DEVOTION
Journal of Research and Community Service

Volume 3, Number 11, September 2022
e-ISSN: 2797-6068 and p-ISSN: 2777-0915

IMPLEMENTATION OF STRETCHING EXERCISE WITH ERGONOMIC BASED HEALTH EDUCATION APPROACH TO REDUCE MUSCULOSKELETAL COMPLAINTS AND FATIGUE IN ORANGE FARMERS IN BAYUNGGEDE VILLAGE

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KEYWORDS
Ergonomics, Stretching Exercise, Education, Musculoskeletal Complaints, Fatigue of Citrus Farmers

ABSTRACT

Agricultural activities such as hoeing, cleaning grass, and fertilizing are activities that affect the work attitude of farmers. The intervention was in the form of giving Stretching Exercises with an ergonomics-based health education approach. This study aims to determine the provision of Stretching Exercises with an ergonomics-based health education approach to reduce musculoskeletal complaints and fatigue in citrus farmers in Bayunggede village. This research is an experimental study, using the same subject design with a pattern (Treatment by subject Design). This study involved 13 research samples selected at simple random. Musculoskeletal complaints were measured using a Nordic Body Map questionnaire on 4 Likert scales, work fatigue was measured using a 30-item rating scale. Measurements were taken before and after work in Period 1 and Period 2 for 3 weeks. Analysis of the data obtained begins with descriptive analysis and normality test of data with Shapiro-Wilk. Furthermore, the data with normal distribution were analyzed using paired t-test at a significance level of 5%. The results showed a significant difference ($p<0.05$) in musculoskeletal complaints and fatigue in Period I and Period II. By doing Stretching Exercises with an ergonomics-based health education approach, it can reduce musculoskeletal complaints by 29.53% and work fatigue by 26.97%. It can be concluded that there is a decrease in musculoskeletal complaints and work fatigue after doing Stretching Exercises with an ergonomics-based health education approach. Thus, it can be suggested to citrus farmers to manage time and work breaks well and regularly stretch.

INTRODUCTION

Indonesia is wrong one country agrarian which part big people with eyes livelihood as a farmer. Indonesia is also known as a reliable producer of various agricultural products. The majority of people in Indonesia are people who work in agriculture, especially people who are or live in rural areas . One of the provinces in Indonesia that mostly work as farmers is the province of Bali , which is a horticultural area . Orange is one of the horticultural crops which has been developed on area agriculture in Province Bali. M majority farmer orange in Bali come from Bangli Regency, Buleleng Regency, and Gianyar Regency (Alitawan & Sutrisna, 2017) . One of the largest local citrus producers is in Bayung Gede Village, Kintamani District, Bangli Regency (Aluhariandu *et al* ., 2016) .

Based on the Central Statistics Agency (2017) Bayung Gede Village is a village with an area of 10.24 km, this village is located about 55 km from the Denpasar sea and about 35 km north of Bangli. There are 2 routes to reach Bayung Gede Village, either from Payangan - Kintamani or Bangli - Kintamani. The environmental status of Bangli district (2015) states that the basic physical condition of the area based on topography, geology, Bayung Gede village is at an altitude of about 800-900 M above sea level which causes Bayung Gede Village to have cool air with the highest peak point being the Writing Peak. Regional conditions vary between sub-districts and are generally in plain (0-2%), sloping (2-15%), wavy (15-30%), steep (30-40%) and very steep (>40%) conditions.). Relatively flat conditions are found at the foot of Mount Batur, and on average wavy in the Kintamani District.

Orange farmers need a lot of energy large enough to manage agricultural land. Agricultural activities such as hoeing, planting, clearing weeds, fertilizing, spraying pests, and harvesting are activities which affect the working attitude of farmers. Traditionally, citrus farmers still apply manual work process without being assisted by modern tools (Malonda *et al* ., 2016) . Based on preliminary studies in field , agricultural activities carried out farmer Citrus fruits in Bayung Gede Village such as hoeing, spraying pesticides, and cleaning weeds are routine jobs, while pruning oranges, fertilizing and picking oranges are seasonal jobs. From the results of direct interviews with some citrus farmers, the physical activity or task they do is quite heavy. Hoeing, cleaning and transporting weeds with a less ergonomic posture and farmers usually bring grass that has been cleaned by carrying or carrying by hand manually has a high risk. The type of activity of citrus farmers that poses a high risk to health is when hoeing, spraying pesticides and cleaning weeds, the attitude of farmers who always bend over and work for a long time will cause musculoskeletal complaints and work fatigue.

