method

In the picture below, it can be seen that the worker is doing the cutting cloth while sitting in a chair. This forms an upright posture with the neck leaning forward.

In the process of cutting the fabric using a *Cloth Cutting Machine*, the position of the spine in doing this work forms an upright posture in a sitting position and is well supported by the angle of the thigh with the neck slightly leaning forward to form an angle of 15°, while the right upper arm forms an angle of approx. 25°, as well as the left upper arm posture, has the same score, for the right forearm posture position forms an angle of 90° and vice versa for the left forearm posture forms the same angle, then the worker's posture position on the right wrist forms an angle by 10°, while the left wrist forms an angle of 0°.

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

Posture Group A (Arm and Wrist Analysis)
- Upper Arm Posture (upper arm)
The upper arm forms an angle of 25°. Where the position is at an angle of 30 ° - 45°. Then given a score = 2.
- Lower arm posture
The lower arm forms an angle of 90°. Where the position is at an angle of 60° - 100°. Then given a score = 1.
- Wrist (wrist)
The wrist forms an angle of 10°. Where the position is at an angle of 0° - 15°. Then given a score = 2.
- Wrist loop
The wrist is at the end of the spin range. Then given a score = 2.
- Group A's work posture score based on the table above is = 3
- Activity score
The activity is repeated more than 4 times/minute with a score = of 1
- Load score
Occasional loading or force less than 2kg and hold = 0
- Total score obtained for group A (Arm and Wrist Analysis), 3 + 1 + 0 = 4

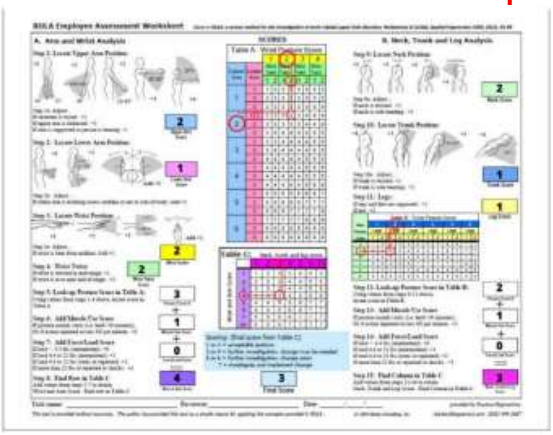
Group B Posture (Neck, Trunk, and Leg Analysis) - Neck Posture
The neck in doing this work looks slightly forward to form an angle of 15 °. Where the position is at an angle of 10°-20°. Then given a score = 2.
- Posture of the torso (Back)
The back in doing this work forms an upright posture in a sitting position and is well supported by the angle of the thigh. Then given a score = 1.
- Legs Posture
The legs look balanced when sitting because the legs are supported by a balanced weight. Then given a score = 1

Neck	Back											
	1		2		3		4					
	Laki		Laki		Laki		Laki		Laki		Laki	
	1	2	1	2	1	2	1	2	1	2	1	2
1	1	2	2	3	3	4	5	5	6	6	7	7
2	2	3	2	3	3	4	5	5	6	7	7	7
3	3	3	3	4	4	5	5	6	6	7	7	7
4	5	5	5	6	6	7	7	7	7	7	8	8
5	7	7	7	7	8	8	8	8	8	8	8	8
6	8	8	8	8	8	8	8	9	9	9	9	9

- Group B's work posture score based on the table above is = 2
- Activity score
The activity is repeated more than 4 times/minute with a score = of 1
- Load score
Occasional loading or force less than 2kg and hold = 0
- Total score obtained for group B, 2 + 1 + 0 = 3
- After obtaining Group A and Group B scores, the final scores for both groups are required.
C score = A score + muscle use score + loading score for group A = 4
D score = B score + muscle use score + loading score for group B = 3
- This final score can be determined using the table to calculate the final score, here are the

final scores from Group C and Group D.

