

Low Impact Aerobic Dance as a Useful Exercise Mode for Reducing Body Mass in Mildly Obese Middle-Aged Women

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Abstract. The purpose of this study was to test the hypothesis that a low impact aerobic dance is a useful exercise mode for weight loss in obese middle-aged women. Sixty Japanese women, aged 50.9 ± 6.7 years (initial %fat = $35.2 \pm 5.3\%$), participated in our 3-month weight-loss program consisting of diet and exercise prescription. To compare the effectiveness of exercise modes, the subjects were divided into the following two groups: aerobic dance group and jogging and/or cycling group. As a result, body mass (-3.1 and -3.3 kg respectively) and %fat (-6.1 and -5.3% respectively) significantly decreased ($P < 0.05$) in both groups, while fat-free mass remained essentially unchanged. Aerobic power such as maximal oxygen uptake and oxygen uptake corresponding to lactate threshold significantly increased ($P < 0.05$) in both groups. Significant differences in the alterations of these variables between groups could not be seen. The data of this study indicates that our weight-loss program with a low impact aerobic dance is as useful as jogging or cycling in improving body composition and aerobic power for mildly obese middle-aged women.

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Keywords: low impact aerobic dance, weight-loss program, obese women, body composition, aerobic power

Introduction

Obesity largely contributes to various cardiovascular diseases, and how to reduce body mass, especially body fat, is a major problem in industrialized countries (Krotkiewski et al., 1983; Lapidus et al., 1984; Larsson et al., 1984; Manson et al., 1990; Terry et al., 1991). A large number of investigators such as clinicians, sports scientists and dietitians, have been greatly interested in reducing body mass of obese persons and some athletes, and have explored the effect of exercise training on the

alteration of body composition (Forbes, 1991; Hill et al., 1989; King and Tribble, 1991; Lohman, 1986; Prentice et al., 1991; Segal and Pi-Suyet, 1989; Tanaka et al., 1989b, 1993; Walberg, 1989; Wilmore 1983; Zuti and Golding, 1976). However, opinions as well as findings are different among researchers on this issue.

Many different exercise modalities have been used as a physical training for reducing body mass (Forbes, 1991; Stefanick, 1993; Wilmore, 1983). Among these exercise modalities, running and cycling have been considered most useful and are still very popular. It is for this reason that these modalities could be maintained at a suitable intensity (*i.e.*, 40-60 % $\dot{V}O_{2max}$), which is recognized to be most effective for producing several health benefits (Tanaka and Shindo, 1992). Currently however, it is well understood that aerobic dance is also one of the most commonly practiced adult fitness activities. Nevertheless, the effectiveness of this type of exercise modality in eliciting reduction of body mass has been questioned, especially when compared with exercise modalities such as running and cycling (Williford et al., 1989).

Aerobic dance consists of high (traditional) and low (now popular) impact, depending on the style of dance and intensity. The high impact style allows both feet to be simultaneously off the supporting surface and is considered ballistic. On the other hand, low impact dance exercise is characterized by the participant maintaining one foot in contact with the floor all the time and allows no movement which incorporates hopping or jumping. Dowdy et al. (1985), Williford et al. (1988), Parler et al. (1989), and Johnson et al. (1984) studied on body composition alterations following high impact aerobic dance training, and reported that there were favourable changes in body composition and aerobic power. However, a small pool of data presently exists concerning the training out of low impact aerobic dance (Williford et al., 1989). Accordingly, the purpose of this study was to examine if low impact aerobic dance is a

Table 1 Alterations in anthropometric, body composition, and cardiorespiratory variables

