Ergonomically Oriented Work Methods Reducing Musculoskeletal Complaints of Tofu Factory Workers in Tonja Village

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Abstract

Industrial activities develop from all sectors, both formal and informal sectors. The informal sector has an important role in developing countries including Indonesia. Every type and place of work for both formal and informal workers has a risk of hazards that can cause occupational accidents and occupational diseases. In the tofu production process, there are activities that pose a risk of occupational disease and occupational accidents, so choosing the right work method is very important to ensure the health of workers. This research was conducted to determine whether the ergonomically oriented work method in the process of making tofu can reduce musculoskeletal complaints in workers. The research was designed with the same subject design (treatment by subject design). The research was conducted at the Tofu Factory located in the Tonja Village, Bali in September 2020. Sample were seven workers in the tofu factory. The difference in conditions before and after activities using non-ergonomically oriented work methods and ergonomically oriented work methods were compared and statistically tested. The comparative test was carried out on the musculoskeletal complaint score. The results showed that the ergonomically oriented work method caused a decrease in the score of musculoskeletal complaints by 40.03% ($p<0.05$). It can be concluded that ergonomics-oriented work method significantlyreduced musculoskeletal complaints of the tofu factory workers in Tonja Village.

Keywords: ergonomically oriented work methods, musculoskeletal complaints

Metode Kerja Berorientasi Ergonomi Menurunkan Keluhan Muskuloskeletal Pekerja di Pabrik Tahu, Desa Tonja

Abstrak

Kegiatan industri berkembang dari semua sektor, baik sektor formal maupun informal. Sektor informal memiliki peran yang besar di negara-negara berkembang termasuk Indonesia. Setiap jenis dan tempat kerja baik pekerja formal maupun informal memiliki risiko bahaya yang dapat menimbulkan kecelakaan kerja dan penyakit akibat kerja. Dalam proses produksi tahu terdapat kegiatan yang menimbulkan risiko penyakit akibat kerja dan kecelakaan kerja, sehingga pemilihan metode kerja yang tepat sangat penting untuk menjamin kesehatan pekerja. Penelitian ini dilakukan untuk mengetahui apakah metode kerja yang berorientasi ergonomis dalam proses pembuatan tahu dapat mengurangi keluhan muskuloskeletal pada pekerja. Desain penelitian ini adalah rancangan sama subjek (treatment by subject design). Penelitian dilakukan di Pabrik Tahu yang berada di Desa Tonja. Diselenggarakan pada bulan September 2020. Sampel sebanyak 7 orang pekerja di pabrik tahu. Perbedaan kondisi antara sebelum dan sesudah kegiatan yang menggunakan metode kerja tidak berorientasi ergonomi dan metode kerja berorientasi ergonomis dibandingkan dan diuji secara

statistik. Uji komparatif dilakukan terhadap skor keluhan muskuloskeletal. Hasil penelitian menunjukkan bahwa metode kerja yang berorientasi ergonomis menyebabkan penurunan skor keluhan muskuloskeletal sebesar 40,03% (p<0,05). Kesimpulan dari penelitian ini adalah metode kerja berorientasi ergonomis secara signifikan (?) untuk mengurangi keluhan muskuloskeletal pekerja di pabrik tahu Desa Tonja.

Kata kunci : metode kerja berorientasi ergonomis, keluhan musculoskeletal

INTRODUCTION

Nowadays, the development of industry in various fields is an inseparable part of people's life. Industrial activities develop from all sectors, both formal and informal sectors. The informal sector has a big role in developing countries including Indonesia. Employment in the informal sector is very diverse. Most of the business sectors in this sector are categorized as micro, small and medium enterprises. These fields often receive less attention from the government. Every type and place of work for both formal and informal workers has a risk of hazards that can cause occupational accidents and occupational diseases.

Tonja Village has an informal sector which is engaged in processing soybeans, namely a tofu factory. The production process includes activities that pose a risk of occupational accidents and occupational diseases starting with the distribution of raw materials, processing, printing, storage and distribution of finished products. All operational activities carried out at Tofu Factory have various kinds of potential hazards including physical hazards such as construction, machinery, work space, temperature, and light. Chemical hazards include chemicals used as thickening agents in soybean dough to make tofu. Ergonomic hazards include the design of workplaces / tools / machines, repetitive movements, work postures / positions, manual transportation, which can cause musculoskeletal complaints.

