PSYCHO-PHYSIOLOGICAL ANALYSIS OF AN AEROBIC DANCE PROGRAMME FOR WOMEN

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ABSTRACT

The purpose of this study was to determine: (1) the energy cost and (2) the psycho-physiological effects of an aerobic dance programme in young women. Twenty-one college-age women participated 40 minutes a day, three days a week, for a 10-week training period. Each work session included a five-minute warm-up period, a 30-minute stimulus period (including walk-runs) and a five-minute cool-down period. During the last four weeks of the training period, the following parameters were monitored in six of the subjects during two consecutive sessions: perceived exertion (RPE) utilising the Borg 6-20 scale, Mean = 13.19; heart rate (HR) monitored at regular intervals during the training session, Mean = 166.37; and estimated caloric expenditure based on measured oxygen consumption (VO₂) utilising a Kofranyi-Michaelis respirometer, Mean = 289.32. Multivariate analysis of variance (MANOVA) computed between pre and post tests for the six dependent variables revealed a significant approximate F-ratio of 5.72 (p < .05). Univariate t-test analysis of mean changes revealed significant pre-post test differences for VO₂ max expressed in ml/kg min⁻¹, maximal pulmonary ventilation, maximal working capacity on the bicycle ergometer, submaximal HR and submaximal RPE. Body weight was not significantly altered. It was concluded that the aerobic dance training programme employed was of sufficient intensity to elicit significant physiological and psycho-physiological alterations in college-age women.

Key Words: dance training, aerobic power, perceived exertion.

INTRODUCTION

In recent years there has been a marked trend for women to become increasingly interested in the potential health benefits of exercise. It is well established that certain forms of exercise may be used to improve aerobic power which in turn has been linked with physiological parameters such as cardiac output, maximal stroke volume, heart volume and A-VO₂ difference (Åstrand and Rodahl, 1977). Although jogging is often recommended as a means of training aerobic power (Cooper and Cooper, 1973), some women find cultural biases against this type of exercise difficult to overcome (Metheny, 1965; Burke, et al, 1975). Other forms of exercise, termed “aerobic” due to the utilisation of fairly high percentages of maximal aerobic power for sustained periods of time, have been recommended. Unfortunately, such “aerobic” exercises as cycling, cross country, skiing and swimming are each dependent on either favourable climatic conditions or special facilities.

A possible “aerobic” activity, less often discussed, is dance. Since antiquity, humans have enjoyed dance as an art form and as a means of social intercourse. Women have always been particularly attracted to dancing as a means of entertainment and enjoyment. But few have thought of dance in the same context as some of the earlier mentioned “aerobic” exercises.

Sorensen (1972) has designed a set of dance routines which she termed aerobic dance. These routines set to popular music incorporate the basic steps from a wide variety of dance forms, e.g. folk, modern, jazz, ballet, charleston or disco in conjunction with certain body movements and calisthenics such as hopping, skipping, walking, running, jumping, situps, toe-touches and various stretches. If aerobic dance is shown to be of physiological benefit, perhaps physical educators and others responsible for the administration of organised exercise programmes would be more likely to recommend this form of exercise for women.

REVIEW OF LITERATURE

Research studies needed to establish the validity of aerobic dance have been few. Based upon data from ten adult females, Weber (1974) found that aerobic dance can require on average VO₂ of 29 ml/kg min⁻¹ for durations of 30 minutes. He concluded that such an exercise was of sufficient duration and intensity to elicit a training effect. Foster (1975) collected expired air from women, aged 20 to 38, during one aerobic dance routine. He reported a mean VO₂ of 33.6 ml/kg min⁻¹ which was approximately 77 percent of estimated VO₂ max. Maas (1975) found that college women enrolled in an aerobic dance programme significantly increased in 12-minute walk/run distances and had a decrease in resting heart rate. Sorensen (1974) also reported improvement in 12-minute run scores as a result of an aerobic training programme for women. Due to an apparent lack of research needed to support aerobic dance scientifically, the present study was deemed necessary to determine (1) the energy cost and (2) the psycho-physiological effects of a ten-week aerobic dance programme for college-age women.
METHODS

