

Combination of Stretching and Acupressure as an Effort to Reduce the Incidence of Musculoskeletal Disorders in Coconut Tappers

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ABSTRACT

This study evaluated the effectiveness of simple stretching movements and Body Space Medicine (BSM) acupressure in reducing Work-Related Musculoskeletal Disorders (WMSDs) among coconut tappers. A quasi-experimental design involved 68 participants who engaged in two 5-minute sessions of stretching and BSM acupressure, three times a week for four weeks. The incidence of WMSDs was assessed using the Nordic Body Map (NBM), which includes 28 questions. Statistical analyses were conducted using the Wilcoxon Test and Paired T-Test to compare pre- and post-intervention results between the intervention group (IG) and the control group (CG). The IG showed a significant reduction in WMSD incidence ($P < 0.001$), while the CG exhibited no significant difference ($p > 0.001$). Notably, significant differences were observed between the IG and CG regarding WMSD incidence ($P = 0.000$ for IG; $p = 0.943$ for CG). The IG experienced marked reductions in WMSDs across all body parts, particularly in the right elbow (-11.8%), right forearm (-10.8%), right hand (-13.8%), left thigh (-11.7%), and left calf (-12.7%). These findings suggest that incorporating simple stretching and BSM acupressure into occupational health strategies can effectively reduce WMSDs among coconut tappers.

Keywords: Work-Related musculoskeletal disorders, stretching, acupressure, coconut tappers, occupational health.

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1. INTRODUCTION

In The work of coconut tapping is often exposed to many dangers due to inadequate risk control measures and cannot be considered “proper”, this work is not guaranteed to have a safe and healthy working environment (1) . Harvesting coconuts is a very difficult and dangerous job because the structure of coconut trees does not have branches and only skilled people can do this work (2) (3) . Coconut trees have smooth trunks and can reach a height of 30 meters (4) (5) . Coconut tree climbers use abnormal foot and lower leg joint movements and generally do not use any safety equipment (6). Coconut tapping is a heavy work category and requires a lot of energy to carry out the work (7)(8)(9). Coconut sugar tappers are at risk of experiencing many health problems that affect their productivity and health (10). The risk factor that occurs is the occurrence of Work Associated Musculoskeletal Disorders (WMSDs)(11)(12).

WMSDs occur due to unergonomic work habits, such as; repetitive movements and excessive load on one side of the body (13)(14). WHO and ILO from 2000 to 2016 stated that workers in various types of work were vulnerable to risk actors for work-related injuries, one of which was the agricultural sector (15). The causes of WMSDs in tree climbers are working posture, length of work, age, and length of service (16). Workers who climb coconut trees are more at risk of suffering from musculoskeletal disorders than other types of injuries and illnesses (17). Musculoskeletal disorders are related to the physical workload carried out by workers (18). Climbing work uses the main strength of the upper extremities and shoulders, this kind of work causes a high risk of musculoskeletal disorders (19). Variables that are significantly related to

workers' WMSDs are age, smoking, body fitness, BMI (Body Mass Index), repetitive activities, work posture, and workload with the workload variable being the most dominant(20). In 2018, the International Labor Organization found that every year 380,000 workers or 13.7% of 2.78 million workers suffered from work-related health problems. More than 374 million people are injured and become ill annually due to WMSDs (21)(22).

In previous studies, it has been reported that stretching exercises (23)(24)(25) and acupressure (26) can control risk factors for the occurrence of WMSDs. Training that can be an alternative includes physical exercise (27), stretching (28), strength training (29), and endurance stretching (28)(30). Strength and endurance training then stretching exercises and acupressure showed a better effect on reducing muscle pain(31). Stretching physical exercises can be done in many variations, for example resistance training once a day for 20 minutes, three times a week for 4 months(30); resistance training was carried out for 12 minutes per week for 10 weeks (24); strength training 1 hour once a week, 20 minutes three times per week, and 7 minutes nine times per week for 2 weeks(27); stretching twice per week 5–15 minutes for 6 weeks (32); exercise 10 to 15 minutes per week 3 times for 11 weeks(33); exercising twice a week in 3 months(30); low-intensity running sessions for 1 hour three times per week for six weeks (30); each stretching movement takes 10 to 15 seconds and is carried out for 15 to 17 working days(34); a once-daily 10-minute workplace-based physical activity program for 12 months(35); daily exercise for 2 months; physical exercise 20 minutes a day 3 times a week for 12 months; And stretching exercises last 10–15 minutes, twice a day for 4 weeks(36).

