

## **FLEXIBLE STICK EXERCISE COULD INCREASE FLEXIBILITY, MUSCLE STRENGTH, ENDURANCE, AND IN HEALTHY SUBJECTS**

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**ABSTRACT:** The study on the effects of resistance exercise by using elastic band found that it could increase muscle strength and physical performance, but the study of the effects of flexible stick with aerobic exercise are also less. The aim of this study was to examine the effects of flexible stick on muscle strength, muscle endurance, and flexibility in healthy subjects. Twenty-five subjects ( $20.5 \pm 1.1$  years; BMI:  $21.4 \pm 4.1$  kg/m<sup>2</sup>) were included in this study and they performed a moderate aerobic dance with resistance training exercise by using flexible stick for 40 minutes per time which included a 5-minute of warm up, a 30-minute of exercise, and a 5-minute of cool down, 3 times per weeks, for 4 weeks. Weight, back muscle strength, abdominal muscle endurance, and flexibility were measured before and after doing the exercise. This study found that there was significant increase in back muscle strength ( $p=0.33$ ), abdominal muscle endurance ( $p=0.001$ ), and flexibility ( $p=0.0001$ ) after exercise. However, 4 weeks of exercise did not affect on body weight. We concluded that 4 weeks of aerobic exercise with flexible stick could increase back muscle strength, abdominal muscle endurance, and flexibility in healthy subjects.

*Keywords: Aerobic Dance, Exercise, Muscle Strength, Muscle Endurance, Flexibility*

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### **1. INTRODUCTION**

Aerobic and resistance exercise are usually used for improving physical performance. The previous study found that aerobic and/or resistance exercises were useful for improving body composition and physical fitness [1]-[4]. Aerobic dance is a kind of aerobic exercise that can be most easily performed and it is a flexible exercise that people can decide the way to dance matching with the chosen melody and rhythm. Moreover, we can create variety of ways to dance. Aerobic dance focuses on cardiorespiratory endurance, muscle strength, flexibility, muscle endurance, and agility. However, exercising can become more beneficial if more loads are added to increase intensity in exercises [5].

The flexible stick, which was adapted from DaroonwanSuksom's flexible stick [6], was used for the exercise to increase resistance. It is made from rubber that is readily available and inexpensive. The property of flexible stick is reflexing reaction or pulling back force after being stretched out which is called stretch reflex. Every time the elastic straps are stretched out, proprioception will be stimulated by the property of the elastic straps to be aware and react to the stretched straps. A study on the effects of resistance exercise by using elastic band found that it can increase muscle strength [7]-[8] and physical performance, including balance, speed, and muscle endurance [8]-[9].

From the previous study, it showed that both aerobic and resistance exercise provide a lot of benefits on health. Thus, this study was to investigate the effects of aerobic exercise by using aerobic dance combined with resistance exercise by using flexible stick on muscle strength, muscle endurance, and flexibility in healthy subjects.

### **2. MATERIAL AND METHOD**

This study was a pre-experimental one-group pretest-posttest study approved by the Ethical committee of Mahasarakham University, Thailand (241/2557). Twenty-five volunteers signed and gave consent to participate in this study. The volunteers aged  $20.5 \pm 1.1$  years, and had BMI of  $21.4 \pm 4.1$  kg/m<sup>2</sup>. They were excluded from the study if they had muscle or joint pain, a history of chronic systemic or musculoskeletal diseases and use of medications with known effects on musculoskeletal system. The aerobic exercise with flexible stick program performed 40 minutes a day, 3 days a week for 4 weeks consecutively. The exercise started with warming up for 5 minutes, aerobic dance with flexible stick exercise (32 postures) for 30 minutes, and cooling down for 5 minutes. Body weight, back muscle strength, abdominal muscle endurance, and flexibility were measured before and after the exercise.

## 2.1 Research instrument and measurement

The flexible sticks consisted of a pair of 20 centimeter tubes and were connected by flexible sticks in the form of continuous small loops which were about 30 centimeters long. Each connecting loop consisted of 3 elastic bands (Fig. 2)

Back muscle strength was measured by using leg dynamometer. The volunteers were instructed to set their feet six inches apart in the parallel position; the hands catch the handheld of the instrument, and they held their head, back, as well as legs in a straight line. Then they had to bent the body forward 45 degree. After that they pulled the handheld by keeping the body straight. Back muscle strength was measured in kilogram [10].