College women served as subjects in this study; their ages ranged from 19 to 24 years. Subjects were selected from a group of interested individuals on the basis of availability, willingness to participate for the entire programme and a lack of regular participation in any other form of "aerobic" exercise. Twenty-four women were tested prior to the ten-week programme; 21 completed the entire programme and were available for post-testing. The subjects participated in aerobic dance classes three times a week with each class lasting approximately 40 minutes. The classes were conducted by the female investigator according to the procedures suggested by Sorensen (1972). Each class consisted of one warm-up dance, six to seven aerobic dance routines and one cool-down dance. Interval periods of walk/jog and stretching/calisthenic exercises were interspersed between the dances. The same educational photograph record of Sorensen's programme was used for each class.

Testing, involving a discontinuous progressive work test on a Monark bicycle ergometer, took place in the exercise physiology laboratory at Ithaca College. Following a five-minute warm-up at 300 KPM, a series of three-minute work bouts interphased with five-minute rest periods were conducted. Expired air was collected during the last minute of each work bout in a Tissot gasometer. Beckman F-2 oxygen and LB-1 carbon dioxide analyzers were utilized for gas analysis. Submaximal heart rate (HR) and perceived exertion (RPE) according to the scale of Borg (1970) were determined in the last 15 seconds of the five-minute warm-up period. Physical work capacity (PWC) was defined as that work load (KPM-min\(^{-1}\)) at which VO\(_2\) max was achieved.

Six subjects volunteered to be measured for VO\(_2\) during each of two sessions. VO\(_2\) was measured continuously during each 40-minute session with the use of a Kofranyi-Michaelis respirometer calibrated with the use of a Tissot gasometer at gas volumes typical of tidal volumes measured during the dance sessions.

Statistical analysis

Multivariate analysis of variance (MANOVA) was used to test for a significant overall difference between pre and post testing sessions. Univariate analysis was then performed with the use of the student's 't'-test.

RESULTS

Mean \(\overline{X}\) and Standard Error of the Mean (SEM) for pre and post test dependent variables are presented in Table I. MANOVA for the six dependent variables revealed a significant \((p < .01)\) approximate F-ratio of 5.72 (df 6,15). Univariate analysis as displayed in Table I revealed significant \((p < .01)\) improvements in VO\(_2\) max ml/kg min\(^{-1}\), maximal pulmonary ventilation (VE max BTPS), PWC, submaximal HR and submaximal RPE. Weight was unchanged.

**TABLE I**
Mean, Standard Error of the Mean, and Univariate Analyses for Selected Dependent Variables used in Multivariate Analysis

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>'t' Test</th>
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<tbody>
<tr>
<td></td>
<td>X</td>
<td>SEM</td>
<td>X</td>
</tr>
<tr>
<td>VO(_2) max (ml/kg/min)</td>
<td>34.38</td>
<td>1.57</td>
<td>38.79</td>
</tr>
<tr>
<td>VE max BTPS (l/min)</td>
<td>58.27</td>
<td>2.91</td>
<td>67.82</td>
</tr>
<tr>
<td>Maximal Working Capacity (kpm)</td>
<td>700</td>
<td>34</td>
<td>876</td>
</tr>
<tr>
<td>Submaximal HR</td>
<td>150</td>
<td>5.6</td>
<td>129</td>
</tr>
<tr>
<td>Submaximal RPE</td>
<td>11</td>
<td>0.40</td>
<td>9</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>58.3</td>
<td>2.3</td>
<td>59.0</td>
</tr>
<tr>
<td>* p &lt; .01</td>
<td></td>
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</table>

**TABLE II**
Mean Values for Test-Retest Measures of VO\(_2\) and work intensity in 6 women during a 40-Minute Aerobic Dance Session