Grand Score							
Score C*	Score D = Score B + Muscle + Power						
	1	2	3	4	5	6	7+
1	1	2	3	3	4	5	5
2	2	2	3	4	4	5	5
3	3	3	3	4	4	5	6
4	3	3	3	4	5	6	6
5	4	4	7	7	6	7	7
6	4	4	5	6	6	7	7
7	5	5	6	6	7	7	7
8+	5	5	6	7	7	7	7



The final score for sitting posture using a Cloth Cutting Machine based on the table above is = 3.

The final score for the fabric cutting process activity at Home Industry Rangganesvi with a sitting posture using a *Cloth Cutting Machine* based on the table above is = 3. Based on this score, the activity or work undertaken by the worker is at risk level 2 which indicates that in the future it is necessary to hold a further investigation and further changes may be required if necessary.

Fabric Cutting Machine Design

The design of this tool is carried out according to the rules of ergonomics to determine the size of the cloth cutting machine or *Cloth Cutting Machine*. This height determination is carried out for the convenience of the position of the worker operating the tool which has a tool length of 75 cm, the height of the base of 75 cm, a width of the base of 75 cm, blade height of 10 cm and distance between table edge and blade of 45 cm. There is a drawer where the machine is used for storage, the rotary button and the power connector on the right are 25 cm high. Using this cloth cutting machine is more convenient and safer. With the new and ergonomic design of the fabric cutting machine, it can increase productivity, effectiveness, efficiency, and worker performance and bag production output is increasing rapidly. In addition, the work posture in the process of cutting the fabric can reduce the risk of *Musculoskeletal*

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

Disorders (MSDs).

From the design of the Cloth Cutting Machine, it can be seen the comparison of the production process of cutting cloth manually and by using a machine. As in the table below:

Comparison	Manually	Using machine
Work Posture	- Sitting on the floor - Left leg bent, right leg straightened - Back bent with neck leaning forward and looking down	- Sit on the chair - Both leg straight up - Back straight with neck and looking forward
Advantages	- Tool easy to operate - Tool easy to maintenance and cleaned up	- Machine easy to operate - Semi-automatic cutting machine and can load production in large quantities - Frame made of the best quality and durable - High level of safety, comfort and ergonomics
Disadvantages	- Tool components are separate and easy to lose - Non-durable tools - Low level of safety, comfort and ergonomics - All manual	- The size of the cloth cutting amchin is quite large

CLOSING

Conclusion

Based on the results of the *Nordic Body Map Questionnaire (NBM)* to 11 workers, they do the work of cutting cloth manually and often experience fatigue. The most dominant body part felt by workers in the back, so the NBM score obtained is 4 which means the back is very sore. So that all workers experience *Musculoskeletal Disorders (MSDs)* with an average high-risk category that can affect muscles, bones, and joints.

In the results of data processing using the Rapid User Limb Assessment (RULA) method of the back which forms an angle of 23° with a score of = 3, the score is given because the back position is 20° - 60° flexion. Assessment of work posture in a sitting position on the floor has a risk with a total final score = of 6. Based on this score, the activity or work undertaken by the worker is at risk level 3 which indicates that further investigation is needed and changes

are needed as soon as possible. Therefore, in the work posture at Home Industry Rangganesvi, there are many inappropriate work postures, this work posture is very uncomfortable to do and not ergonomic. To overcome this, it can be done to improve changes in work posture by carrying out the process of cutting cloth using a Cloth Cutting Machine on the proposed work posture. In cutting cloth using a Cloth Cutting Machine, the back position in doing the work forms an upright posture in a sitting position and is well supported by the angle of the thigh with a score = 1, with a final score = 3 being at risk level 2 which can reduce the risk of Musculoskeletal Disorders (MSDs). It can be concluded that the complaints of Musculoskeletal Disorders (MSDs) felt by workers have a high risk so that the repairs made using this Cloth Cutting Machine greatly affect the work posture where the position is better, comfortable, and ergonomic but maybe in the future it is necessary to conduct further investigations. further and changes may be required if necessary.

