

WORKPLACE EXERCISE PROGRAM TO REDUCE MUSCULOSKELETAL COMPLAINTS AND INCREASE THE PRODUCTIVITY OF BATIK MAKERS IN PEKALONGAN REGENCY

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Abstract

Pekalongan City is famous as the world's batik city which is a world heritage site determined by UNESCO (United Nations Educational, Scientific and Cultural Organization) on October 2, 2009. The development of the industry in both Pekalongan City and regency encompasses not only large-scale operations but also small and medium-sized enterprises. This is influenced by the increasing demand for batik both nationally and internationally. The impact of this increase causes an increase in workload and health problems. One of the problems that arise in batik workers is musculoskeletal complaints and increased physiological loads so that it can reduce worker productivity. Promotive and preventive measures can be implemented through workplace training programs. The training program provided to minimize these problems is by doing stretching and breathing exercises during their break times. By paying attention to the health of batik makers, it can maintain the sustainability of the batik industry in Pekalongan City. This study aims to help reduce musculoskeletal complaints of batik makers and increase their productivity by offering breathing exercises and active stretching exercises. This research is experimental research, using the same subject design (treatment by subject design). The number of research subjects 24 people. Based on the results of hypothesis testing, the average musculoskeletal complaint was significantly different between periods 1 and 2 with $t=18.574$ and p value 0.000 ($p<0.05$). The average increase in productivity with a work pulse obtained t value = 4.956 and p value 0.000 ($p < 0.05$). The results showed a significant decrease in musculoskeletal complaints and batik worker productivity in period 1 and period 2. Active stretching and breathing exercises for batik workers are urgently needed to reduce musculoskeletal complaints and a decrease in work pulse, which means it can reduce the physiological workload of batik workers so that it affects the health status of batik workers which in turn increases the productivity of batik workers.

Keywords: Batik makers, Musculoskeletal Disorders (MSDs), Breathing Exercise, Active Stretching Exercise

INTRODUCTION

Indonesian batik has been recognized by UNESCO which needs to be preserved, therefore the batik industry in the regions is starting to compete to improve its quality and quantity. One area that produces batik until it reaches foreign markets is Pekalongan. Pekalongan batik possesses unique characteristics compared to other regions. One of the

areas in Pekalongan that produces batik is Wonokerto area, the Wiradesa district of Pekalongan. One of them is Jambean Mukti Batik, Sijambe Village, Wonokerto Pekalongan.

The working environment conditions for batik with floors that are waterlogged due to spilled coloring water are also at risk of slipping and causing injury due to the absence of proper drainage. The work environment temperature, ranging from 29-30°C, contributes to worker discomfort, exacerbated by the coastal climate and exposure to chemical dyes during nighttime wax burning. Wax burning for batik produces pollutants that can harm the health of the workers. Heated wax or batik wax will emit smoke, where the smoke contains gases NO₂, SO₂, CO₂, CO, HC, H₂S and particles (Fauzia, 2015). The presence of these pollutants is dangerous for workers and the environment (Adi, 2012; Amaliasani, 2013; Nurroisah, 2014; Sasongko, 2010).

The results of research that has been conducted on 327 workers who were exposed to batik wax smoke and gas released by heating devices obtained 20.7% lung function disorders with details of obstruction 11.8%, restriction 7.8% and combination 1.1%. These pollutants if inhaled by workers will cause acute or chronic damage to lung tissue, depending on the concentration of pollutants, duration of exposure, and body susceptibility. If this process lasts a long time, it can cause occupational diseases. Pollutant gases are irritating to the respiratory tract, especially SO₂ and NO_x gases. Concentration of pollutants is influenced by the levels of these materials. If inhaled, it can cause abnormalities in the respiratory tract in the form of a decrease in VO₂max levels and respiratory complaints (Fauzia, 2015; Lubis, et al., 2002).

All batik workers often complain of pain in the muscles, especially in the neck, upper back, waist and legs. After measuring pain complaints using a nordic body map, it was found that the average value of pain complaints was 38 written batik, 34 stamped batik, 46 coloring, and 30 drying. This is influenced by the use of tools and work attitude of batik dyes.

