The Effect of Awkward Postures and Musculoskeletal Disorder Incidents: A Case Study of Bakery Workers

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Abstract. Musculoskeletal complaints or MSDs are common in the bakery industry. Observations and analyses of work posture among bakers are crucial to determine the most practical solution to MSD subjective complaints. This study aims to analyze the impact of work posture on musculoskeletal events in bakery industry workers. This research is quantitative research with a cross-sectional approach. This study recruited 52 bakers. Work posture data was obtained by utilizing the Rapid Entire Body Assessment (REBA) instrument. The subjective musculoskeletal complaint data were collected using the Nordic Body Map (NBM) instrument. The results indicated that most workers (90.4%) were in the young category, 67.3% were male, and 51.9% had a long permanent contract. Most respondents are in the high ergonomic risk category (75%). The lower back (63.5%), neck (25%), and ankle (25%) were subjectively reported by the respondents using the NBM instrument. There was no significant relationship between ergonomic risk and MSD complaints (p-value = 0.721 at $\alpha = 0.05$). The bakers were exposed to ergonomic limitations and experienced some subjective MSD complaints. However, no significant association was found between ergonomic work posture limitations and MSD complaints. The non-significant finding might be related to the small sample study size or the measurement bias.

1 Background

Today's bakery has an important social value. A common problem in this industry is wages and limited resources. Bakeries usually have a hard time investing. However, business owners still need to ensure a safe and healthy work environment. In addition, the government's limited reach in monitoring occupational health and safety conditions is an obstacle to change in this type of industry.[1]

Based on the preliminary survey found that the production process of the bakery industry begins with the preparation of tools and ingredients, mixing of the raw material and preparation of proofing dough (dough development), cooking (oven baking, frying), post-cooking handling (topping, cake decoration), packing, and distribution (to bakery and customers).

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Currently, many bakery industries are developed on Java Island, particularly in Central Java. One of them is the bakery industry in Batang Regency. The preliminary survey also found that this bakery industry has employed around 52 workers. They are divided into several stages of the bread production process. The produced bread in this industry includes white bread, doughnut, sweetbread, and sponge cake. This industry produces on a daily basis to supply bread orders from its customers and bakeries.

Many workers are involved in the production process. Some of them use automatic production machines to help their work while others work manually. One of the problems experienced by the workers is related to manual handling, which includes activities to lift, transport, pull, and push. The particular activity involves putting pressure on the dough and doing some repetitive work. Doing repetitive work in an awkward posture can lead to Musculoskeletal Disorders (MSDs).[2]

Grounded on the preliminary survey, the workers in this bakery industry were found to do repetitive work (lifting a heavy weight) in an awkward posture. The workers were reported to complain that they feel tired, sore, and suffer muscle aches. The workers lack understanding of the appropriate working posture for lifting and transporting. Therefore, this research aims to analyze the working posture toward the complaint of Musculoskeletal Disorders (MSDs) of the bakery industry workers in Batang.

2 Methods

This research employed an observational approach using a cross-sectional study design. It was conducted in the bakery industry in Batang. The workers in the selected site were involved as the research population. Employing the total sampling technique, around 52 workers were involved in the present research. The data were obtained from observation and interviews, which aimed to describe the working process and working posture of the bread-making workers. Nordic Body Map (NBM) questionnaire was used to identify the data for MSD complaints.[3] The working posture was observed and analyzed using Rapid Entire Body Assessment (REBA).[4] This research has gained ethical clearance from the Health Research Ethics Commission of the Faculty of Public Health, Diponegoro University, number 142/EA/KEPK-FKM/2022.

3 Results and Discussions

The research results on various research variables are presented in Table 1.

Table 1. Age, Gender, Work Period, Ergonomic Risk, and MSD Complaint

Characteristics	**f = 52**	**%**
Age		
Young	47	90.4
Adult	5	9.6
Gender		
Male	35	67.3
Female	17	32.7
Work Period		
New	25	48.1
Old	27	51.9
REBA Result		
Medium Risk	5	9.6

High Risk	39	75.0
Very High Risk	8	15.4
MSDs Complaint		
Lower Back	33	63.5
Neck	13	25.0
Elbow	7	13.5
Wrist	11	21.2
Upper back	9	17.3
Hip	5	9.6
Knee	8	15.4
Ankle	13	25.0

Table 1 shows that the majority of the respondents were in the young age (< 35 years old) category (90.4%), male (67.3%), and had a relatively long period (> 1 year) of working (51.9%).