	Total		Group AD			Group JC	
	(n=60)		(n=37)			(n=23)	
	Pre	Post	Pre	Post	Pre	Post	
Age, year	50.9 ± 6.7	–	49.1 ± 7.9	–	51.7 ± 6.1	–	
Height, cm	156.4 ± 5.2	–	156.4 ± 4.8	–	156.4 ± 5.8	–	
Body mass, kg	61.9 ± 7.8	58.8 ± 8.0 *	61.9 ± 8.1	58.8 ± 8.2 *	62.0 ± 6.7	58.7 ± 7.2 *	*
BMI	25.4 ± 2.0	23.8 ± 2.2 *	25.4 ± 2.1	23.6 ± 2.3 *	25.3 ± 1.9	23.9 ± 2.2 *	*
Breast C, cm	93.1 ± 5.7	90.6 ± 6.6 *	93.6 ± 5.4	90.3 ± 6.5 *	92.8 ± 6.0	90.8 ± 6.9 *	*
Waist C, cm	92.0 ± 6.3	90.6 ± 7.4 *	91.1 ± 5.6	88.9 ± 6.7 *	92.6 ± 6.8	91.9 ± 7.9 *	*
Subscapular S, mm	29.7 ± 6.3	24.7 ± 6.5 *	30.3 ± 5.2	25.2 ± 7.2 *	29.3 ± 7.0	24.3 ± 6.3 *	*
Triceps S, mm	28.1 ± 7.7	23.0 ± 6.0 *	27.4 ± 7.5	22.5 ± 6.6 *	28.1 ± 8.1	23.1 ± 5.6 *	*
Fat mass, %	35.2 ± 5.3	29.6 ± 5.8 *	36.7 ± 5.8	30.6 ± 7.4 *	34.1 ± 4.7	28.8 ± 4.2 *	*
Fat mass, kg	21.8 ± 5.2	17.4 ± 5.5 *	22.7 ± 5.9	18.0 ± 7.3 *	21.1 ± 4.1	16.9 ± 4.2 *	*
Fat-free mass, kg	40.1 ± 4.2	41.4 ± 3.2 ns	39.2 ± 4.1	40.8 ± 3.2 ns	40.9 ± 6.8	41.8 ± 5.0 ns	ns
$\dot{V}O_{2max}$, ml/kg/min	26.7 ± 4.2	31.2 ± 4.4 *	26.4 ± 4.1	31.1 ± 3.7 *	26.9 ± 4.5	31.3 ± 5.0 *	*
$\dot{V}O_{2LT}$, ml/kg/min	15.8 ± 2.7	18.4 ± 2.6 *	15.8 ± 2.7	18.4 ± 2.8 *	15.9 ± 2.7	18.4 ± 2.6 *	*

*Significantly different from pre-value ($P < 0.05$). ns: not significant.

C: circumference, S: skinfold thickness, ST: skinfold thickness method, BI: bioelectrical impedance method.

useful training modality for reducing body mass in obese middle-aged women.

Methods

Subjects

Sixty women volunteered to participate in the study. The subjects were classified into either one of the following two groups: the aerobic dance group (Group AD) and the jogging and/or cycling group (Group JC). Their physical and physiological characteristics are shown in Table 1. Before participation in this study, informed consent was obtained from all subjects, after having been fully informed of the nature of the experimental protocol. None were taking medications during the period of this study, and none had a history of cardiovascular or respiratory complications.

Weight-loss program

All subjects participated in our weight-loss program that comprised exercise prescription and food restriction. In Group AD, the exercise program consisted mainly of 60 min of aerobic dance 2-3 d/wk. Each dance exercise session included a 10 to 15-min warm-up period, an aerobic dance period of 40 minutes, and a 5- to 10-min cool-down period. All subjects of Group AD could choose any one of the classes according to their level of physical fitness. The intensity of the dance exercise session corresponded to the intensity of 12 to 14 in Borg's ratings of perceived exertion (RPE) (Borg, 1970). Energy expenditure during this exercise session was calculated as approximately 200-250 kcal. To calculate the energy expenditure of this exercise session, 5 randomly selected

subjects performed the same exercise routine and exercise expenditure was assumed by $\dot{V}O_2$ changes during exercise. In Group JC, the exercise program consisted of aerobic exercise such as jogging and cycling 2-3 d/wk. Intensity of this exercise corresponded to the intensity of 12 to 14 in Borg's RPE scale, which approximated to lactate threshold (LT) level. The subjects were also required to attend a 60-min diet meeting once a week at which daily dietary records of each subject were reported. The duration of this program was 3 months. Other considerations, such as emergency management or clinical supervision, were based on recommendation made by American College of Sports Medicine (1995).

