

## Stretching exercise to reduce musculoskeletal pain among x bakery's workers

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### ABSTRACT

X bakery has 51 workers and produces approximately 60.000 pieces of bread in a day for nine working hours. Most of the production activities are manually handled and only. The low-level musculoskeletal pain reported by 92% of packaging workers. This study aims to analyze the effectiveness and ideal duration of stretching exercise in reducing musculoskeletal disorders (MSDs) among workers. Using quasi-experimental design, 51 workers involved as respondents who were asked to do a simple stretching exercise in specific duration, five days a week in at least 4 weeks. The MSDs score were measured using the nordic body map (NBM) questionnaire. Intervention divided into 4 categories based on the duration. There is lower level of musculoskeletal pain among all exercise group in average, but comparison test doesn't show a significant difference compared to control group (p-value=0.232). The group with 15 minutes exercise is the only group that significantly difference compared with the control group (p-value=0.020). The workers with 15 minutes stretching exercise, five days a week tend to have 5.16 % lower level of musculoskeletal pain compared to the control group. Another type of exercise and various durations might be needed as comparison to obtain more representative result.

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## 1. INTRODUCTION

Bakery Industries in Indonesia are dominated by small and medium industries (approximately 60 %) [1] that most of its production activities are manually handled with traditional method instead of using machine [2]. Therefore ergonomic problems are commonly occurred in bakery's workers (bakers) due to the high demand and posture incompatibility. The most common risk caused by incompatibility of work design is work-related musculoskeletal disorders (WMSDs) [3], [4]. According to Habib [5], in His study among 504 bakeries selected randomly across Lebanon, 23% of bakers reported upper extremity pain. Study in Kashan city, Iran also showed that 107 of 175 traditional bakers (61.1%) worked in heat stress situation [3].

Hedge [6] found that workstation design from an ergonomics perspective can effectively enhance productivity and minimize posture stress. If work station did not ergonomically designed, workers may expose to posture stress caused by repetitive movement [7], and lifting heavy materials [8]. Workers who report inconveniences caused by posture stress will easily exhausted and have their productivity affected [9]. These conditions lead to workplace hazards, poor workers health, disabilities, and reduction of workers productivity and products quality [9]–[11]. Furthermore, there are several reported significant relationship between ergonomic problems and work accident [12], decreased participation in daily living activities [13], raised risk of family conflict, mental stress [14], raising production cost [7], and many other disadvantages to the company.

There are several factors that highly related to WMSDs among bakery's workers, including repeated movements [4], prolonged work duration [15], high vibrations, lifting heavy equipment [16], bad standing or sitting posture and do a monotone activity for a long time [15] that manifest to posture stress. Based on the study of musculoskeletal disorders among Taiwanese bakery's workers, the prevalence of posture stress was 93.0%, with the the most common symptom is in the hands/wrists (66.1%), followed by the shoulders (50.6%) and the lower back (48.2%) respectively [4].

As the one of biggest bakery in Ponorogo City, X bakery has 51 workers and produces approximately 60.000 pieces of bread and cake in a day. Most of the production activities are manually handled and only a few processes are using machines. In a day, a worker had to finish at least 600 pieces of cake. They also work for nine hours a day for each shift in average depending on daily target. Based on the preliminary study at the same company, the low level of musculoskeletal pain reported by 92 % of packaging workers [17].

Based on the OSHA 3125 (2000) recommendation, two ways to do ergonomics improvement are improving technique and/or management engineering [18]. Specific exercise can be applied as ergonomics management to prevent MSDs and posture improvement among workers [19]–[21]. It could also increase physical health and overall quality of life [22]. Based on Serra, [20] Simple Physical Exercise with meditation is a potential method to reduce WMSDs among workers. The study showed the lower prevalence of MSDs for the trunk workers in the last seven days and 12 months after applying Physical Exercise in the Workplace. Based on Nooryana [19], dynamic stretching exercises and active rest could reduces musculoskeletal symptoms among garment's workers. Stretching exercise applied as a treatment to reduce musculoskeletal pain among constructions workers is effectively reduce pain/disability and increase muscle flexibility [23]. People who used to exercising also tend to feel relaxed, resistant to work pressure and feel less stressed [24]. An exercise treatment to reduce musculoskeletal pain was also successfully applied by Andersen among 549 office workers in Danish [21]. The study showed that both resistance training and physical exercise for office workers affect in reducing musculoskeletal symptoms in exposed regions of the upper body.