Suggestion

The advice given to Home Industry Rangganesvi is to improve work methods to reduce fatigue and increase productivity. This can be done in several ways, namely:

1. To reduce pain in the back, waist, and thighs, workers should change their posture periodically. And don't do that painful posture again. Workers should take care of their health apart from not engaging in postures that may cause pain. Because your health is also necessary.
2. The Home Industry Rangganesvi should pay attention to the work posture of activities in the production process carried out by each of its workers so that injuries do not occur in the future. In this case, it is expected to provide ergonomic work facilities so that workers are more comfortable, such as Cloth Cutting Machines.

BIBLIOGRAPHY

1. Bintang A,N., Dewi, S, K., 2017. "Analis Postur Kerja Menggunakan Metode OWAS Dan RULA (Studi kasus Di PT PG TJOEKIR) . Jurnal Teknik Industri, Vol.18, No. 01, Februari
[2] Biru laut. 25 Maret 2010 Rula Rapid Upper Limb Assessment https://mutiamanarisa.wordpress.com/2010/03/25/rula-rapid-upper-limb-assessment/
[3] Ergonomics Plus. (n.d), The Definition and Causes of Musculoskeletal Disorders, https://ergoplus.com/musculoskeletal-disorders-msd/ , Diakses pada hari Senin, 22 November 2021 Pk. 00.00 WIB.
[4] Hartono, A. & Soewardi, H. (2018). "*Analisis Faktor-Faktor Resiko Penyebab Musculoskeletal Disorders Dan Stres Kerja (Studi Kasus Di Pln Pltgu Cilegon), Vol. 6 No. 3,* 165 – 173
[5] Hasrianti, Y., 2016. Hubungan Postur Kerja dengan Musculoskeletal Disorders, Skripsi Fisioterapi FK Unhas, pp. 1–93.diunduh dari : http://repostory.unhas.ac.id pada tanggal 25 Oktober 2019.
[6] L. McAtamney and E. N. Corlett, "RULA: a survey method for the investigation of workrelated upper limb disorders," Applied ergonomics, vol.24, pp. 91-99, 199
[7] Materibelajar.co.id. (2021, 24 Agustus). Egonomi Lingkungan Kerja. Diakses pada 13 Desember 2021, dari https://materibelajar.co.id/pengertian-ergonomi

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)

[8] McCauley-Bush P. 2012. Ergonomics: Foundational Principles, Aplications, and Technologies, New York: CRC Press.
[9] Ngafiati,N. (2019). *"Analisis Postur Kerja dan Keluhan Musculoskeletal Disorders (MSDs) pada Pekerja Pembuatan Batu Bata di Dusun Plandi Pasuruan Mertoyudan Magelang".* Karya Ilmiah . Yogjakarta: Politeknik Kesehatan Kementrian Kesehatan Yogjakarta
[10] Occupational Health and Safety Council of Ontaria. (2007). Resource Manual for the MSD prevention Guideline for Ontario. http://govdocs.ourontario.ca/node/25 980 Diakses 18 Juli 2019
[11] Octaviani, D. (2017). *"Hubungan Postur Kerja dan Faktor lain terhadap keluhan Musculoskeletal Disorders (MSDs) pada Sopir Bus Antar Provinsi di Bandar Lampung"*. Skripsi. Lampung: Universitas Lampung
[12] Purwaningsih Ratna, 2007 "Buku Ajar Ergonomi Industri", UPT PUSTAKA, Universitas Diponegoro. Semarang
[13] Riadi, Muclisin.2014."Analisis Metode Rapid Upper Limb Assessment (RULA)", diakses pada tanggal 20 Desember 2021 pukul 22.02 https://www.kajianpustaka.com/2014/06/analisis-metode-rapid-upper-limb.html
[14] Seputarpengetahuan.co.id. (2021, 4 April). Ergonomi. Diakses pada 13 Desember 2021, dari https://www.seputarpengetahuan.co.id/2021/04/ergonomi-adalah.html
[15] Suma'mur, 2009. Higiene Perusahaan dan Kesehatan Kerja, Jakarta: CV Sagung Seto
[16] Tarwaka, 2015. Ergonomi Industri 2nd ed.,Surakarta: Harapan Press.

HALAMAN INI SENGAJA DIKOSONGKAN

ISSN 2798-3471 (Cetak)
ISSN 2798-3641 (Online)