The activities of citrus farmers in Bayung Gede Village are carried out by female and male workers. The work of citrus farmers in the garden is usually done by 2 to 4 farmers. However, the extent of agricultural land causes a heavy workload and takes a long time to complete. The duration of work is 8 hours of work in a day and erratic rest hours. The activities of hoeing, clearing weeds and spraying pesticides, which often involve bending down and bending over, cause a lot of muscle complaints after work. Heavy workloads such as repeatedly carrying 10 to 30 kg of heavy fertilizer, and spraying with a 15-20 kg heavy lifting machine. The placement of water reservoirs that are far away and the unavailability of automatic faucets make farmers have to draw when spraying, causing an increase in the workload of citrus farmers in addition to carrying the spray machine for a long time. Farming is one of the jobs that uses a lot of muscle power and has a high risk of experiencing musculoskeletal complaints and work fatigue, farmers can be said to be workers who have a high risk of muscle injury caused by doing work still manually so that many workers' body movements are still carried out in the wrong position and attitude and are not in accordance with the limits of body functions (Utami *et al* . , 2017) .

Based on a preliminary study of the results of measurements of 10 citrus farmers, on average, they complained of moderate fatigue and musculoskeletal complaints with a score of 58 to 86 with a score of pain. Of the 10 farmers in the preliminary study, on average, the most complained of pain in the neck, shoulders, upper arms, waist and buttocks caused by static movements, large loads and carried out for long periods of time and erratic rest hours. Complaint prevalence musculoskeletal problems in farmers in a study in Sweden 47% had complaints in the lower back, 56% in the neck and shoulders, 46%on the knee, (Aluhariandu

et al . , 2016) . While research in Nigeria, on average, complains about the lower waist about 72% due to repetitive work, excessive use of energy, static working position, poor working position, mechanical stress, vibration and temperature extreme in the place work (Faujiyah, 2020) .

The prevalence of fatigue in farmers in the study of workload and work fatigue in Minahasa district has the largest prevalence, namely moderate fatigue as many as 53 people (62.3%), fatigue caused by workload and long working time > 8 hours of work in a day, then the work environment , as well as monotonous work for a long time will trigger work fatigue (Wurarah *et al.* , 2020) . Farmer activities that are monotonous, long work intensity, mental, physical work resistance, non-ergonomic work environment, tension, health and nutritional disorders, and sleep disorders will trigger work fatigue (Ramdan, 2018) .

Research Agrawal, *et al.* (2018) stated that agricultural work should avoid bad work positions, take breaks between work hours, avoid long working hours to reduce occupational diseases, implement prevention strategies such as reducing injuries and overwork. Agricultural activities will also result in farmers experiencing stress, muscle tension and work-related musculoskeletal disorders that result in several diseases and disabilities (Ghosh *et al.* , 2018) .

Other studies also show that farmers have the wrong work attitude due to a lack of knowledge of farmers about good and correct work attitudes (Lestari, 2010) . Knowledge of farmers in carrying out farming activities is also very influential on the activities carried out at work and the work risks caused such as occupational health, work safety, work-related injuries, and work-related fatigue (Murtiningrum & Silamat, 2019) . The work of citrus farmers with a heavy workload and the use of excessive muscle power, long working hours and monotonous activities causes the use of excessive muscle, tendon, and joint power which will increase pressure on nerves and will cause fatigue to workers (Damantalm et al., 2018) .