Measurements

All variables were measured pre and post our weight-loss programs.

Anthropometric measurements

Body mass was measured on a calibrated scale accurate to 0.01 kg. Skinfold thicknesses were measured to 0.1 mm at the triceps (back of the upper arm, halfway between the olecranon and the acromial process) and subscapular (inferior tip of the right scapula, following the diagonal line of the left edge of the scapula) regions on the right side of the body with an Eiken-shiki caliper (MK-60) calibrated to exert a constant pressure of 10 g/mm². The body density was computed according to the formula described by Nagamine and Suzuki (1964). The %fat was derived from body density according to the equation described by Brozek et al. (1963). Fat-free mass (FFM) was calculated by subtracting fat mass from total

Table 2 Alterations in dietary intake

	Total		Group AD		Group JC	
	(n=60)		(n=37)		(n=23)	
	Pre	Post	Pre	Post	Pre	Post
Total energy intake, kcal	1866.1 ± 452.3	1674.0 ± 360.7 *	1874.3 ± 478.0	1689.8 ± 353.5 *	1854.7 ± 419.8	1652.0 ± 375.6 *
Protein, g	66.4 ± 16.2	58.5 ± 14.6 *	66.4 ± 15.4	59.4 ± 14.2 *	66.5 ± 17.5	57.2 ± 15.2 *
Fat, g	67.0 ± 20.1	61.4 ± 17.5 *	67.8 ± 22.4	62.5 ± 68.1 *	65.9 ± 16.7	59.8 ± 16.9 *
Carbohydrate, g	237.5 ± 64.7	212.5 ± 49.3 *	238.9 ± 68.7	213.7 ± 48.4 *	235.5 ± 59.7	210.9 ± 51.5 *

*Significantly different from pre-value ($P < 0.05$).

mass. Circumferences were measured at breast (horizontal plane at the fourth costosternal joints during mid-tid volume) and waist (maximum horizontal girth of the torso at the same level or a little above the umbilicus). These measurements were taken by a trained investigator demonstrating good reliability using this technique ($r = 0.97$ and $r = 0.98$ for skinfold thickness and circumference, respectively).

Aerobic power

Maximal oxygen uptake ($\dot{V}O_{2max}$) and oxygen uptake corresponding to lactate threshold ($\dot{V}O_{2LT}$) as an index of aerobic power were determined during a graded exercise test, using a Monark cycle ergometer (Tanaka et al., 1986, 1989a). Following 2 minutes of warming-up at 0 watt, the work rate was increased every minute by 15 watts until exhaustion was reached. The frequency of pedaling was 60 revolutions per minute. During exercise, expired gas was analyzed continuously for O_2 and CO_2 concentration using standard techniques of open-circuit spirometry with the Mijnhardt Oxycon system or the Fukuda Sangyo IS-6000 system. $\dot{V}O_{2LT}$ was defined as the $\dot{V}O_2$ corresponding to the point at which blood lactate concentration exhibited a systematic increase above resting base-line value. To determine the LT, blood samples of 0.5-1.0 ml were taken from an antecubital vein through an indwelling needle every minute. All blood samples were analyzed by the electrochemical enzymatic method using a Yellow Springs lactate analyzer (model 23L). For establishing the LT, the $\log [\dot{V}O_2] - \log [la]$ transformation method was used.

Dietary intake

The subjects recorded food, drink and nutritional supplements ingested over a 3-month period. Dietary intake such as total energy, protein, fat, and carbohydrate, was calculated from the average of continuous five-day dietary records at pre and post training by a dietitian.