Acupressure is a traditional treatment originating from China and a development of acupressure which developed in Asia more than 5000 years ago (37). The way acupressure works is by identifying a disease based on acupressure points or *acupoints* located in the meridian channels (38). Massaging with acupressure will balance the flow of energy so that it can reduce pain (39). Carrying out *acupressure* certainly requires preparations so that the *acupressure process runs* smoothly (40). To practice, there are several things that must be prepared first. It is not enough just to master the theory and practical skills that must be prepared. There is another thing, namely the equipment and tools used during practice must already be there. The *acupressure room* is a room for masseurs to *carry out acupressure* (37). BSM Acupressure is an abbreviation for Body Space Medicine (41). BSM science will study the body space for treatment that has energy flow. There are 8 points applied in BSM acupressure, namely BL67 or little toe point (42), SP6 or above ankle point (43), ST36 or below knee point (44), LI4 or hand point (43), DU20 or head point (43), Changxiang or tailbone tip point (45), PC6 or wrist point (46), and GV14 or lower back neck point (47)(48). The energy movement in BSM acupressure starts from Hui Yin and rises forward to Dan Tian and then flows throughout the body (41).

Medications to reduce pain usually have side effects on the body (49). Acupressure is a complementary therapy that can be used to reduce pain and has minimal side effects (50). Acupressure is an alternative therapy to reduce the intensity of acute to chronic pain(51). Acupressure is effective in reducing acute to chronic pain in various types of diseases(52). Acupressure has an effective function to reduce the intensity of acute pain and chronic pain(53). Pain arises due to an imbalance in the flow of qi energy in the body(47). Acupressure is able to balance the body's qi flow thereby reducing the intensity of pain and curing disease(54). Balanced qi energy will increase the body's vitality to avoid the dangers of disease(37).

Several studies on stretching and acupressure were able to reduce the incidence of WMSDs such as in tailor workers (31), sports climbers (36), office workers (55), and driver(56). Until now there has been no stretching and acupressure research that focuses on coconut tapping. This study provides a combination of stretching and acupressure. Therefore, this study aims to examine the effect of a combination of stretching and acupressure on coconut tappers to reduce the incidence of WMSDs.

2. MATERIALS AND METHODS

Study design

Research with a quasi-experimental design using one intervention group (IG) and one control group (CG). Coconut tappers in Wonosobo Regency were used in this research: The Wonosobo Agriculture Service was willing to allow visits and direct interactions with respondents during the research data collection process. There were 68 coconut tappers studied and taken from 3 villages from 3 sub-districts in Wonosobo Regency, Central Java Province, Indonesia.

Sample size and sampling technique

Respondents who participated in this research were male coconut tappers. A total sample of 68 coconut tappers was selected and given permission and research willingness sheets. Personal data of coconut tappers such as: age, length of work, BMI and blood pressure. The coconut tappers participated voluntarily and were divided into two groups, namely the intervention group (IG) = 34 and the control group (CG) = 34. The intervention was carried out for 5 minutes for each session (two sessions), and was carried out three times a week for 4 weeks. In the first session, stretching movements were carried out before going to work and 2 hours after work. This stretch consists of 18 upper, middle and lower body movements with a

count of 2×8 (Figure 2.1). The second session consisted of eight acupressure massages with 30 pressures on each point (figure 2.2) with a total time of 5 minutes chosen according to the work of the coconut tapper and adapted from the eight BSM (Body Space Medicine) movements.

The intervention needs to be carried out three times a week for four weeks. The intervention group was video guided and directly supervised by researchers to maintain the accuracy of the movements made by the respondents. During the intervention, the IG carried out the intervention program, while the CG continued to carry out its duties as usual. The intervention program provides 18 stretching movements and 8 acupressure movements on body points. The stretches and independent acupressure that are carried out are those that have been adapted to the work carried out by coconut tappers which have been assessed based on the characteristics of the work carried out. Stretching and acupressure are given to reduce the incidence of WMSDs from the neck muscles to the leg muscles.

Data analysis

WMSDs evaluation results are compiled using ratio data. IBM SPSS Statistics 28 (IBM, Armonk, NY, USA), this program measures variable values from median (Med), minimum (Min) and maximum (Max) values, interquartile range (IR), and standard deviation (SD). Variables that are not normally distributed use the Shapiro-Wilk test, while for homogeneity of variance use the Levene test. Differences in results before and after the occurrence of WMSDs were tested using the Wilcoxon test. The p value was $p < 0.05$, and there were significant differences seen between the before and after results in each group. The Mann-Whitney test determined the difference in WMSDs results of the intervention and control groups. The p value <0.05 indicates that there is a difference between IG and CG.