To overcome the problems and improve the health quality of farmers, intervention or ergonomics application is needed. Research needs to be done by combining *stretching exercise* with an ergonomics-based health education approach where *stretching exercise* is believed to reduce musculoskeletal complaints and fatigue. Giving *stretching exercises* is able to overcome musculoskeletal complaints, increase morale, increase blood circulation, improve physical function, and increase muscle flexibility so that it will reduce muscle injury and will certainly reduce musculoskeletal complaints and fatigue (Syafrianto, KH, & Zulfa, 2019) .

In previous studies, there were research gaps identified regarding the effects of *stretching exercise* and work modification on musculoskeletal complaints and fatigue. In previous studies, by modifying work without doing *stretching exercises* , there were no significant changes in musculoskeletal complaints and fatigue . While giving regular stretching exercises, it turns out that stretching exercises are *effective* in reducing musculoskeletal complaints and fatigue (Shariat et al., 2018) .

Health Promotion Program or health promotion in the workplace, one of the strategies that can be done for an ergonomics-based health education approach and increase work productivity. By promoting health to farmers, it will maintain balance and physical, mental, social elements and will increase health knowledge related to habits related to good physical condition, energy, and vitality (Cancelliere, Cassidy, Ammendolia, & Côté, 2011) . The scope of health promotion in the workplace is also very broad, covering the physical, psychosocial aspects of workers, the workplace, good rest periods, use of work equipment and the work environment (Pereira et al., 2019) .

METHOD RESEARCH

This study aims to determine musculoskeletal complaints and levels of fatigue before and after working for citrus farmers in Bayunggede. This research is an experimental study, using the same subject design with a pattern (Treatment by subject Design). This study involved 13 research samples selected at simple random. Musculoskeletal complaints were measured using a Nordic Body Map questionnaire on 4 Likert scales, work fatigue was measured using a 30 item rating scale. Measurements were taken before and after work in Period 1 and Period 2 for 3 weeks.

The independent variable in this study is work attitudes that are not ergonomic. The dependent variable is (a) musculoskeletal complaints, (b) the level of fatigue. The data obtained in this study (a) were analyzed descriptively by looking for the mean and standard deviation or standard deviation, (b) normality test of musculoskeletal complaints and fatigue were analyzed by Shapiro-wilk test, and (c) data of musculoskeletal complaints and fatigue were analyzed by paired t-test at a significance level of 5%.

RESULTS AND DISCUSSION

The results of the descriptive test of the characteristics of the citrus farmers who are the research subjects can be seen in table 1 as follows:

Table 1. Subject Characteristics Data on Farmers

Variable	Average±SB
Age (years)	47.62±9.605
Gender	1.46±0.51
Weight (kg)	54.77±10.19
Height (cm)	160.31±4.76
Body mass index	21.35±4.28
Work Experience (years)	24.62±6.28

Based on Table 1, the number of research subjects was 13 farmers consisting of 7 men and 6 women. Farmers' activities are very diverse, such as hoeing, cleaning weeds, picking oranges, fertilizing, pruning oranges and other activities. However, in this study, farmers only carried out several activities or jobs such as hoeing, cleaning weeds, and fertilizing citrus. The results of the descriptive analysis of the data on the characteristics of the subject include variables of age, gender, weight, height, body mass index and work experience. Based on the results of data calculations, the average body mass index of the subject was 21.35±4.283, the average was included in the ideal category.

The working environment conditions measured in this research location were the environmental conditions before and when the farmers worked including ambient temperature, humidity, light intensity, noise and wind speed. The data for measuring environmental conditions in the morning before the farmers work in Period 1 can be seen in Table 2. While the data for measuring the conditions of the working environment in the afternoon after the farmers work in Period 2 can be seen in Table 2.

Table 2 Working Environment Conditions (Before Farmers Work)

	Period 1 Pre	Period 2 Pre	Score
Parameter	Average±SB	Average±SB	*p*
Dry Temperature (°C)	20.10±0.36	20.82±0.33	0.153

Humidity (%)	66.89±1.70	66.42±1.69	0.396
Intensity Light (Lux	1624±75.87	1644±84.36	0.352
Noise (dB)	38,20±1.19	38.33±1.38	0.815
Wind velocity	0.73±0.19	0.67±0.09	0.275

Based on Table 2, it can be seen that the results of the significance test on environmental temperature, environmental humidity, environmental light intensity, environmental noise, and wind speed in the work environment did not have a significant difference between Period 1 before the farmer worked and Period 2 before the farmer worked. This shows that both periods have the same environmental characteristics.

