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# ANALYSIS OF THE USE OF ERGONOMIC TROLLEY ON MUSCULOSKELETAL COMPLAINTS ON WORKER TRANSPORTING GALLONS OF WATER AND LPG 12 KG

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***Abstract.*** The need for drinking water and gas in the family is very urgent. Every day humans definitely need to drink and eat. Each family will also use gas for cooking purposes. Many companies that sell drinking water and LPG gas now produce in quite large sizes, such as 19 liter gallons of water and 12 kg LPG gas cylinders. The weight of gallons of water and LPG cylinders will make it difficult for humans/workers to lift and transport them. The 12kg LPG cylinder in full gas condition weighs 27 kg. The sizes of gallons of water and LPG gas cylinders have similar dimensions. If the family has difficulty in lifting and transporting gallon water or LPG gas cylinders, they will ask workers for help to lift them. Lifting and transporting these heavy gallons of water and LPG gas cylinders will cause muscle complaints and even muscle injury for workers, especially if they do the same job many times a day. Workers will also get tired quickly and productivity will be low. For this reason, research is carried out by making a tool in the form of a trolley which is ergonomically designed to provide solutions to these problems. This research was conducted experimentally using the one short study method and with the same subject to determine the decrease in muscle complaints and worker fatigue. The sample [of the study was 10 workers. Muscle complaints were predicted with the Nordic Body Map questionnaire. Meanwhile, fatigue was predicted using a 30-item fatigue questionnaire in general. The results of the study stated that the trolley design was in accordance with the worker's anthropometry with a width of 70 cm, a height of 140 cm and a weight of 60 kg which could be moved using wheels. Muscle complaints decreased by 24.9% and fatigue in general decreased by 41.0%.

*Keywords : trolley, musculoskeletal disorders, fatigue*

## 1. INTRODUCTION

Doing lifting and carrying heavy loads will cause muscle injury and fatigue very quickly. The work of lifting 19 liter gallons of water and lifting 12 kg LPG gas cylinders is one of the heavy lifting jobs that is carried out repeatedly in a day. Muscle injuries that occur are usually in the neck, shoulders, wrists, arms, and waist. This work will feel more difficult if the lift and haul trip is quite far or on a multi-storey house. In addition to requiring a large amount of energy, it takes quite a long time, and will quickly reduce our productivity.

The main problems of the work process using muscles and working time are long enough to cause an increase in musculoskeletal complaints and fatigue and an increase in workload which in turn reduces work productivity, increases fuel costs and longer working time. Research conducted by Adiputra, N [1] stated that ergonomic intervention in small industries by using ergonomic work tools will significantly reduce the workload and subjective complaints and will ultimately increase work productivity. Alternative problem solving using an ergonomic approach is the design of ergonomic work tools that are expected to reduce musculoskeletal complaints and fatigue levels, so as to increase worker productivity.

Lifting and transporting that is not in accordance with human capabilities and abilities is an ergonomic problem that must be given a solution. one solution is to design a trolley as a tool to lift and transport gallon water and LPG gas. the design of this trolley needs to follow ergonomic principles such as having to match the anthropometry of workers [2][3], easy to use [4], and inexpensive in design [5].

## 2. METHODS

### 2.1. Research Design

This type of research is a one-short case study with a pre and post-test design group. This research was conducted with an experimental design on the working process of the gallon lifter and LPG gas [6][7]. Chart can be described as follows:

R ⟶ P0 ⟶ PI

Figure1. Research Design

Information:
R = Random sample.
P0 = manual process.
PI = Process with Trolly.

### 2.2 Research Variable

The variables to be measured in this study include: (1). musculoskeletal disorders before and after work was predicted by Nordic body map questionnaire; (2) work fatigue after work by filling out the 30 fatigues rating questionnaire. The initial condition information data and the final condition were then compared to find out the comparison before using the trolley by manual lifting.

### 2.3 Data Analysis

The trolley design data is calculated based on the routine work activities of workers when lifting gallons of water or LPG gas to. Test data before the use of the trolley and after the use of the trolley includes data on musculoskeletal complaints and data on worker fatigue and working time which will then be analyzed descriptively to obtain conclusions.

## 3. RESULTS AND DISCUSSION

### 3.1 Lifting Gallons And Lpg Gas Manually

Based on the results of interviews with workers lifting and transporting Aqua gallons and 12 Kg LPG gas, they work for 8 hours, from 08.00 WITA to 17.00 WITA with 1 hour rest time. With an average lifting distance of up to 800 meters to lift an average of 150 gallons, either to stalls/shops or to consumers' homes and there are also some consumers who live on the 2nd floor, so they have to climb up to 46 stairs for a 4-storey house. 2 by carrying 8 gallons. From this work, the labor market often complains of pain in the wrist and waist

To overcome this problem, workers are advised to use a trolley as a work aid. The use of this trolley is quite easy, safe and comfortable. By positioning the trolley standing and workers can put 2 gallons of water or LPG gas. Furthermore, the gallon of water or LPG gas is tied up for safety, after that it is laid down to be pulled with light power to the consumer.

Figure 2 Craftsman Work Posture

When working, the use of muscles that receive static loads repeatedly over a long period of time can cause complaints in the form of damage to joints, tendons, and ligaments. These complaints are usually referred

to as injuries to the musculoskeletal system or musculoskeletal disorders (MSDs) [2][8]. Based on recommendations from the Occupational Safety and Health Administration (OSHA), ergonomic measures to prevent disease sources are in two ways, namely engineering through the design of work stations and tools and management engineering through work criteria and organization [9][10][11].