Instead of type, the intensity and exercise duration should also be concerned. The American Heart Association (AHA) [25] recommends to exercise at least five days a week, at least 30 minutes in a day. The dynamic stretching exercises based on Nooryana's [19] intervention have 15 minutes total duration of exercise performed at work six times a week after work hours. It consist of 7 movement levels divided into 11 types of movements including neck and trunk movements, control of movements from neck to neck [19]. Meanwhile Based on Hess and Hecker [26] stretching at the workplace regularly 2-3 times a week for at least 15 minutes would be effective in reducing WMSDs. This study aims to analyze the effectiveness and an ideal duration of physical exercise intervention in reducing musculoskeletal pain among X Bakery's Workers.

## 2. RESEARCH METHOD

This study is using quasi-experimental design research. Data were collected during April-August 2020 at X Bakery, Ponorogo. Fifty-one (51) workers involved as respondents who were totally selected from all sections. The workers were over 20 years age and had at least finished high school. They were informed about the objectives and procedures of the study and voluntarily participated as respondent by signing an informed consent. As an Intervention, they were asked to do a simple stretching type of physical exercise in specific duration, five days a week in at least four weeks. Subjective MSDs symptoms (MSDs) were measured before and after interventions as illustrated as shown in Figure 1.

The MSDs score were measured on a numerical scale using the nordic body map (NBM) questionnaire. All respondent were measured a week before intervention as a preliminary test. This test is used as a reference for further comparison. The stretching exercise consisting of seven movement levels divided into 11 types of movements including neck and trunk movements, control of movements from neck to neck. legs, stretching movements from the arms to the hands, stretching movements and controlling movements in the trunk, torso movements in the pelvic and control of the deep core lumbar muscles, isotonic

movements of the legs, and isotonic movements of the ankles. Intervention divided into four categories based on the duration; 30 minutes (30min-SE), 15 minutes (15min-SE), less than 15 minutes (>15min-SE) and no stretching exercise (Non-SE) in at least five days a week.

Data were both descriptive and analytically analysed. Microsoft Excel and Statistical package for social sciences software (SPSS) version 24.0 was used in all steps of analyses. Independent t-test with the 95% of confidence interval (CI) used as comparison test among groups.

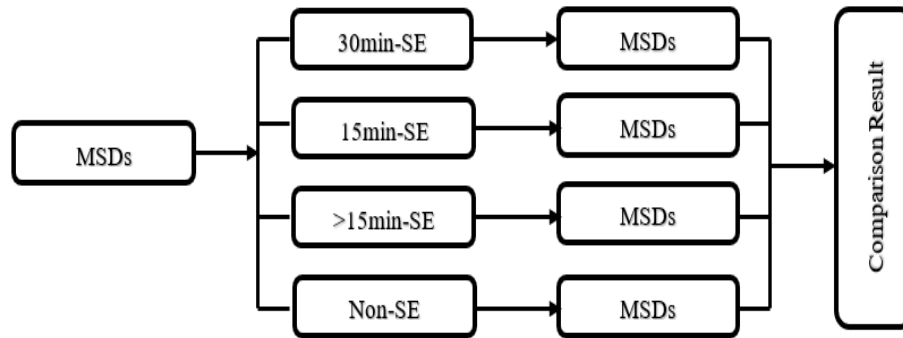


Figure 1. Research design

**3. RESULTS AND DISCUSSION**

**3.1. Result**

Table 1 described the subjective musculoskeletal pain in the 16 limbs of the body among 51 respondents based on measurement using NBM instrument in the 16 limbs. There are 4 groups of intervention as shown in the table; no SE group, 30 min SE, 15 min SE and less than (<) 15 SE with the number of respondents for each group are 11, 12, 13, and 15. The “no SE” group represent the control group to be compared with intervention group (30 min SE, 15 min SE and <15 min SE).