Musculoskeletal complaints are also influenced by the length of service of a person who works in batik workers, data on batik workers who work more than 5 years tend to increase their musculoskeletal complaints which can be measured by the nordic body map (NBM), while for workers less than five years the complaints are lower. However, with increasing age, musculoskeletal complaints will increase with an age range of 25-65 years (Sari & Rifai, 2019). With the problems that arise, prevention efforts are needed to reduce musculoskeletal complaints and reduce the risk of decreased productivity. Several physiotherapy methods can be used for this treatment using active stretching exercises combined with slow deep breathing which are useful for reducing muscle tension and relaxing the body as a step to prepare workers' bodies in good condition and physiological work attitudes.

The stretching that can be given to batik workers is active stretching, where the workers stretch without outside assistance, which means that they are done alone. One of the stretches that can be given to reduce pain or muscle tension in the upper back is to move the right - left rotation of the trunk and trunk extension with 3-5 repetitions. One form of body

preparation before work is to do stretching or stretching that can be done alone or called Active Stretching with simple forms of stretching exercises (Ningrum, 2018).

Stretching the muscles of the workers will make the body ready to carry out activities and can reduce the impact of very vulnerable injuries, increase flexibility or flexibility by 48.01% and increase productivity by 48.84% (Indrawati et al., 2013).

The effectiveness of stretching with slow deep breathing given to office workers can reduce neck tension and increase relaxation in a short time (Kulwarang Wet al., 2018). By doing slow stretching and carried out in conjunction with periods of deep inhalation can increase HRV parasympathetic activity and decrease pain. Giving stretching exercises with SDB performed at least four times for one exercise can reduce muscle tension, reduce pain and relaxation.

Based on the above statement, it can be concluded that batik workers will experience musculoskeletal complaints and decreased productivity. For the treatment, active stretching with slow deep breathing is needed as an effort to prevent and create working conditions that are effective, comfortable, safe, healthy and efficient (ENASE) which can be measured with indicators of decreasing musculoskeletal complaints, workers' pulse and increasing productivity of batik dyes. Therefore, the authors are interested in conducting research on giving active stretching with slow deep breathing to batik to decrease musculoskeletal complaints and increase productivi.

METHOD

Research Methods

This research is experimental with treatment by subject design. This design is given an interval between the time periods required for washing out, to eliminate the effect of the first period on the next period. This research took place in the Wonokerto batik industry, Pekalongan Regency from October 2021 - December 2021. The sample was taken with a total sampling of a population of 24 people in Jambean Mukti batik.

Active stretching and breathing exercises were administered to 24 batik workers engaged in various tasks, over two distinct periods. The first period is called the washing out period/time without any work activities, given for approximately 1 week, this is intended to distinguish the conditions between before the intervention and after the intervention. Period 2 or treatment period, in this period respondents or batik workers were given an intervention in the form of active stretching with slow deep breathing. Exercises are given 3 times a week, 3 repetitions, 10 movements for 3 weeks. Training period starts on Tuesday, Thursday, Sunday. On Tuesday, the day when the pressure or workload increases, on Thursday the peak day or before the work holiday (Friday off) and along with the day of giving wages where the workers accumulate the results of their work to achieve the target, this makes the workload increase. On Sundays, the second day of work or after a holiday where the muscles begin to adapt to the conditions of the workers.

Data analysis to determine the decrease in musculoskeletal complaints and increase productivity in batik workers by giving Active Stretching, Breathing exercise with t-paired parametric test.

Stretching Exercise Program for Batik Artists

The stretching exercise model and breathing exercise that can be done by batik artists includes stretching several parts of the body such as the neck and shoulders, back, legs and lower body, and wrists.

Things to consider when doing stretching exercises include:

1. Do slow deep breathing / deep breathing slowly, shortly after leaving the work room (batik) during a break. Do it in 3 breaths.
2. Pay attention to the position / posture of the body when sitting / standing
3. Do light stretching
4. Take advantage of break time.

Tabel 1. Stretching Exercise Program

No.	Types of Exercises	Repetitions	Set
1.	Neck and shoulders	8 – 12	2 set
	a. Shoulder shrug up and down	8 – 12	2 set
	b. Bow your head and pull it down	8 – 12	2 set
	c. Pull your head to the right side	8 – 12	2 set
	d. Pull your head to the left side	8 – 12	2 set
	e. Turn your head to the right side	8 – 12	2 set
	f. Turn your head to the left side	8 – 12	2 set
	g. Pull your hands up	8 – 12	2 set
	h. Pull your elbows behind your head, alternating right and left	8 – 12	2 set
2.	Spine		
	Stand up straight with your feet shoulder-width apart, raise both hands to shoulder height, turn your body to the right – left	6 – 8	2 set
	a. Stand up straight, both hands behind your waist, pull your body back	6 – 8	2 set
	b. Sit on a chair, Cross your legs, turn your body in the opposite direction	6 – 8	2 set
3.	Legs and Lower Body		
	a. Right leg bent forward, left leg pulled back (alternately)	6 – 8	2 set
	b. Right leg angled to the right side, knee bent, left foot to the left side, both hands on the right thigh (alternately)	6 – 8	2 set
	c. Right leg bent backwards, right hand holding right leg (alternately)	6 – 8	2 set