Ethical standards disclosure

This research has been approved and given permission to be conducted by the Health Research Ethics Committee, Faculty of Public Health, Diponegoro University, Indonesia (ref no 619/EA/KEPK-FKM/2023).

3. RESULTS

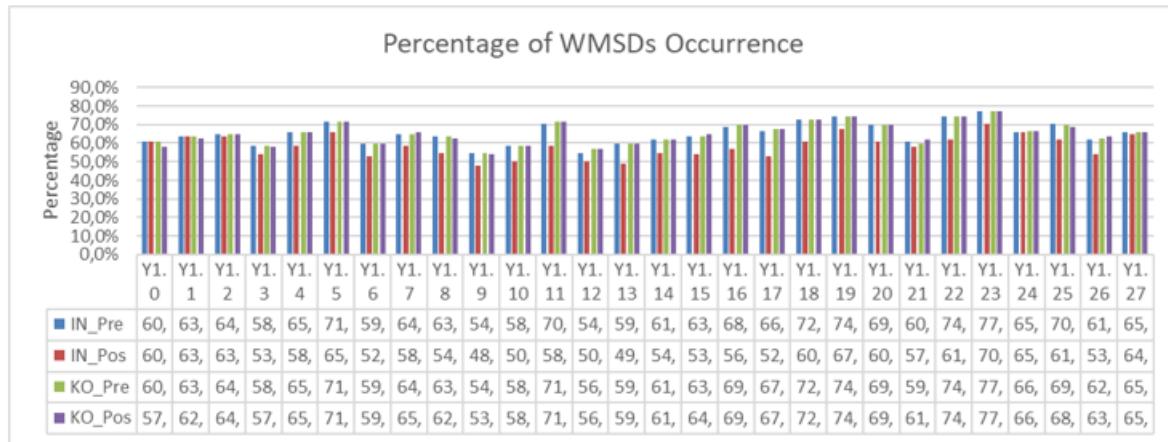
A total of 68 coconut tappers recruited in this study met the specified criteria. Random sampling technique was used to divide 2 groups, namely the intervention group (IG: 34) and the control group (CG: 34). The characteristics of the respondents are presented in **Error! Reference source not found.**. There were no significant differences in the homogeneity test between the characteristics of the respondents in the intervention group and the control group ($p > 0.05$).

The incidence of WMSDs before the intervention and eight months after the intervention showed that the largest percentage occurred in the right calf with the percentage in the IG group (before the intervention) being 77.5% to 70.6% in the CG group (eight weeks after the intervention), namely a decrease (- 6.9%). Furthermore, in the left calf there was a decrease (- 12.7%), in the right thigh there was a decrease (-6.9%), in the left thigh (-11.7%), and in all intervention groups all parts experienced a decrease in percentage. Meanwhile, the control group tended to be more diverse, there were constants, increases and decreases. In the control group, the thighs and calves had the same percentage values between pre and post intervention, while other parts tended to vary, with increases and decreases as in **Error! Reference source not found.** and **Error! Reference source not found.** below.

Table 1. Test Results of Differences in the Incidence of WMSDs and Work Accidents Before and After Intervention in the Intervention and Control Groups

| Group | WMSDs occurrence | |
|---------------------|------------------|-------|
| | Pre | Post |
| Intervention | | |
| Mean | 54.79 | 49.00 |
| Elementary school | 5.06 | 6.94 |
| Mean Diff | -5.79 | |
| p | 0,000** | |
| Control | | |
| Mean | 54.94 | 54.85 |
| Elementary school | 5.03 | 4.97 |
| Mean Diff | -0.09 | |
| p | 0.943* | |

Note: * = Wilcoxon test ; ** = Paired T test



Notes Graph 1: IN_Pre (intervention group before intervention), IN_Pos (intervention group after intervention), KO_Pre (control group before), KO_Pos (control group after), Color; blue (before intervention), red (2 weeks after intervention), green (4 weeks after intervention, purple (4 weeks after intervention), Y (indicates body part pain); Y1.0 (upper neck), Y1.1(neck lower), Y1.2(left shoulder), Y1.3(right shoulder), Y1.4(left upper arm), Y1.5 (back), Y1.6(right upper arm), Y1.7(hip), Y1.8(buttock), Y1.9(button), Y1.10(left elbow), Y1.11(right elbow), Y1.12(left forearm), Y1.13(right forearm), Y1.14(left wrist), Y1.15(right wrist), Y1.16(left hand), Y1.17(right hand), Y1.18(left thigh), Y1.19(right thigh), Y1.20(left knee), Y1.21(right knee), Y1.22(left calf), Y1.23(right calf), Y1.24(left ankle), Y1.25(right ankle), Y1.26(left foot), Y1.27(right foot).