The work method is an orderly method used to carry out a job so that it is achieved as desired. The work method also means a systemized way of working to facilitate the implementation of an activity in order to achieve the specified goals. The main objective of applying work methods, standards and job designs is to increase productivity and product safety, lower unit costs and thus enable more quality goods and services to be produced for more people. Selection of the right work method can simplify the work done and have an effect on increasing work productivity (Niebel and Frievalds, 1999).

The work methods applied in tofu factories, especially methods of lifting or transporting soybeans for soaking or soybean dough to be cooked to become tofu, are lifting workers. The manual lifting activity with bending due to too heavy loading could causes spinal injury (*musculoskeletal disorder*) and other muscle disorders. The heavier the load being lifted, the harder the spine will work to withstand the load. Excessive loading on the spine causes the spine to become damaged which is one of the factors in the occurrence of low back pain (Nurmianto, 1996). Therefore it is necessary to prevent damage to the spine, one of which is by paying attention to weight lifting techniques (Suma'mur, 1989). In ergonomic lifting techniques, the weight is located on both legs and not on the spine or back. Thus the spine does not have to work hard to support the load, so that the possible spinal damage will be small, and will reduce the risk of being exposed to low back pain. So the more ergonomically lifting technique used to lift weights, the smaller the risk of exposure to lower back pain.

In this study, the researchers suggested an ergonomic lifting and transportation process. So that this ergonomically oriented work method can reduce the risk of musculoskeletal complaints that occur in workers. The ergonomics-oriented work method in question is to pay attention to the load that workers can lift / transport manually. Study on ergonomic work

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position such as the right position when lifting / lifting weights manually, in the tofu factory, Tonja Village has never been reported.

From a preliminary study of four workers carrying out manual lifting, workers felt musculoskeletal complaints, especially in the back of the neck, shoulders, upper arms, waist and calves. The percentage of musculoskeletal complaints felt by workers is shown in Figure 1.

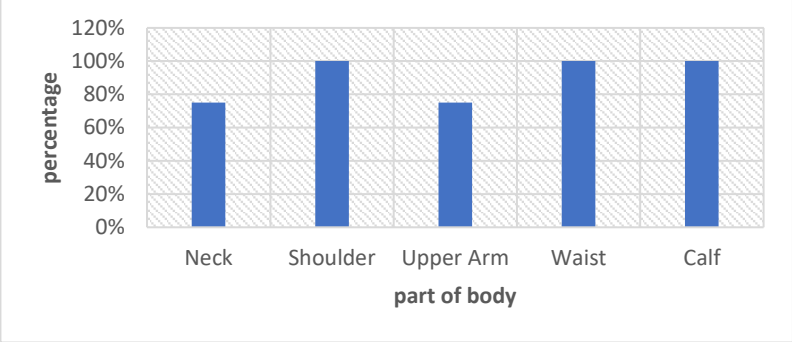

Figure 1. Musculoskeletal complaints of workers in Tofu Factory

Choosing the right work method during work can reduce the risk of musculoskeletal complaints from workers in tofu factories. Therefore it is necessary to do research in an effort to overcome the problems that arise. Participatory approach efforts with tofu factory workers and business owners show that the alternative chosen is to apply work methods related to lifting / transporting permitted loads and proper lifting / transporting techniques at tofu factories. This intervention effort was chosen to determine ergonomics-oriented work methods during lifting and transportation process to reduce musculoskeletal complaints in the Tofu Factory of Tonja Village.

This research is expected to be able to solve problems related to occupational diseases, especially musculoskeletal complaints in the informal sector, because so far the informal sector has not received special attention, but workers in the informal sector are quite large and their health and safety during work need to be guaranteed. The application of this work method is expected to reduce the incidence of occupational diseases in the informal sector.

METHOD

This research is an experimental study, using treatment by subject design (Bakta, 2000). The same-subject design is a serial design, where all samples are subject to control and treatment, in different time periods. The target population is tofu workers. The affordable population is the tofu maker in the tofu factory in Tonja village, amounting to seven people. The technique of determining the sample for this research was to use a simple random selection technique (simple random sampling) with the lottery method. The number of samples was seven people.

The work method is the way of working done by each worker in the tofu factory. Work methods that are not ergonomically oriented are work methods that do not pay attention to the loads that workers can lift / transport manually. Not paying attention to ergonomic work positions such as the right position when lifting / lifting weights manually. Ergonomics-oriented work method is a work method that takes into account the load that workers can lift / transport manually. Pay attention to ergonomic work positions such as the right position when lifting / lifting weights manually. Musculoskeletal complaints are complaints in the skeletal muscle system caused by work and work environment factors that are obtained when doing

work that is recorded using a questionnaire *Nordic Body Map* with 4 Likert scale. The results of the study were processed and analysed using a computer with the SPSS (*Statistical Package for the Social Sciences*) program.