	Right leg crossed in front, right hand on waist, d. left hand up	6 – 8	2 set
4.	Wrist		
	a. Both hands pass forward, right wrist down, left hand pushes right hand down (alternately)	8 – 12	2 set
	b. Close palms, pull down	8 – 12	2 set
	c. Close palms, rotate down	8 - 12	2 set

RESULT AND DISCUSSION

This research was conducted in Sijambe Village, Wonokerto District at the Kraton Batik Workers. In October - November 2021 with the number of research subjects as many as 8 batik workers with various sections of work. The initial data of the study obtained the characteristics of the research subjects including gender, age and years of service. The following is a description of the characteristics of the subject in the following table:

Table 2. Subject Characteristics

Characteristic	Total Sample (N)	%
Gender		
Male	12	50
Female	12	50
Age (Year)		
17 – 30	6	25
31 – 40	3	12,5
41 – 50	6	25
51 – 60	3	12,5
61 – 70	6	25
Working Year		
< 5 Years	6	25
> 5 Years	18	75

Table 1 shows that the number of workers who were the subjects of the study were 24 people, with 12 men (50%) and 12 women (50%). Research subjects have variations in age ranging from 17 years - 70 years. Research subjects with a tenure of less than 5 years as many as 6 people (25%) and more than 5 years as many as 18 people (75%).

Table 3. Results of Environmental Conditions in Batik Workplace

Variable	Period 1			Period 2		
	Mean	Std.Deviation	p value	Mean	Std.Deviation	p value
Temperature (0c)	30.20	0.309	0.061	29.73	0.45898	0.945
Humidity	77.60	0.89443	0.579	80.86	650.251	0.866

The results of the correlation test between environmental conditions of temperature and musculoskeletal complaints in period 1 with $p = 0.061$ and period 2 $p = 0.945$ ($p > 0.05$) means that the temperature in period 1 and period 2 is comparable or gives a similar effect to changes in variables. Correlation test of humidity with musculoskeletal complaints in period 1 with $p = 0.579$ and period 2 $p = 0.866$ ($p > 0.05$) means that humidity in period 1 and period 2 gives a similar effect to changes in variables.

Table 4. Normality Test Results Nordic Body Map Index Values and Work Pulse Rates Period 1 and Period 2

Nordic Body Map Index	Kolmogorov-Smirnove	Shapiro-Wilk
	Sig.	Sig.
Period 1	0.200	0.760
Period 2	0.200	0.838
Work Pulse	Kolmogorov-Smirnove	Shapiro-Wilk
	Sig.	Sig.
Period 1	0.200	0.631
Period 2	0.200	0.170

Based on the results of the normality test (Saphiro Wilk Test) the data for period 1 of the Nordic body map measurement obtained a p value > 0.05 , period 2 obtained a p value > 0.05 and period 1 data on the measurement of the working pulse obtained a $p > 0$ value. $.05$ and the data in period 2 obtained $p > 0.05$, so the conclusion from these results is that the data is normally distributed. Hypothesis Testing on Musculoskeletal Complaints and Productivity.

Table 5. Hypothesis Test Results on Musculoskeletal Complaints and Productivity of Batik Workers

Variable	Mean	Std.Deviation	T	Df	Sig. (2-tailed)
Nordic Bady Map Index period 1 - period 2	9.37500	2.47268	18.574	23	0.000

Working pulse period 1 - period 2	9.50000	9.39010	4.956	23	0.000
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Table 5 shows the average musculoskeletal complaints of batik workers with the nordic body map index and the productivity of batik workers with a work pulse. Hypothesis testing was used to determine the decrease in musculoskeletal complaints between Period 1 and Period 2. Based on the results of the hypothesis test, the mean musculoskeletal complaints were significantly different between periods 1 and 2 with $t=18.574$ and p value 0.000 ($p<0.05$). The average increase in productivity with a work pulse obtained t value = 4.956 and p value 0.000 ($p <0.05$). The results showed a significant decrease in musculoskeletal complaints and batik worker productivity in period 1 and period 2.