Table 1. Average musculoskeletal pain per body limbs

Limbs	Before intervention	After intervention groups				SE group (average of 2,3,4)
		No-SE/Control (1)	30 min SE (2)	15 min SE (3)	< 15 min SE (4)	
Upper neck	2.50	2.10	2.40	2.00	1.90	2.10
Lower neck	1.60	2.00	2.20	1.50	1.90	1.87
Shoulders	2.50	2.20	2.40	1.90	2.00	2.10
Upper arms	2.50	2.40	1.80	2.00	1.60	1.80
Back	2.60	2.20	2.40	2.00	1.40	1.93
Waist	2.00	1.90	2.30	1.50	2.10	1.97
Hip	1.20	1.80	2.20	1.40	1.90	1.83
Bottom	1.90	1.50	1.90	1.40	2.20	1.83
Lower arms	2.50	1.90	1.40	1.90	1.90	1.73
Wrists	2.20	2.30	2.40	2.00	1.80	2.07
Hands	2.70	2.00	1.80	2.40	1.70	1.97
Thights	1.80	1.60	1.90	2.00	1.80	1.90
Knees	1.50	1.60	1.80	1.70	2.00	1.83
Legs	2.20	1.90	2.00	1.50	2.10	1.87
Angkles	1.90	2.00	1.80	1.70	2.10	1.87
Foots	2.00	2.20	1.50	1.40	1.90	1.60
Average individual score	2.07	1.97	1.99	1.75	1.89	1.89

\*the paired limbs are averaged

Table 1 shows the comparison of the average individual scores in the five sample groups (Before and After Intervention Groups). It is known that the mean score in the 15-minute intervention group was the lowest (1.75) than the other groups. Table 1 also provides information about the level of musculoskeletal pain of each limb. Based on the classification on the NBM, a score 1 indicates level 1 of pain ("no pain"), 2 indicates level 2 of pain ("low pain"), 3 indicates level 3 of pain ("moderate pain") and four means "very painful". Based on reference group (before intervention), it is known that the hands and back were the limbs

with the highest pain level (2.70 and 2.60), followed by shoulders (2.50), and upper neck (2.50). In the SE group, symptoms known to be reduced, but the shoulders and upper neck still had the highest score (2.10). Figure 2 shows the comparison of the average musculoskeletal pain between three groups.