Table 3 Working Environment Conditions (After Farmers Work)

	Period 1 Post	Period 2 Post	Score
Parameter	Average±SB	Average±SB	*p*
Dry Temperature (°C)	24.94±0.99	25.23±2.11	0.550
Humidity (%)	67.73±2.16	67.47±1.78	0.310
Intensity Light (Lux	1658±64.69	1641±86.40	0.248
Noise (dB)	39.80±2.53	40.37±3.25	0.168
Wind velocity	0.73±0.225	0.70±0.1414	0.133

Based on Table 3, it can be seen that the test results of the significance of environmental temperature, humidity, light intensity, noise, and wind speed did not have a significant difference between Period 1 after the farmer worked and period 2 after the farmer worked. This shows that the two periods have the same environmental characteristics.

The results of the comparability test for musculoskeletal complaints and fatigue can be seen in Table 4. In Table 4. shows the results of the paired t-test to assess the comparability of data before farmers work between period 1 and period 2 which can affect the effect of the intervention.

Table 4. Comparability Test Results for Musculoskeletal Complaints and Fatigue

	Period 1	Period 2	Score
Variable	Average±SB	Average±SB	*P*
MSDs Before Work	38,21±3,630	37.65±3.935	0.652
Fatigue Before Work	37.65±3.935	38.67±3.494	0.633

Based on Table 4. it can be explained that there is no significant difference between the data before farmers work in Period 1 and Period 2 ($p > 0.05$). This means that there is no effect of the previous condition in Period 1 that affects changes in the dependent variable. In addition, the washing out period is sufficient to give the effect of returning to the initial condition as in the condition before the farmer worked in Period 1. Thus, the intervention effect occurs purely because of the treatment.

In this study, the research subjects were given an intervention in the form of implementing stretching exercises and health promotion programs as an ergonomics-based health education approach. Giving stretching exercises or stretching at work was carried out for 15 minutes on the sidelines of the break at 13.00 WITA 3 times a week for 3 week. Meanwhile, the health promotion program is given in the first and last weeks. To determine the effect of the treatment effect on reducing musculoskeletal complaints and fatigue, a paired t-test was performed. The results of the analysis can be seen in Table 5.

Table 5. Test of Treatment Effects Using the t-paired . test

	Period 1	Period 2	Score
Variable	Average±SB	Average±SB	*P*
MSDs Post Last Day	58.62±11.6 6	41.31±5.6 1	0.000
Fatigue Post Last Day	6 6 , 79±11.63	48, 78± 7.5 3	0.000

The results of the different tests as shown in Table 5 show that there is an overall significant difference between musculoskeletal complaints on the last day of week 3 (three) after farmers work in Period 1 and Period 2 using the paired t-test. The results of the different tests as shown in Table 5 also show that there is a significant difference in fatigue on the last day of the third week after farmers work in Period 1 and Period 2 using the paired t-test.

Table 6. Additional Test of Treatment Effects Using the t-paired . test

	Period 1	Period 2	Score
Variable	Average±SB	Average±SB	*P*
MSDs Pre Last Day	45.24±6.8 5	36.85±6.49	0.009
MSDs Post Day One	59.31±9.19	36.16±3.8 1	0.000
MSDs Difference	13.38±11.2 7	5.154±6.8 6	0.010

In this study, it can also be seen in Table 6. test the effect of additional treatment on musculoskeletal complaints which as an additional test to determine the long-term effect of giving the intervention by measuring musculoskeletal complaints on the last day of the third week in Period 1 and Period 2. . And the short-term effect in Period 1 and Period 2 which was measured on the first day of the first week after working in Period 1 and Period 2. As well as an additional effect to see muscle endurance formed in Period 1 and Period 2. after intervening for 3 times in a week for 3 weeks.