Active stretching exercises have been widely used as a reference for reducing musculoskeletal complaints in workers because of their effects and benefits for preventing and treating injuries to muscles because stretching exercises can increase muscle elasticity and muscle relaxation thereby reducing muscle tension that causes discomfort (Ferdyastari et al. , 2018; Wahyono & Saloko, 2014). Stretching exercises can accelerate the exchange of oxygen and carbohydrates in cells, so that they can maintain and increase flexibility and elasticity in muscles naturally in muscles that are experiencing tension (Ningsih, 2013).

Studies show stretching can increase Range of Motion (ROM) by 17% and reduce musculotendinous unit (MTU) stiffness by 47%, as observed in an analysis involving eight male participants performing one-minute passive stretches. This is caused by changes in the nature of the connective tissue in muscles (Sari et al., 2019) so that active stretching can reduce musculoskeletal complaints. With a combination of active stretching and slow deep breathing, it can reduce musculoskeletal complaints and increase work productivity of batik artisans with changes or effects on decreasing heart rate.

This is in line with the research of Kulwarang (2017) which examined the effectiveness of stretching with slow deep breathing to reduce neck tension and increase relaxation in a short time. heart rate variability (HRV) parasympathetic activity. Breathing exercise can increase the central inhibitory rhythmus and can activate the baroreflex, thereby reducing sympathetic nerve activity which will cause a decrease in blood pressure. Slow deep breathing can affect the increase in tidal volume thus activating the heuring-breurer reflex which has an impact on decreasing chemoreflex activity, increasing broreflex sensitivity, decreasing sympathetic nerve activity, and lowering blood pressure (Joseph et al, 2005).

Breathing exercise can also increase peripheral skin temperature so that it affects a decrease in heart rate, respiratory rate and electromyographic activity (Kaushik et al., 2006). This increase in productivity occurs because of the provision of active stretching and breathing exercise after work. After the intervention, workers felt more relaxed so that it resulted in a decrease in workload which was marked by a decrease in work pulse as a decrease in physiological load after resting and active stretching. The results of this study

are supported by previous research by (Ferdyastari et al., 2018) which stated an increase in productivity as seen from the cheerful rest of injection cleaning workers.

In line with research by (Rusni et al., 2017) which states that there is a significant increase in work productivity of 66.67% by providing Workplace Stretching Exercise interventions to workers in the garment industry in Muding, Badung Regency. Dynamic stretching exercises and rest increase productivity in adhi fashion garment industry screen printing workers by 31.25% (Nooryana et al., 2019).

Muscle stretching exercises can relax muscles and improve blood circulation to muscles more optimally so as to improve physiological responses by reducing musculoskeletal complaints and ultimately increasing productivity. According to (Pitt & Shew, 2017) an increase in productivity seen from an increase in the economy, a decrease in stress, an acceleration of working time and the use of tools, where in this study there was a decrease in the work pulse.

The decrease in work pulse is a decrease in the physiological load on batik dye workers, this occurs because of the provision of active stretching and deep slow bearing. The decrease in work pulse is also caused by a decrease in muscle tension and improvement in blood circulation so that the physiological system returns to stability (Kroemer & Grandjean, 2000). The decrease in muscle tension shows a decrease in musculoskeletal complaints because the muscles experience improvement and relaxation. The results of this study are supported by previous research by (Gede Suarjana et al., 2018) which stated that there was a decrease in the work pulse of 18.14% in Tabanan dough industry workers.

According to (Daryono et al., 2016) the presence of active stretching and redesign can reduce the workload by 30.3% for screen printing workers. Increased productivity in workers seen from the increased health of workers refers to a decrease in musculoskeletal complaints and a decrease in work pulse. The resulting product remains the same because it has been determined by the owner so that it improves health which increases work productivity.

CLOSING

Conclusion

Active stretching and breathing exercises are essential for reducing musculoskeletal complaints and lowering the work pulse, ultimately decreasing the physiological workload and enhancing the health and productivity of batik workers

Sugession and Recommendation

The recommendation from this study to maintain the sustainability of batik and the sustainability of the batik industry in Pekalongan City, it is important for batik production house owners to pay attention to the health of batik makers, especially physical health (musculoskeletal). Providing space for batik makers to exercise in between working hours is one solution to prevent musculoskeletal disorders.

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