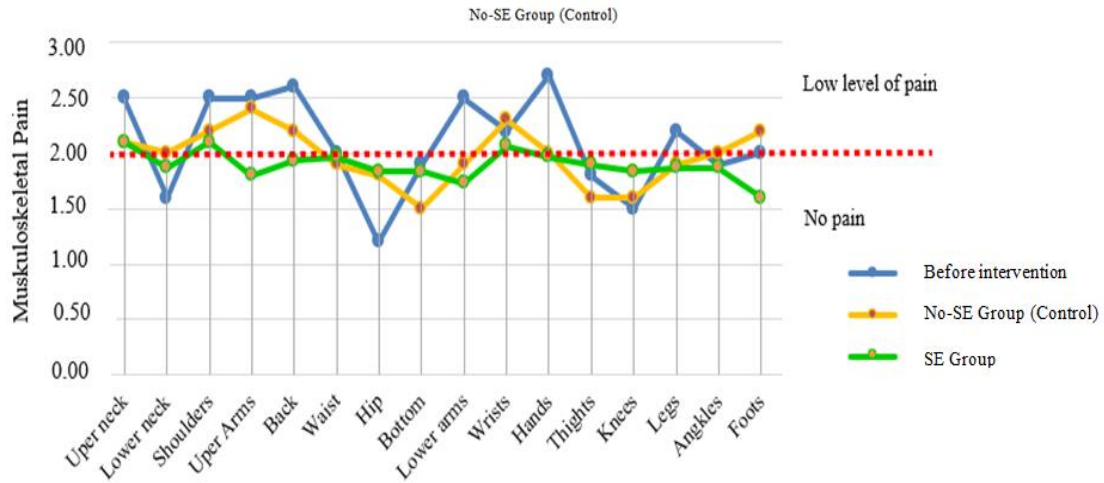


Figure 2. Musculoskeletal pain comparison between reference group, control group and SE group

Based on the descriptive comparison in the Figure 2, We can see that the musculoskeletal pain in most limbs of SE group is under the red line of level 2 (the level that indicates low level of pain). Though some limbs in both reference and control group are lower compared to SE group. The Table 2 showed 5 pairs of comparison analysis results based on paired t-test analysis (with the 95 % CI).

Table 2. The paired T-test result

Comparisons (A-B)	Mean difference (A-B)		Correlations	Sig (2-tailed)
	Value	Percentage		
Before intervention - No SE (control)	0.12500	3.12%	0.580	0.182
Before intervention - SE group	0.20812	5.20%	0.327	0.063
No SE (control) - SE Group	0.08312	2.08%	0.201	0.232
No SE (control) - 30 min SE	-0.03750	-0.94%	0.240	0.687
No SE (control) - 15 min SE	0.20625	5.16%	0.360	0.020
No SE (control) - <15 min SE	0.08125	2.03%	-0.530	0.437

The 1<sup>st</sup> comparison needed to ensure that there is no term difference between before intervention and control group (no SE group). It is proved by p-value score 0.182 (CI=95%), which indicates the condition before intervention and in the control, group are assumed the same (that there is no term change caused by any factors). Comparison between the before intervention and SE group didn't showed a significant difference (p-value=0.063 >0.05) with 0.208 mean difference. So does the control and SE group comparison (p-value=0.232). The 15 min SE intervention is the only group that significantly difference compared with the control group (p-value=0.020) with 0.206 mean dirrerence (5.16% based on maximum pain level). It is interpreted that workers with 15 minutes stretching exercise 5 days a week tend to have 5.16 % lower nlevel of musculoskeletal pain compared to control group. The score in the <15 min SE may seem lower compared to the control group but paired t-test doesn't show the significant different between groups. In the 30 min SE group, the musculoskeletal pain seems higher compared to control group, though there is no significant difference too.

**3.2. Discussion**

Based on the results as shown in Table 1, it is known that the average score of musculoskeletal pain in bakers before the intervention was 2.07. Score level 2-3 indicates that there is musculoskeletal pain felt at

least in a part of the limb. According to preliminary studies by Rosanti [17] at the same company, non-ergonomic work postures caused minor pain among 92% workers of the packing section. There are 7 sections based on the activities in the X bakery including mixing raw materials, making dough, molding dough, topping, baking, packing and finishing. In a day, a worker had to finish about 600 pcs of bread in about nine hours. Most activities are traditionally or manually handled so it could be a potential risk to over workload. Improved work design is the most needed solution to overcome these problems. But individual exercise such as simple stretching could be applied as an individual undertaking.

Serra shows that PEW is a potential method to reduce MSDs in workers [20]. An exercise treatment to reduce musculoskeletal pain was also successfully applied by Andersen [21] among 549 office workers in Danish. The study showed that both resistance training and physical exercise for office workers affect in reducing musculoskeletal symptoms in exposed regions of the upper body [21].