Based on the Nordic body map questionnaire measurements in this study, it was found that the musculoskeletal complaints of citrus farmers decreased between Period 1 and Period 2 by 29.53%. This shows that the intervention provided can improve the health of workers as seen from the decrease in musculoskeletal complaints of citrus farmers. In Period 1, many farmers experienced musculoskeletal complaints in the category of pain in the left shoulder, as many as 8 people (61.54%), right shoulder as many as 4 people (30.77%). In the left upper arm in the pain category as many as 10 people (61.54%), the right upper arm in the pain category as many as 11 people (84.62%), then in the waist with pain category (84.62%), and complaints on the left knee as many as 10 people (76.92%) and right knee as many as 8 people (61.54%). While in Period 2 musculoskeletal complaints after the intervention, there was a decrease in musculoskeletal complaints in the shoulders by 23.08%, in the upper arms by 15.38%, then in the waist by 7.69%, and in the knees by 15.38%.

Figure 1. The Process of Farmers Working Hoeing, Fertilizing, and Cleaning Grass

In the study of (Daryono *et al* ., 2016) , static and forced loading can cause blood flow to be blocked so that the oxygen supply to the muscles is not enough. This situation causes the accumulation of lactic acid deposits and body heat which in turn causes fatigue in the skeletal muscles which is felt as a form of muscle pain in workers and triggers musculoskeletal complaints.

The decrease in musculoskeletal complaints occurred in the final condition or after work that the average musculoskeletal complaints in Period 1 was 58.70±9,096 while the average musculoskeletal complaints in Period 2 was 42.41±4,090 . This indicates a decrease of 29.53%. The decrease is caused because when given active stretching, the muscles can recover and can build the substances needed for the muscles, in this case the lactic acid left over from muscle metabolism is recycled and converted into carbon dioxide (CO2), water and glycogen and protein which will reused for energy. This statement is also in line with research by Adiatmika *et al, (* 2007) , changes in working conditions cause working muscle cells to have the opportunity to perform optimally. Recovery is required by cells to restore microtrauma state. Setting the working attitude causes the muscles to contract optimally, so that the forced labor attitude is reduced. Rest arrangements provide an opportunity for optimal body recovery. Stretching activities at rest allow the cell to undergo alternate relaxation contractions. So by doing stretching or *stretching exercises* will reduce musculoskeletal complaints.

Short-term effect of intervention on musculoskeletal complaints The effect of decreasing musculoskeletal complaints that occurred because of the intervention that has been given in the form of *workplace stretching exercise* or stretching on the sidelines of working hours. The intervention or stretching exercises provided have the effect of relaxing muscles and joints and improving blood circulation around them, thereby reducing muscle pain and decreasing musculoskeletal complaints (Syafrianto et al., 2019) . This is also in accordance with research (Smith et al., 2019) that by doing *exercise* or exercise can trigger the release of endorphins from the pituitary and hypothalamus which in turn activates peripheral and central opioid receptors that trigger the endogenous opioid system. With the activation of opioid receptors which will later produce a strong analgesic effect on the pain felt in musculoskeletal complaints, during *exercise* the human body will naturally produce endogenous opioids. So that when someone does exercise or *exercise* in the short term, it will

respond to a decrease in musculoskeletal complaints which is a mechanism for reducing pain when doing exercise or *exercise* .

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Tabita *et al.* , (2017) research explains the occurrence of long-term effects by doing stretching exercises on reducing musculoskeletal complaints because stretching exercises lead to adaptations in both the cardiovascular and musculoskeletal systems that support increased capacity and overall sports performance. Local adaptations in skeletal muscle, such as increased mitochondrial biogenesis and capillary density, aid the body's ability to transport and use oxygen to generate energy and therefore delay the onset of muscle fatigue during prolonged aerobic performance. This causes a decrease in musculoskeletal complaints in the long term.