Statistical analyses

All values were reported as mean \pm standard deviation (SD). Comparisons of pre and post program were

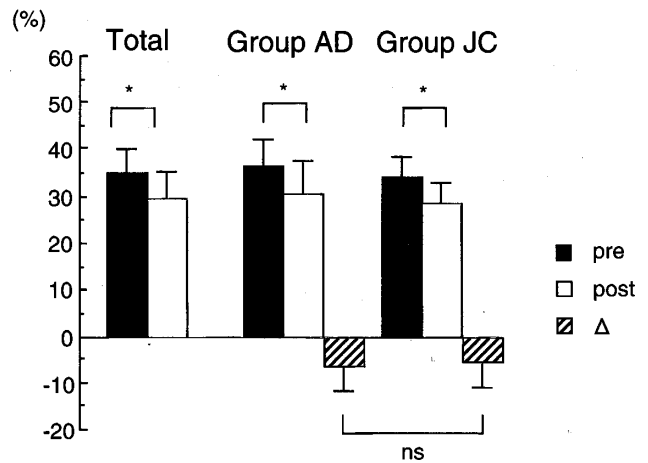


Fig. 1 Changes in %fat during weight-loss programs. * $P < 0.05$, ns: not significant.

analyzed by Student *t*-test. Unpaired *t*-test was used to evaluate the statistical significance of the difference between two pre means obtained from Groups AD and JC. In all analyses, the significance level was set at $P < 0.05$.

Results

The effects of our weight-loss programs on selected anthropometric, body composition, cardiorespiratory variables, and energy intake are presented in Tables 1, 2, and Fig. 1. Also included in the table are means \pm SD for these variables.

In all subjects, body mass and %fat decreased significantly ($P < 0.05$) on the mean basis. On the other hand, FFM marked a non-significant increase. $\dot{V}O_{2LT}$ and $\dot{V}O_{2max}$ improved significantly ($P < 0.05$). Energy intake as well as protein, fat, and carbohydrate significantly decreased ($P < 0.05$). In each group, body mass and %fat decreased significantly ($P < 0.05$), while FFM increased. Both $\dot{V}O_{2LT}$ and $\dot{V}O_{2max}$ improved ($P < 0.05$). Dietary status was significantly restricted ($P < 0.05$). Significant differences in the alterations in these variables between groups could not be seen.

Discussion

Wilmore (1983) mentioned in full detail that exercise training appeared to result in moderate losses in total body mass, moderate-to-large losses in fat mass, and small-to-moderate increases in FFM. The magnitude of these alterations varies directly with the frequency, intensity, and duration of the activity and the period of the study. However, it must be noted that the risk of adopting regular exercise for obese people could not be by-passed. Such risks consist primarily of musculoskeletal injuries due to heavier weight and a lack of exercise. As recommended by ACSM (1995), the initial exercise prescription should be based on low intensity and progressively longer durations of activity particularly for severe obesity.

Williford et al. (1989) showed in their edited review that the reported metabolic demands of aerobic dance differed depending on the style and the intensity of exercise. As mentioned in a previous paragraph, it is recommended that exercise training for obese people should use as low intensity as possible. Thus the present study we adopted the low impact aerobic dance as a major component for exercise program.

In the present study, body mass and %fat decreased significantly ($P < 0.05$), while FFM tended to increase. This is in accordance with well-designed studies of previous researchers (Forbes, 1991; Wilmore, 1983; Zuti and Golding, 1976), in which exercise and diet prescription lead to loss of a significant amount of fat mass but to slightly gained FFM. It has been well recognized that an extremely low calorie diet induces a significant amount of FFM loss (Stefanick, 1993). In the present study, FFM remained essentially unchanged, due probably to the continuation of physical training and an appropriate diet restriction with no difference between two groups. No subjects stopped participating in this program due to the musculoskeletal injuries in lower limbs. These results of this study suggest that our weight-loss program was effective from the view point of body composition alterations.