The type of physical exercise is highly determining the result. The exercise used as an intervention in this study was a simple dynamic stretching method. As Nooryana [19] who combined dynamic stretching method and active rest interventions to reduce musculoskeletal problem among Garment's workers in Bali, this study did the same dynamic stretching method, but without any combination. Physical exercise such as stretching affect in improving joints and muscles flexibility [27]. Flexibility is commonly defined as the range of movement possible around a specific joint or series of joints, and this definition is applied in most clinical studies. Stretching has also been proven effective in reducing the risk of joint and muscle injury, cramps, muscle pain, fatigue and several musculoskeletal problems [28]. It is commonly believed that those who are less flexible are more likely to have musculoskeletal pain and resultant injury.

Muscle pain syndrome (myofascial syndrome) is associated with decreased blood flow in the muscles due to continuous contractions for a long time [20]. Stretching results in more efficient muscle contraction that requires less oxygen. Skeletal muscles adapt to pressure or stretch by changing gene response to produce an increased cytoprotective protein known as heat shock proteins (HSPs). This protein used to maintain homeostasis, injury repairment, and provide protection against future attacks. The fatigue sensations during exercise are protecting subject from the deleterious effects of exercise. Due to these sensations, the subject will adapt his or her exercise strategy so the future physical demands wouldn't caused major pain [26].

The physiological effects of stretches might also contribute in reducing discomfort and pain. Several physiological effects of stretching have been reported. The mechanism for reducing MSD complaints through the serotonin release that occurs when a person does simple exercise such as stretching and yoga [23]. Stretching indirectly relaxing muscles due to physical calmness during exercise. Yoga and meditation play a role in serotonin release that reduces nervous pressure and affect in body relaxation [29]. People with relaxed mind tend to feel less tired compared to depressed one [30]. Occupational stress is an associated with higher prevalence of musculoskeletal symptoms at work. This may be because pain caused people tend to less tolerant to work demands and caused occupational stress [31].

Besides the type, frequency and duration of physical exercise are the strong determinants for musculoskeletal pain level. Over-stretching instead will lead to muscle stress and fatigue. This study showed physical exercise was effective with a 15 minutes duration, five times a week. At a lower (<15 minutes) or higher (30 minutes) duration, the exercise was not significantly affect the pain level. There are several combinations of types, duration and intensity of ideal exercise recommended by researchers, but the various physical condition and activities in the community might require different interventions. According to the AHA [25] a type of moderate intensity aerobic exercise for 150 minutes a week or 30 minutes a day, five days a week is an ideal exercise for adults in general. For vigorous types of exercise, the ideal duration is 75 minutes per week. Based on those recommendation, the ideal duration depends on the type and intensity of the exercise. Meanwhile Hess and Hecker [26] found that stretching at the workplace regularly 2-3 times a week for at least 15 minutes would be effective in reducing WMSDs, but the type of exercise is highly depends on the working type [26]. Exercise programs for WMSDs reduction purpose should be designed based on job activity or the body region most exposed to injury and pain risk at work. For example, in construction, where low back pain is frequently reported, it may be effective to apply exercise by stretching the low back in flexion and extension as well as stretching the hamstrings and other related muscles. While, office workers may be suitable to do exercise that stretch the neck, shoulder, and upper extremity.

Our study however, require a further review. In our study, where workers perform different work activities for each section, different types of exercise might show another result. The more groups of duration intervention might also need to compare in order to obtain better result. The conclusion of this study however described X Bakery's workers with their own characteristics and conditions. We can't be sure the same intervention would bring out similar result if applied to another group of subjects.

#### 4. CONCLUSION

There is lower level of musculoskeletal pain among stretching exercise group in average, but comparison test doesn't show a significant difference compared to control or reference group. Based on duration, the 15 minutes of the physical exercise is the only intervention that significantly difference compared with the control group (p-value=0.01 and correlation coefficient 0.46). X bakery's workers with 15 minutes stretching exercise has a 5.15 % lower level of musculoskeletal pain compared to the workers with no exercise. Another type of exercise and various durations also needed as comparison to obtain more representative result. However, improved work design is the most needed solution to overcome the musculoskeletal pain problems in the X bakery.

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