Figure 1. Percentage of WMSDs Occurrence

Table 2. Percentage of WMSDs occurrence per body part in Coconut Tappers

| Code | Location | IN Pre | IN Pos | RE IG | KO Pre | KO Post | RE CG |
|-------|----------------------------------|-----------|-----------|----------|-----------|------------|----------|
| Y1.0 | Pain/stiffness in the upper neck | 60.8% | 60.8% | 0% | 60.8% | 57.8% | -3% |
| Y1.1 | Pain in lower neck | 63.7% | 63.7% | 0% | 63.7% | 62.7% | -1% |
| Y1.2 | Pain in left shoulder | 64.7% | 63.7% | -1% | 64.7% | 64.7% | 0% |
| Y1.3 | Pain in right shoulder | 58.8% | 53.9% | -4.9% | 58.8% | 57.8% | -1% |
| Y1.4 | Pain in left upper arm | 65.7% | 58.8% | -6.9% | 65.7% | 65.7% | 0% |
| Y1.5 | Back pain | 71.6% | 65.7% | -5.9% | 71.6% | 71.6% | 0% |
| Y1.6 | Pain in right upper arm | 59.8% | 52.9% | -6.9% | 59.8% | 59.8% | 0% |
| Y1.7 | Pain in the waist | 64.7% | 58.8% | -5.9% | 64.7% | 65.7% | +1% |
| Y1.8 | Pain in the buttocks (bottock) | 63.7% | 54.9% | -8.8% | 63.7% | 62.7% | -1% |
| Y1.9 | Pain in the buttocks (bottom) | 54.9% | 48.0% | -6.9% | 54.9% | 53.9% | -1% |
| Y1.10 | Pain in left elbow | 58.8% | 50.0% | 8.8% | 58.8% | 58.8% | 0% |
| Y1.11 | Pain in right elbow | 70.6% | 58.8% | 11.8% | 71.6% | 71.6% | 0% |
| Y1.12 | Pain in left forearm | 54.9% | 50.0% | -4.9% | 56.9% | 56.9% | 0% |
| Y1.13 | Pain in right forearm | 59.8% | 49.0% | 10.8% | 59.8% | 59.8% | 0% |
| Y1.14 | Pain in left wrist | 61.8% | 54.9% | -6.9% | 61.8% | 61.8% | 0% |
| Y1.15 | Pain in right wrist | 63.7% | 53.9% | -9.8% | 63.7% | 64.7% | +1% |
| Y1.16 | Pain in left hand | 68.6% | 56.9% | -8.7% | 69.6% | 69.6% | 0% |
| Y1.17 | Pain in right hand | 66.7% | 52.9% | 13.8% | 67.6% | 67.6% | 0% |
| Y1.18 | Pain in left thigh | 72.5% | 60.8% | 11.7% | 72.5% | 72.5% | 0% |
| Y1.19 | Pain in right thigh | 74.5% | 67.6% | -6.9% | 74.5% | 74.5% | 0% |
| Y1.20 | Pain in left knee | 69.6% | 60.8% | -8.8% | 69.6% | 69.6% | 0% |
| Y1.21 | Pain in right knee | 60.8% | 57.8% | -3% | 59.8% | 61.8% | +2% |

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| Code | Location | IN Pre | IN Pos | RE IG | KO Pre | KO Post | RE CG |
|-------------|---------------------|-------------------|-------------------|------------------|-------------------|--------------------|------------------|
| Y1.22 | Pain in left calf | 74.5% | 61.8% | 12.7% | 74.5% | 74.5% | 0% |
| Y1.23 | Pain in right calf | 77.5% | 70.6% | -6.9% | 77.5% | 77.5% | 0% |
| Y1.24 | Pain in my ankle | 65.7% | 65.7% | 0% | 66.7% | 66.7% | 0% |
| Y1.25 | Pain in right ankle | 70.6% | 61.8% | -8.8% | 69.6% | 68.6% | -1% |
| Y1.26 | Pain in left leg | 61.8% | 53.9% | -7.9% | 62.7% | 63.7% | -1% |
| Y1.27 | Pain in right leg | 65.7% | 64.7% | -1% | 65.7% | 65.7% | 0% |

4. DISCUSSION

Coconut tappers will work every morning and evening for a varying number of hours depending on the number of trees they climb. Usually for one tree crane it takes around 5-10 minutes to climb, tap and descend the tree. On average, coconut tappers complete their work in around 30-60 minutes each time they tap. After finishing tapping coconuts, these coconut tappers will do various other jobs ranging from working in rice fields, looking for grass, hoeing fields to other odd jobs. Most coconut tappers make coconut tapping work their main job to meet their daily needs.