Working posture as presented in Figure 1 is one of the workers' observed postures during the cake decorating process.

Fig. 1. Worker's posture during the cake decorating process

Working posture is the body's position during working activities related to the design of the work area and task requirements. Non-natural or significantly deviant body position while working is called awkward posture. Workers with awkward postures frequently mean workers force on their body performance, leading to injury or trauma in the soft tissues and nervous system [5,6].

Several awkward postures observed in the bakery industry work include the workers' posture during the cake decorating process which forced them to crouch and look down toward the cake for a long period. Moreover, egg-washing work also led to awkward posture since the workers need to sit on a small bench and look down at the egg for a long time. Several workers were also observed to stand in awkward posture while working with cutting. The scoring result based on the REBA form showed that most respondents were at a high risk of suffering from MSD complaints with a total of 75.0%. According to the result, further investigation and posture improvement were needed to decrease ergonomic risk.

This research result is in accordance with the study conducted by Andriani et al. (2020) who reported that sewing workers in Ulak Kerbau Village were suffering from MSD complaints that were frequently felt by the respondents every day during and after working. In this work, a discrepancy between workplace design and workers' activities was found, which led to an awkward posture. The sewing workers' workplace design did not have a proper seat back or cushion, and the non-suitable height of the chair. If it happens frequently, the sewing workers may injure their bodies, especially the neck, back, and shoulders. Doing

awkward positions for hours in a day can also lead to muscle fatigue and stress because the body position tends to be the same as doing repetitive activities. [7]

Research by Putri (2022) showed that based on the research on the working posture using the ROSA method, it was found that 4 of 6 Batam City Environmental Office workers scored more than 5, which meant that the workers' working postures were at risk. Muscle complaints (MSD) and the risky working posture indicated that improvement measures were needed. Improvement measures can be carried out by the Batam City Environmental Office by conducting socialization on the ergonomic implementation at the office, improvement of work facilities, and doing muscle stretching and regular workout for the workers. Other interventions that can be carried out include the improvement of workers' posture and design facilities such as tables and chairs appropriate to the workers' anthropometric applying sitting concept. [8,9]

Musculoskeletal disorders (MSD) become the highest contributor to work-related disease (*penyakit akibat kerja - PAK*) due to a lack of attention on the ergonomic work posture. This disorder played a role in the morbidity of some work areas and was known as an important work health problem since it increased health fund compensation, decreased the workers' productivity, decreased life quality, decided to move to other work, and even caused a disability for the workers. MSD is a complex problem and quite problematic in the work area. [10,11,12]

Based on the NBM instrument used in this research, the majority of respondents were found to experience some complaints in their lower back for around 63.5%, followed by the neck and ankle for 25.0% each.

MSD complaints that were mostly experienced by the workers were in their lower back, neck, and ankle due to some workers working in a standing position for a long period such as in the process of bread packing using a machine and dough shaping. In addition, several workers were sitting on a small bench for a long time such as the cake decorating workers and egg washing workers. Several workers have to lift heavy weights such as flour, sugar, and other bread ingredients' sacks.

Similar research by Chen et al. (2020) presented that around 66.3% of the bread-making workers in Taiwan were found to have MSD complaints around their right hand/wrist and around 50.6% of MSD complaints on the right shoulder. It was due to many bread-making workers in Taiwan using their hands manually to make dough. In addition, complaints on the shoulders and lower back were caused by the goods lifting process, such as moving flour sacks and removing baking sheets from the oven (> 20 baking sheets per day). This research also reported that the number of complaints from the bread-making workers was at 93.0% every year, with the most frequent complaints about the wrist, shoulder, and lower back. [13]

Sarkar et al. (2016) reported in their study that awkward posture could increase the risk of MSD. Awkward postures were frequently found in activities such as lifting, carrying, and lowering. The weight carried by the workers was varied, and commonly they could carry as much as 100 kg, either lifting or putting it above their head. The research result showed that 95% of the workers suffered from MSD complaints, with the most frequent complaints about their lower back, neck, knee, and shoulders. [2]

Table 2 shows that no correlation was found between age and lower back MSD complaints (p-value = 0.419). The muscle's maximum strength was at the age range of 20–29 years old, and at the age of 60, the average muscle strength decreased by 20%. Another factor, such as non-ergonomic habits, led to complaints of musculoskeletal disorders. Back pain complaints started to be experienced around the age of 20–40, which was likely due to degeneration factors and static weight and also osteoporosis. Respondents involved in the research were between 25–34 years old, so that they included in the productive age category. [14]

Table 2. Correlation between Independent Variables and Lower Back MSD Complaints.