The long-term effect of the intervention on muscle endurance in this study, after doing *stretching exercises* or stretching exercises. From the results obtained, there is a significant difference between the difference between Period 1 and Period 2 of 0.010. In the study of DeFreitas *et al.* , (2011) stated that doing *stretching exercises* for 3-4 weeks significantly causes skeletal muscle hypertrophy. Muscle hypertrophy can be defined as an increase in muscle mass due to an increase in the content of contractile proteins and connective tissue. Muscle hypertrophy can occur due to stimuli such as resistance and stretching exercises for a long time. So that by doing resistance training and stretching or *stretching exercises* can provide muscle endurance when done for a long time, when the exercise has reached 6-7 weeks it will show hypertrophy or a more significant increase in muscle mass so that it will trigger muscle endurance and increase strength. muscle. In addition, endurance and muscle strength that occurs when doing stretching exercises are also supported by agonist muscle activation, neuron stimulation, motor unit synchronization, antagonistic muscle activation, which are proven to be the main contributors in doing exercises to increase muscle endurance and strength in the first 3-4 weeks.

Fatigue is a body's protective mechanism to avoid further damage or it can be said as a body alarm that signals a person to rest immediately. Fatigue can occur characterized by frequent yawning triggered by monotonous work, fatigue in the form of stiff pain in the back and shoulders is muscle fatigue.

This means that the treatment or intervention can significantly reduce the fatigue of citrus farmers. Work fatigue occurs due to muscle cells working statically, menoton and repetitive. By always carrying out lifting, pressing, and lowering activities for a long period

of time, namely with a bent standing posture causes farmers to become tired quickly due to less ergonomic work (Rasna et al., 2015) .

This research is in accordance with Dewi's research, (2018) Giving stretching in the form of *stretching exercises* can reduce work fatigue by 26.97%. WSE (*workplace stretching exercise*) uses the principle of stretching movements in the neck muscle group to the leg muscle group. In muscles that experience spasm, there will be shortening of muscle fibers because the myofilaments overlap each other. At the time of *stretching* with holding for a few seconds in an elongated muscle position, the muscle fiber structure, especially the sarcomeres, will stretch because the overlapping myofilaments will decrease and automatically cause the *muscle fiber structure* to become elongated. With the lengthening of the *muscle fiber structure* , spasm can be reduced and will reduce fatigue that occurs (Wahyono & Saloko, 2014).

Figure 2. *Health Promotion Program* as an Ergonomics-Based Health Education Approach

In this study, conducting health education programs has a very important role for farmers to provide education that working ergonomically according to their abilities is very important to improve the health of farmers. In this study, it was found that there was a decrease in musculoskeletal complaints and work fatigue caused by the intervention. *Health Promotion Program* or health promotion in the workplace, one of the ergonomics-based health education approach strategies that can be done to increase work productivity. By promoting health to farmers, it will maintain balance and physical, mental, social elements and will increase health knowledge related to habits related to good physical condition, energy, and vitality (Cancelliere et al., 2011). The scope of health promotion in the workplace is also very broad, covering the physical, psychosocial aspects of workers, the workplace, good rest periods, use of work equipment and the work environment (Pereira et al., 2019).

(a) Neck and shoulder stretch

(b) Shoulder, neck and arm stretch

(c) Shoulder Stretch

(d) Arm and upper back stretch

(e) Shoulder, arm and chest stretch (f) Hand, wrist stretch hands, fingers and forearms

(g) Upper back stretch

(h) Back, shoulder and arm stretch

(i) Stretching the back, hips groin and hamstrings

(j) Stretching the joints of the legs and feet

(k) Lower leg and ankle stretch

Figure 3. *Stretching Exercise* on Orange Farmers in Bayunggede Village

CONCLUSION

Based on the results of the analysis and discussion that have been described previously, it can be concluded that the application of Stretching Exercise with an Ergonomics-Based Health Education Approach reduces musculoskeletal complaints in citrus farmers by 29.53%. Application of Stretching Exercise with Ergonomics-Based Health Education Approach reduced musculoskeletal complaints in citrus farmers by 26.97%.

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