Providing simple stretching and BSM acupressure during 5 minute sessions for 4 weeks showed a significant reduction in the incidence of WMSDs. Similar research was also carried out by Ismayenti by providing 5 minute sessions of BG+TfH stretches and movements for 4 weeks which were able to reduce muscle pain in tailors (31). Our research compared two groups of research respondents into two groups, namely intervention and control. The intervention was carried out by carrying out 18 stretching movements and massaging 8 body acupressure points that had been identified according to work characteristics and the occurrence of WMSDs in coconut tappers. In the intervention group, all parts of the body experienced a decrease in pain, whereas in the intervention group it tended to vary, namely constant, increasing and decreasing.

The parts of the body that underwent intervention experienced a significant reduction in the incidence of WMSDs, namely the right elbow (-11.8%), right forearm (10.8%), right hand (13.8%), left thigh (11.7%), and left calf (12.7%). Overall, in the control group, all parts of the body experienced a significant decrease, and from the results, the highest percentage of pain levels was the incidence of WMSDs in the thighs and calves. Meanwhile, the control group did not show a significant decrease, namely upper neck (-3%), lower neck (-1%), right shoulder (-1%), buttock (+1%), button (+1%), right leg (-1%), left foot (-1%). Meanwhile, other parts tended to increase, such as the hip (+1%), right wrist (+1%), knee (+2%), while other parts in the control group had no changes both before and after monitoring.

So with the characteristics of the work of coconut tapping, it is necessary to provide stretching (57)(58) and acupressure(59) which involves stretching the muscles from head to toe and involves strengthening the left and right muscles equally(60). These results are consistent with research showing the benefits of stretching for this condition; for example, previous research provided a physical activity program before rock climbing(35). Climbers will use the most dominant muscles in the hands, arms, feet, thighs and calves (36). In coconut tappers, the neck muscles will point upwards, forwards and to the sides when climbing, tapping and descending the tree. These three movements will cause pain in the neck, back, hands, waist and legs. Positioning the head out of alignment with the spine causes neck pain(61), increasing neck and shoulder muscle endurance can prevent neck pain(62). In addition, coconut tapping positions that use the strength of the whole body, arms and legs cause complaints of pain in the shoulders, arms, hands, waist, back, buttocks, buttocks, elbows, thighs, knees and ankles(63).

A 6-minute daily stretching program for 15-17 days in office workers can reduce the incidence of WMSDs(34). A combination of stretching and BG+TfH movements for 5 minutes in two sessions three times a week in monotonous work can reduce the incidence of WMSDs(61). Most other studies were conducted over longer periods of time(33); this study showed a general decrease in the incidence of WMSD during the four weeks of intervention. Previous research conducted within 4 weeks showed a significant reduction in musculoskeletal pain in the neck and shoulders (50). Most studies involved strengthening or resistance training(64); These stretches emphasize that specific strengthening and resistance exercises of the upper extremities can reduce the incidence of WMSD in office workers. However, this study looked at the effect of a combination of stretching and BSM acupressure which can reduce the incidence of WMSD without using any equipment, the stretching movements carried out do not have a high risk to health, the movements are easy and light. Then acupressure uses hand strength without any tools with an easy and simple massage, and there is no risk of danger if you give the wrong massage.

Limitations in this research include; Firstly, the small sample size of 68 respondents was due to the difficulty of finding coconut tappers who could be involved in the research, which made the results difficult to interpret. Second, the duration of the intervention was only 8 weeks; Longer time intervention studies are needed to confirm these findings with their long-term effects. Third, difficulties in providing time for intervention and data collection processes because the work of coconut tappers is on plantations and is informal work.

5. CONCLUSION

The conclusion obtained from this study is that comparing the two groups, it was found that the combination of simple stretching and BSM acupressure was able to reduce the incidence of WMSDs. The level of pain associated with WMSDs significantly decreased in the intervention group namely right elbow (-11.8%), right forearm (-10.8%), right hand (-13.8%), left thigh (-11.7%), and left calf (-12.7%). Meanwhile, other parts experienced a decline of below 10%. There has been no previous research regarding the provision of stretching and acupressure interventions to coconut tappers. Carrying out light massage at 8 selected points for a total of 5 minutes with intervention twice a day can be beneficial for coconut tappers who do heavy and risky work by climbing, tapping and descending coconut trees which requires them to be careful and focused in their work. This study can be used as a reference for future interventions with the same objectives, larger samples and longer intervention times.

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