Variables	MSD (Lower Back) Complaints				Total		*p*-value
	Suffering		Not Suffering				
	F	%	f	%	f	%	
Age							
Young	18	38.3	29	61.7	47	100	0.419
Old	1	20	4	80	5	100	
Gender							
Male	16	45.7	19	54.3	35	100	0.049
Female	3	17.3	14	82.3	17	100	
Work Period							
New	13	52.0	12	48.0	25	100	0.026
Old	6	22.2	21	77.8	27	100	
Ergonomic Risk							
Medium Risk	1	20.0	4	80.0	5	100	0.721
High Risk	15	38.4	24	61.6	39	100	
Very High Risk	5	62.5	3	37.5	8	100	

Similar to research conducted by Andriani et al. (2020), a correlation between age and MSD complaints was found among the sewing workers in Ulak Kerabu Village. Sewing workers aged < 35 years were more likely to experience MSD, due to the long sewing period since the longer the individual works, the higher the risk to experience MSD. Around 30% of sewing workers aged < 35 years have worked for more than or equal to 3 years. Therefore, to decrease the risk of MSD complaints, the sewing workers were suggested to pay more attention to their physical condition, such as by working out since the increase of age tends to lower the individual's physical strength. [7]

A correlation between gender and MSD complaints (p-value = 0.049) was found in this research. Several studies have shown a relationship between gender and musculoskeletal disorders. It was also reported that females were more likely at risk of suffering musculoskeletal disorders than males. Gender was closely related to MSD complaints since physiologically, the muscle strength of males is stronger than females. Some experts argued differently on the impact of gender and musculoskeletal complaints. However, some other research found that gender showed a significant impact on muscle complaints risk. Females' muscles were smaller in size and only two third (60%) stronger than the males' muscles, especially the arm, back, and leg muscles. This natural condition makes women more susceptible to musculoskeletal disorders. The comparison of muscle complaints between men and women was 3 to 1. Pal (2018) also presented in his research that women were more likely to be at a high risk of suffering from MSD. This research found that some women worked in awkward positions for a long period and that the women needed to finish their house chores such as cooking, cleaning, and washing before they moved to the field, which often burdened them. [12,14,15]

The statistical test result showed a significant correlation between work period and MSD complaints (p-value = 0.026). The longer the work period, the higher the musculoskeletal complaints of an individual. This research is also similar to the research conducted by Devi in 2017 that showed a significant correlation between workload and musculoskeletal complaints. It is probably because musculoskeletal disorders commonly would not occur spontaneously or directly, but gradually to the point that someone begins to feel the pain. [16,17]

According to Table 2, no significant correlation found between ergonomic risk and MSD complaints (p-value = 0.721). It is in accordance with the research by Devi in 2017 who reported that no significant correlation was found between the level of ergonomic risk and MSD complaints. However, it was evident that a high number of respondents possessed a high level of ergonomic risk although no statistical correlation was found. It may lead to many MSD complaints if no intervention or improvement is conducted and left as it is for a long time. Working in an awkward body posture can be a habit with an effect of movement or shortening of soft tissues and muscles. A non-natural working position will lead to muscle movement that should not happen, which will lead to a waste of energy and increase the total energy needed by the workers. At the same time, energy transfer from muscles to the skeletal tissues will not be efficient, which leads to exhaustion. [17]

Abarougu's (2016) research result showed that a significant correlation was found between WRMD (*Work-Related Musculoskeletal Disorders*) and particular physical work, especially repetitive work. The REBA calculation showed around 55.8% of respondents were possessed a high risk of having MSD complaints. It was due to repetitive work and inappropriate workstations [18]. Another research by Daika (2019) reported a remarkably high level of ergonomic risk and high MSD complaints. It is caused by limited workplace and awkward postures, such as bending, crouching, and lifting. [19]

4 Conclusions

It can be concluded that workers in the bakery industry experience a high ergonomic risk. They also complained about MSD. Although no significant relationship was found, a further investigation needs to be conducted regarding the ergonomic risks to prevent the increase of MSD.

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