Abdominal muscle endurance was measured by sit-ups test. The volunteers were instructed to lie down with tuning face up on mattresses, bent their knees in the right angle, and separated their feet a little. Then they had to join their hands on their chests and had other volunteers, who were kneeling down, grabbing and pressing the ankles of the volunteers who were lying down. After the signal had been given, the lying volunteers had to do sit-up in 30 seconds as many times as possible and counted how many times they could do [10].

Flexibility was measured by using flexibility meter. The volunteers were instructed to sit on the ground, extended their legs forward, and used their feet in dosiflexion position touching the flexibility meter. Then they had to bend their bodies forward with arms extending straight, and used their fingers to touch the scale written on a material, for 2 seconds. The unit of scale was in centimeter [10].



Poses for exercise	description
	Grip the sticks with both hands. Stretch out to the front and then spread your arms by using both hands at a time.
Poses for exercise	description
	Step on a sticks. Grip the other, extend your arms forward, and stretch the flexible stick up and down.

Fig.1 The example posture of aerobic dance with flexible stick exercise

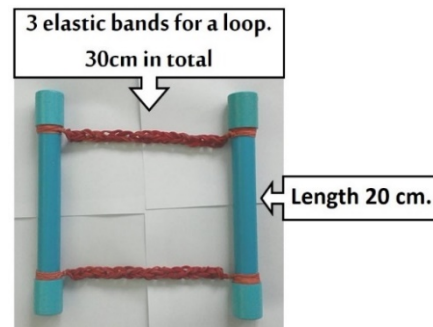


Fig. 2 Flexible stick (adapted from Daroonwan Suksom' flexible stick [6])

## 2.2 Statistical Analysis

The data were presented as mean  $\pm$  SD. Kolmogorov-Smirnov was used to verify normal distribution. Paired t-test and Wilcoxon Sign Rank-Test were used to compare the outcome variables before and after TTM treatment within group. Statistical significance was set at the  $p < 0.05$ .

## 3. RESULTS

This study demonstrated that back muscle strength was significantly increased ( $p = 0.033$ ). Abdominal muscle endurance was significantly increased ( $p = 0.001$ ), and flexibility was significantly increased ( $p = 0.0001$ ) after aerobic dance with flexible stick exercise was done. However, weight showed no significant differences within-groups comparison (Table 1).

Table 1 Comparison on the body weight, back muscle strength, abdominal muscle endurance, and flexibility between before and after aerobic dance with flexible stick exercise.

outcome	aerobic exercise with flexible stick (n = 25)	
	before mean $\pm$ SD	after mean $\pm$ SD
Body weight	57.89 $\pm$ 10.57	57.62 $\pm$ 10.11
95%CI	53.53, 62.25	53.45, 61.80
Back muscle strength	65.16 $\pm$ 38.11	72.77 $\pm$ 29.78*
95%CI	49.43, 80.90	60.50, 85.06
Abdominal muscle endurance	18.60 $\pm$ 4.83	22.08 $\pm$ 4.12**
95%CI	16.61, 20.60	20.38, 23.79
Flexibility	9.36 $\pm$ 7.51	11.96 $\pm$ 7.43**
95%CI	6.26, 12.46	8.90, 15.03

\*Significant difference at p-value <0.05

\*\*Significant difference at p-value <0.01

#### 4. DISCUSSION

The aim of this research was to study the effects of aerobic dance with flexible stick exercise on back muscle strength, abdominal muscle endurance, and flexibility. From this study, it was found that aerobic dance with flexible stick exercise can improve back muscle strength, abdominal muscle endurance, and flexibility. The results of this study were corresponded with Larsson et al. [1], Sanal et al. [3], and Rhyu et al. [7] which found that a 15-week and a 12-week resistance exercise, and a six-week elastic band exercise could increase muscle strength, respectively. Moreover, Jin et al. [8] showed that a 12-week and a 5-month elastic band resistance exercise could increase muscle endurance. The present study demonstrated that just a 4-week aerobic dance with flexible stick exercise could improve physical fitness as indicated by an increase of muscle strength, muscle endurance, and flexibility in healthy volunteers.

Body weight was not significantly changed after doing the exercise. The result of this study was consistent with Nassis et al. [11] which found that 12 weeks of aerobic exercise training could not change body weight in overweight and obese girls whereas Taghian et al. [12] found that aerobic exercise, which a maximal heart rate percentage of 60-65 and 80-85 and the duration of 15-20 and 45-50 minutes, at the beginning and the end of exercise could decrease body weight in obese women.

#### 5. CONCLUSION

The present study showed that aerobic dance with flexible stick exercise for 40 minutes a day, 3 days a week within 4 weeks could increase back muscle strength, abdominal muscle endurance and flexibility. However, a four-week exercise had no effect on body weight change.

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