### 3.2 Trolley Design Model

An effort to create a safe and comfortable working condition, it is necessary to have good interaction from the three components mentioned above, namely humans, machines, and the work environment. In ergonomics, humans are the most important component that must be considered with all the limitations it has. In other words, the demands of work tasks should not be too low (underload) and should not be too excessive (overload) because both will cause stress [12]. A good design can be produced by recognizing the characteristics, limitations, and abilities of humans. Humans play a central role in their activities, namely as planners, designers, implementers, and evaluators in every activity (work). Humans as a source of labor are still dominant in carrying out the production process, especially activities that are repetitive. Ergonomically designed equipment needs to be carried out based on ergonomic principles.

Stone tools such as trolleys should be designed to be easy and practical to use. Basically, in making this tool, it aims to simplify the work process of the workers. The product of this trolley design is expected to improve the health and work effectiveness of the workers themselves.

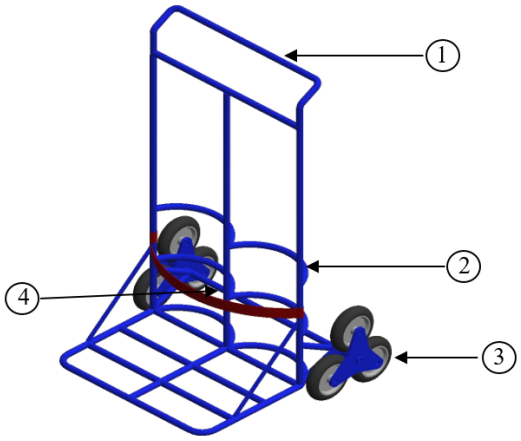


Figure 3 Trolley Design

Information:

1. Iron Pipe
2. Iron Strip
3. Trolley Tires
4. Axle

### 3.3 The Result Of Ergonomics Test Using Trolley

***a. Musculoskeletal complaint***

Every human being works, regardless of the type of work done, the muscles of the body will definitely contract and relax alternately [10][13]. This occurs as a result of the activity of the limbs in maintaining a stable body position, or certain movements in carrying out tasks. The more movements that are contrary to physiological rules are carried out, the more energy is used [2][14]. The more the attitude of the body against the neutral stance of the body the more the muscles work. Likewise, if the body is increasingly fixed in a working position in a certain work position, the longer certain muscle groups will contract. Moreover, if it is done repeatedly, it will result in muscle fatigue [2][15][16]. This form of muscle fatigue is accompanied by a sensation of pain or in the muscles. All of which can be detected in the form of complaints in the muscles. Which type of muscle is affected depends on the severity of the task, and the monotony of the movement.

musculoskeletal disorders data were obtained subjectively by the Nordic body map questionnaire. The data obtained were tested with a normality test. Based on the normality test with Shapiro-Wilk, the results are as shown in Table 1.

Table 1. Measurement Results Of Musculoskeletal Disorder

| *Descriptions* | Everage difference musculoskeletal disorder | | t | p |
|---|---|---|---|---|
| | *Mean* | *Standard deviation* | | |
| Manual process | 44,02 | 2,56 | 6,578 | 0,00 |
| Process with trolly | 33,04 | 4,17 | | |

***b. Fatigue***

Each individual provides different fatigue conditions. This fatigue condition will lead to reduced efficiency and ability, and work productivity. There are two kinds of fatigue, namely muscle fatigue and general fatigue. Muscle fatigue occurs due to symptoms of pain when muscles are under excessive tension, whereas fatigue is generally characterized by a reduced sense of readiness to use energy. Fatigue in general can be seen from symptoms of psychological changes in the form of sluggish motor and breathing activity, feeling sick, heavy eyeballs, weak and decreased motivation, decreased physical and mental activity.[2]. Fatigue can start from very light to very tired. This subjective fatigue usually occurs at the end of working hours, when the workload has exceeded 30-40% of the worker's maximum aerobic power.[2], [9][17].

Table 3. Work Productivity Of Craftsmen In The Roasted Grated Coconut Process

| Description | Mean | SD | t | p |
|---|---|---|---|---|
| Manual process | 159.69 | 2.17 | 0,157 | 0,000 |
| Trolly process | 94.21 | 3.22 | | |

This study is in line with other researchers who state that ergonomics aids can reduce muscle complaints, work fatigue, and even increase work productivity [18]–[20].

## 4. CONCLUSION .

Based on the results and discussion, the conclusions of the study are as follows:

1. Work postures of workers who have to rely on the waist and wrist muscles cause musculoskeletal complaints and increased fatigue complaints due to monotonous or repetitive work attitudes and can even cause work accidents.
2. The dimensions of the trolley design are: 70 cm wide and 140 cm high with a weight of 60 kg, quite simple to move
3. The results of the analysis of musculoskeletal complaints and fatigue in general are:
   a. The mean of manual musculoskeletal complaints of workers was 44.02 (±2.56) and the mean of musculoskeletal complaints using a trolley was 33.04 (±4.17) or a decrease of 24.9%
   b. The average manual fatigue was 152.69 (±2.17) and the trolley fatigue average was 94.21 (±3.22) or decreased by 41.0%.

## 5. ACKNOWLEDGEMENT

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