A comparison of the aerobic cost and muscle use in aerobic dance to the energy costs and muscle use on treadmill, elliptical trainer and bicycle ergometry


aDepartment of Physical Therapy, Azusa Pacific University, CA, USA
bDepartment of Physical Therapy, Loma Linda University, CA, USA

Objective: To determine the energy consumed and muscle use during dance compared to different standard exercise devices.

Design: Longitudinal study.

Methods: Fifteen female subjects were evaluated to assess the energy cost and muscle activity during a 20 minute dance video compared to treadmill, elliptical track and bicycle ergometry. The later 3 forms of exercise were accomplished in four, 5 minute bouts at different intensities of exercise. Subjects were in the age range of 22-24 years old, were free of cardiovascular disease and did not have any neurological injuries. They were not sedentary and exercised at least twice a week. During the exercise, muscle activity was measured by the electromyogram recorded by surface electrodes on 6 muscle groups. A Cosmed metabolic cart was used to measure oxygen consumption during the exercise.

Results: The aerobic dance video that was tested here was equivalent to a hard workout on any of the 3 exercise modalities. The dance routine was equivalent in terms of energy consumed to running at 225 watts of work or running for 20 minutes at a speed of 2 meters per second (4.47 miles per hour). Compared to the bicycle, it was equivalent to cycling at 112 watts for 20 minutes (2.25 kpm), and for the elliptical trainer, dance was equivalent to 435 watts. Concerning muscle use, the dance routine was the most balanced for upper, core and lower body muscles. Although the elliptical trainer was close, it required muscle less muscle use.

Conclusion: A good dance video can be more effective than standard exercise equipment.

Key Words: Aerobic exercise, Exercise, Exertion, Metabolism

Introduction

Exercise has always been the best remedy for obesity and the prevention of senescence of the cardiovascular system and metabolic diseases like diabetes [1-4]. Increasing daily exercise to at least 1 hour per week has been suggested by many federal agencies including NIH and the American Diabetes Association [5-9]. But most people show poor compliance for exercise. While their intentions are good, they start an exercise or diet program and then soon drop out [10-15].

Different types of exercise are often used. Many types of exercise such as skiing and cross country running are performed outdoors. These types of aerobic exercise offer good training in that they decrease caloric intake and causes a sustained increase in caloric output [16]. The sustained aerobic stress on the heart and the cardiovascular system increases blood pressure and heart rate and causes both increased cardiovascular toning and increased basal metabolism during and after exercise (EPOC) [17,18]. In addition, the immune
system increases activity with regular exercise [19]. But many people do not have the time for outdoor exercise. Therefore, there are many types of indoor activities. These include cycle ergometry, treadmill running, and elliptical tracks trainers and other exercise devices.

Each type of exercise has a benefit on cardiovascular training and fitness. The easiest is cycle ergometry since the body weight is supported. Here all of the activity of muscles is to rotate the peddles and not support body weight [20]. This type of exercise is good for people who have arthritis or other disorders where supporting body weight makes accomplishing exercise difficult [21]. It can result in sub-
stantial training of muscle and the cardiovascular system.

Treadmill exercise uses large muscle groups and the work accomplished is increased as a function of body weight [22]. Like bicycle ergometry, the workload can be increased by increasing the speed and the load. Here the load is adjusted by increasing the incline angle of the treadmill. Numerous studies have shown the cardiovascular benefit and increase in muscle tone and strength with treadmill running [23,24]. However, treadmill ergometry is often boring since the person remains essentially stationary.

To increase the muscle used in the exercise, elliptical trainers have been used in health spas and at home. These involve more fluid motion where the exercise is a mixture between a step trainer and a bicycle and treadmill [25]. Body weight is not supported during the exercise. By using stepping exercises the elliptical trainer uses a flywheel like a bicycle and allows forward and reverse motion to increase muscle activity in the lower body and handles for the arms [26]. Elliptical trainers have been studied well and have been shown to have good benefits on the musculoskeletal and cardiovascular systems. They involve some upper body as well as lower body exercise. But they also can be boring.

Many of the newer exercise regimes include dance videos. The concept here is that dance offers aerobic training in the upper and lower body together allowing for a better and more thorough workout. Dance has been shown to have improvements in the immune system and the cardiovascular system [27,28]. An old axiom in exercise is that you can only train the muscles that are being used by an exercise regime. Treadmill work, for example, will train the legs but not the arms and chest muscles. Dance uses extensively core muscles as well as muscles in the legs and arms [29,30]. This should increase caloric expenditure and result in a better training program. An additional benefit is the fun of danc-
ing, certainly much less boring than treadmill exercise. On all of these exercise modalities, it is easy to analyze caloric expenditure by measuring oxygen consumption.

When oxygen use and carbon dioxide production are measured, the respiratory quotient during exercise can be assessed. This provides useful information as to the fuel used during the exercise [31]. If the RQ=1, then carbohydrates are being used by the body whereas with an RQ of 0.7, fats are being burned. The oxygen uptake (oxygen use x vent-
tilation) of the body can also be used with the RQ to de-
termine caloric expenditure [31]. Generally for each liter of oxygen burned, 5 kcal of energy is used [32]. Muscle use is somewhat more difficult to determine.

Historically, the electromyogram (EMG), the electrical activity from underlying muscles, can be used to assess muscle activity [33,34]. The root-mean-square (RMS) average of the EMG is a useful tool with which to assess muscle activity. There is a linear relationship between the EMG amplitude (RMS) and the activity of muscle [34]. However, because different electrode placements and different blood flows in skin and muscle can alter the recorded EMG amplitude, The EMG must first be calibrated and then normalized [33,35-37]. This is accomplished by placing each muscle in the center of its length (mid-range of motion) and then conducting a series of strength measurements. The recorded EMG is then used so that EMG during exercise is divided by the total EMG for that muscle to obtain the normalized EMG as a percent to muscle activity.

The purpose of the present investigation was to assess muscle use and oxygen consumption during aerobic dance compared to treadmill, an elliptical trainer, and bicycle er-
gometry.

**Methods**

**Subjects**

Fifteen female subjects in the age range of 22 to 24 years old participated in the study. Subjects were fit enough to participate in all 4 exercise modalities. Subjects must have ex-

<table>
<thead>
<tr>
<th>Table 1. Demographics of subjects</th>
<th>(N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Height</td>
</tr>
<tr>
<td>Mean</td>
<td>23.9</td>
</tr>
<tr>
<td>SD</td>
<td>1.2</td>
</tr>
</tbody>
</table>

BMI: body mass index.