<table>
<thead>
<tr>
<th></th>
<th>(\overline{\dot{V}O_2}) (1)</th>
<th>Estimated Kcal**</th>
<th>(\overline{\dot{V}O_2}) ml/kg/min</th>
<th>(\overline{X}) % of VO(_2) max</th>
<th>HR</th>
<th>RPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-Up 5 minutes</td>
<td>6.5</td>
<td>32.5</td>
<td>21.45</td>
<td>56.0</td>
<td>145.8</td>
<td>11.2</td>
</tr>
<tr>
<td>Stimulus 30 Minutes</td>
<td>47.4</td>
<td>237.0</td>
<td>26.54</td>
<td>69.3</td>
<td>173.9</td>
<td>14.2</td>
</tr>
<tr>
<td>Cool-Down 5 Minutes</td>
<td>2.96</td>
<td>19.8</td>
<td>13.02</td>
<td>34.0</td>
<td>115.9</td>
<td>9.5</td>
</tr>
<tr>
<td>Total Session</td>
<td>57.86</td>
<td>289.3</td>
<td>24.23</td>
<td>63.0*</td>
<td>163.3*</td>
<td>13.2*</td>
</tr>
</tbody>
</table>

* Weighted, i.e. the stimulus period was given six times the weight of the warm-up cool-down period. ** \(\dot{V}O_2\) in litres multiplied by 5.
As shown in Table II, test-retest measures of $\text{VO}_2$ and work intensity revealed values consistent with an "aerobic" form of exercise. During the 30-minute stimulus period, these young women were working at a $\text{X HR}$ of 173.9, $\text{X RPE}$ of 14.2 and at approximately 69.3 percent of their $\text{VO}_2$ max. Estimated calorie expenditure was $\text{X} = 289.3$ Kcal for the entire 40-minute session.

**DISCUSSION**

The participants in the 10-week aerobic dance programme clearly demonstrated an improved level of cardio-respiratory endurance fitness at the time of the post-programme testing. The increased aerobic power of approximately 13 percent was similar to the improvements reported in the studies of young women in which running, cycling and bench stepping were used as training modalities (Edwards, 1974; Flint et al, 1974; Eisenman and Golding, 1975; Burke, 1977). Other indications of improved circulatory and respiratory systems included a decrease in submaximal heart rate, an increased VE max and an increase in PWC. These findings support the conclusions based upon estimated aerobic power by Durrant (1975), Maas (1975) and Sorensen (1974). The hypotheses of Foster (1975), Weber (1974) and Zohman and Phillips (1973) that aerobic dance could enhance the endurance fitness of persons who regularly participate in the programme, appear to be justified.

The decrease in submaximal HR was accompanied by a significant decrease in submaximal RPE. Similar results have been reported by Docktor and Sharkey (1971), Ekblom and Goldbarg (1971) and Patton et al, (1977). These findings are consistent with Borg's (1970) work which has established a generally linear relationship between heart rate and perceived exertion. Apparently the human organism has the ability to recognise work intensity subjectively, i.e. percent of maximal aerobic power, rather precisely. Thus, with increased aerobic power, the subject accurately perceived the identical work load of 300 KPM-min$^{-1}$ to be of lower intensity.

The improvements in cardio-respiratory endurance fitness are not surprising in view of the individual training session data summarized in Table II. In a recent position statement, the American College of Sports Medicine (1978) has provided the following guidelines for the development and maintenance of cardio-respiratory fitness in healthy adults.

1. Frequency of exercise should be three to five days per week.
2. Duration of exercise should be between 15 to 60 minutes of continuous aerobic exercise.
3. Training intensity should be at heart rates of at least 130 to 135 beats per minute (60-90% of HR reserve); at 50 to 85 percent of $\text{VO}_2$ max.
4. Mode of activity should require continuous rhythmic contraction of large muscle groups.

Since each of these guidelines have been met by the aerobic dance programme employed in the present study, it would appear that this psychologically pleasing form of exercise (recommended by Walker, 1976) may be strongly recommended.

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Dear Sir,

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Yours faithfully,

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Editor-in-Chief.