RESULTS AND DISCUSSION

Data recorded including age, weight, height, body mass index (BMI) and work experience (Table 1).

Table 1
Description of the characteristics of research subjects

No.	Variable	Mean	Standard Deviation
1.	Age (years)	36.14	5.33
2.	Weight (kg)	64.57	4.23
3.	Height (cm)	168.57	3.50
4.	BMI (kg / m2)	22. 70	0.86
5.	Work experience (months)	11.71	4.95

In this study, it was known that the average age of the subjects was 36.14±5.33 years, average body weight was 64.57±4.22 kg, average height was 168.57±3.50 cm, while the average BMI of the subjects was 22,70±0.86 kg/$m^{2.}$ and average work experience of 11.71±4.95 months, if viewed in terms of age, weight, height, and BMI of the subjects included in the normal category. The BMI recommendation for Indonesians for the normal category is 18-25, while the subject's work experience is included in the fairly experienced category.

Data on musculoskeletal complaints were analysed using assumption tests, different tests for musculoskeletal complaints before work without ergonomically oriented work methods and musculoskeletal complaints before work using ergonomically oriented work methods. Assumption test, different test for musculoskeletal complaints after work without an ergonomically oriented work method and an ergonomically oriented work method, and a treatment test (difference) of musculoskeletal complaints without an ergonomically oriented work method and an ergonomically oriented work method.

Before the differential test was carried out, the data was first performed an assumption test to determine the distribution of the data, the results of the Shapiro Wilk test showed that the data were normally distributed ($p > 0.05$), then an independent t-test was performed. The results are presented in Table 2.

Table 2
The results of the different tests for musculoskeletal complaints before work in workers without Ergonomically Oriented Work Methods and Ergonomically Oriented Work Methods

Subject Group	n	Mean	SB	Different Mean	Value t	Value P
Pre-MSDs WOErgonomics	7	33.33	1.31	1.00	-1,267	0.25
Pre-MSDs WErgonomics	7	34.33	1.53			

Before the differential test wass carried out, the data was first examined with an assumption test to determine the distribution of data. The results of the *Shapiro Wilk test* show that the data was normally distributed (p> 0.05), then an *independent t-test* was performed. The results are shown in Table 3.

Table 3
The results of the different tests for musculoskeletal complaints after work for workers without ergonomically oriented work methods and ergonomically oriented work methods

Subject group	n	Mean	SB	Difference Mean	Value t	Value P
Post-MSDs WOErgonomics	7	78.85	2.55	16.81	13.38	0.00
Post-MSDs WErgonomics	7	62.04	1.00			

Before the differential test was carried out, the data was first performed an assumption test to determine the distribution of data, the results of the Shapiro Wilk test showed that the data were normally distributed (p >0.05), then an independent t-test was performed. The results are shown in Table 4.

Table 4
The results of the difference test (difference) of the difference in musculoskeletal complaints among workers without ergonomic work methods and with ergonomic work methods

Subject group	n	Mean	SB	Difference Mean	t Value	p value
Difference Pre-Post WOMetode	7	41.51	2.68	13.80	9.27	0.00
Difference Pre-Post WErgonomics	7	27.71	2.19			

The difference test showed that the mean difference in the scores of musculoskeletal complaints without an ergonomically oriented work method was 41.51±2.68 and the mean difference between the scores for musculoskeletal complaints with the ergonomically oriented work method was 27.71±2.19. These results indicate a decrease in the scores for musculoskeletal complaints by 13.80 or 40.03%. From the results of the two different tests, the difference in musculoskeletal complaints scores after the research activity showed that the scores for musculoskeletal complaints were significantly different (p<0.05).

In this study, working without an ergonomically oriented work method is dominated by lifting activities and heavy loads that are not in accordance with ergonomic principles, through ergonomics-oriented work methods, lifting activities and heavy loads that are not in accordance

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with ergonomic principles have been changed to attitudes that are in accordance with the rules. ergonomics.

Figure 2. Working without an ergonomically oriented work method

Figure 2 shows workers lifting soybean dough with a bent position, where the load occurs on the spine or back. Thus the spine works hard to support the load, thus causing low back pain. The load of soybean dough that is lifted weigh 30 kg at a time, ideally the load that can be lifted manually in a continuous time for men is 15-18 kg, lifting this load is also one of the trigger factors for low back pain felt by workers.