As expected, the weight-loss program over a 3-month period induced a significant increase in $\dot{V}O_{2max}$ (18%) or $\dot{V}O_{2LT}$ (17%), with no significant differences between groups with regard to the magnitude of increase (Fig. 2). These improvements in maximal and submaximal aerobic power are in agreement with previous studies using aerobic dance training for non-obese people (Blessing et al., 1987; Dowdy et al., 1985; Parker et al., 1989; Walberg, 1989; Williams and Morton, 1986; Williford et al., 1988). Gillett and Eisenman (1987) reported a rise of 41% in maximal aerobic power which surpassed what had been reported in other training studies. However, the length of the training period was longer than in other investigations (16 weeks vs 10 to 12 weeks). Several investigators, who

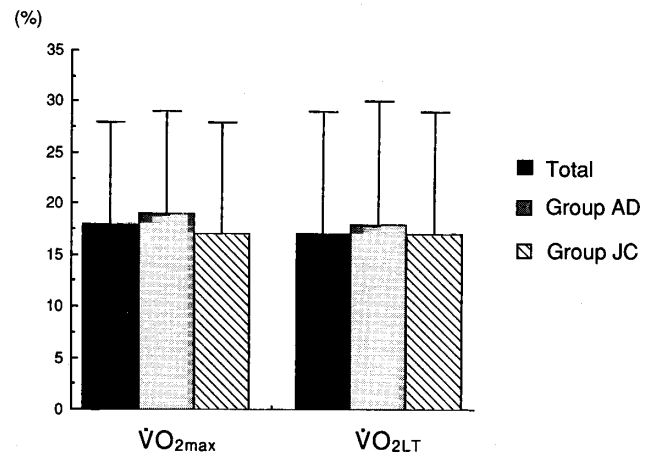


Fig. 2 Comparison of $\Delta\dot{V}O_{2max}$ and $\Delta\dot{V}O_{2LT}$ between Group AD and JC.

used 3-d/wk training regimen, have demonstrated significant improvements in maximal aerobic power following several weeks of dance exercise (Gillett and Eisenman, 1987; Moore et al., 1988; Williford et al., 1989). However, it seems that for women previously trained with traditional high impact aerobic dance, low impact dance may not be sufficiently demanding as a training alternative to maintain maximal aerobic power. Moore et al. (1988) reported that maximum oxygen uptake increased significantly following 12 weeks of low impact aerobic dance in a previously sedentary group of women. After following the same low impact program, a second experimental group consisting of females who had been high impact exercisers, showed a significant 6.6% decrease of maximum oxygen uptake. These reports suggested that, although our weight-loss program with low impact aerobic dance induced improvement in aerobic power, how to keep this effectiveness is debatable.

It may be worth pointing out, in passing, that the effects of exercise training depends on specificity of training modality (Tanaka et al., 1986, 1989a). An enhancement of aerobic system for a certain type of exercise such as running, cycling, or swimming, is most effectively achieved when the individual trains the specific muscles involved in the desired performance. This principle also stated that conditioning or training must be specific for not only developed the major energy systems involved, but also the specific muscle groups involved along with the exact movement of the skill (Shaver, 1981). It was expected that this theory applies to an aerobic dance. Therefore, it is inferred that the results of the subjects in the Group AD was underestimated. There is room for further investigation.

As already mentioned elsewhere in this paper, several studies have documented body composition changes by physical training (Forbes, 1991; Hill et al.,

1989; King and Tribble, 1991; Lohman, 1986; Prentice et al., 1991; Segal and Pi-Suyser, 1989; Tanaka et al., 1989b; Tanaka et al., 1993; Wilmore 1983; Zuti and Golding, 1976). However, there is no paper in which one research group designed exercise program using different training modalities for reducing body mass in the same occasion. Thus it is interesting to note that we conducted weight-loss program by the same researcher in the same occasion. This is a unique point of this study.

In summary, the results of the present investigation indicate that the weight-loss program using low impact aerobic dance induces a significant decrease in body mass. These alterations can be accompanied by a significant decrease in fat mass, maintaining FFM, with improvement in aerobic power. Therefore these favorable body composition alterations were well pronounced following our weight-loss program in obese middle-aged women. We concluded that low impact aerobic dance is a useful exercise modality for weight-loss in Japanese obese middle-aged women.

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