Figure 3. Working with ergonomically oriented work method

Figure 3 shows workers lifting soybean dough in an ergonomic position, the load is on both legs and not on the spine or back. Thus the spine does not have to work as hard to support the load, so the possibility of spinal damage will be small, and will reduce the risk of low back

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pain. The weight of the soybean dough that was lifted was reduced to 15 kg so as not to exceed the lifting capacity of the workers.

Astuti (2016) described that the load that can be transported manually in a continuous time for men is 15-18 kg, while for women is 10 kg. Before implementing ergonomics-oriented work methods, workers lift loads as much as they can, it is uncommon for this activity to cause workers to experience low back pain which ultimately causes workers to be unable to work the next day, this can lead to an increase in absenteeism rates due to occupational diseases (PAK).

During the research, the workers followed the suggestions given in the form of proper lifting techniques and attitudes as well as the weight of the load that was adjusted to the worker's ability and the limitations of lifting and carrying loads. These lifting restrictions can help to reduce pain, aches in the spine (*back injuries incidence*). This lifting limit will reduce work discomfort in the spine (Wignjosoebroto, 2008). This causes workers to feel a decrease in musculoskeletal complaints such as stiffness in the back of the neck, shoulders, upper arms, waist and calves. The condition felt by workers were in accordance with the result of statistical test which revealed the scores of musculoskeletal complaints were significantly different ($p<0.05$)

This research is in line with research conducted by Adiatmika (2007) which states that improving working conditions with a total ergonomic approach can reduce musculoskeletal complaints by 5.24% in metal painting craftsmen in Kediri Tabanan. Marfuah (2018) also states that improving the work system with a participatory ergonomic approach provides a decrease in musculoskeletal complaints by 28.13%. Research conducted by the Negara (2019) that ergonomics-oriented work methods can reduce musculoskeletal complaints by 17.82% and reduce fatigue by 11.86% in sardine cans mopping workers. Thus the application of ergonomics-oriented work methods can reduce the risk of musculoskeletal complaints during work by 40.03% for workers in tofu factories in Tonja Village. The data on the decrease in the musculoskeletal complaint score was presented in Figure 4.

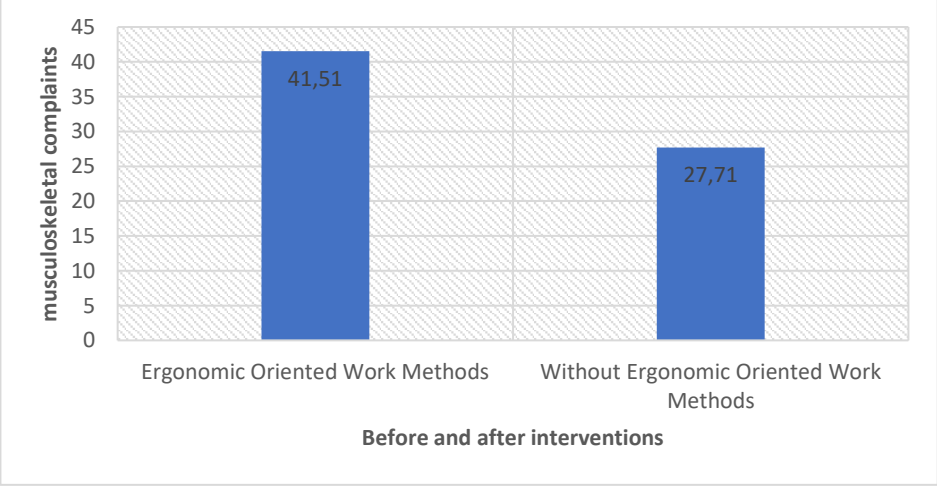

Figure 4. Diagram for Decreasing Musculoskeletal Complaints Score

This work method will be a solution for the workers and business owners at other companies with similar job characteristics, especially the kind of work that lifts or transports loads manually. Ergonomics-oriented work methods are able to reduce the risk of workers musculoskeletal complaints because this work method takes into account the load that can be lifted / transported by workers manually, paying attention to ergonomic work positions such as the right position when lifting / lifting loads manually.

CONCLUSION

From the results of the research and data analysis it can be concluded that the application of ergonomically oriented work methods in the process of making tofu can reduce the risk of musculoskeletal complaints by 40.03%.

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