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AEROBIC DANCE: HEALTH AND FITNESS EFFECTS ON MIDDLE-AGED PREMENOPAUSAL WOMEN

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ABSTRACT

Schiffer T, Schulte S, Sperlich B. Aerobic Dance: Health and Fitness Effects in Middle-Aged Premenopausal Women. ***JEP****online* 2008;11(4):25-33. The goal of the study was to evaluate the long-term adaptations in endurance and strength as well as changes in blood lipoprotein concentrations after participation in an aerobic dance and fitness programme (AD) in middle-aged sedentary healthy women. Eighteen healthy women (Age 43±7 years) participated in the study. Subjects were randomly assigned to either a non exercising control group (n=8) or a training group (n=10). The training group exercised AD twice a week for 3 months. In addition to the anthropometric data and blood lipoproteins, endurance capacity and core muscle strength was analyzed before and after the training period. 12 weeks of AD training (ADI) decreased heart rate significantly at given running speeds ($p<0.05$) in an incremental field test. Strength tests showed an increase in abdominal muscle strength ($p<0.01$). The ADI did not result in any significant alteration of blood lipoproteins and body composition. Length and intensity of the ADI were not sufficient to evoke improvements in blood lipoproteins or body composition. Even though AD partly stresses intensive *anaerobic* metabolic pathways which are considered to have negative effects on blood lipoproteins low and high density blood lipoproteins were not impaired.

Key Words: Strength, Endurance, Lipoproteins, HDL.

INTRODUCTION

Elevated plasma low density lipoprotein cholesterol (LDL) and low plasma high density lipoprotein cholesterol (HDL) concentrations due to physical inactivity are a major cause for developing atherosclerosis related diseases (1). Physical activity per se as well as multidisciplinary approaches seems to be an appropriate treatment for lipid disorders (1-2). While aerobic exercise has a marginal positive effect on LDL concentration, HDL increases after 12 weeks of aerobic exercise in a dose related manner in men (3) and women (4). Results from different cross sectional studies of aerobic dance and fitness programmes (AD), corresponding to ACSM recommendations (5), demonstrate a positive stimulus for cardio-vascular exercise (6), which is as effective as classical aerobic sports.

In contrast to the well established physiological effects of AD compared to aerobic endurance training and to a lesser degree compared to resistance training, there is little information about the impact of AD on plasma lipoprotein concentrations. The movement pattern in classical endurance training interventions which result in an increase of HDL is characterized by continuous cyclic movements of a single type as it is in jogging, cycling or walking (4). In contrast AD consists of a mixture of varying exercise pattern with high and low impact styles, the use of external weights and an individual selectable intensity. The contribution of the energy systems to aerobic dance, as with any sport, will be mixed and is dependent upon the intensity of the exercise. Even during maximal intensity exercise there is a contribution from aerobic metabolism albeit being small (7). The increase in blood lactate during AD reflects a relatively high intensity. Anaerobic exercise with blood lactate (La) values above the anaerobic threshold (8), defined as the increase above or equal to a level of 4.0 mmol$\bullet$l^{-1} blood lactate), as they appear in AD, have been suggested to have negative effects on blood lipoproteins, which could be mediated by a direct exercise-induced inhibition of the lipolysis by La (9-10). There exist no data about the impact on blood lipoproteins after participating in AD for sedentary healthy middle-aged women.

The goal of the present study is to evaluate the long term adaptations concerning endurance and strength as well as alterations of blood lipoprotein concentrations after participation in a common AD in sedentary healthy middle-aged women.

METHODS

Subjects

Eighteen inactive healthy women were recruited by advertisements in a fitness-studio and were randomly selected into two groups. One group (mean ± SD: Age 42.2±8.2 years, height 169.2±5 cm, body mass 63.8±8 kg) participated on an aerobic dance and fitness programme (AD) for 3 months, twice a week, the other group served as a physically inactive control group (Age 44.4±4.5 years, height 166.2±9.4 cm, body mass 60.5±9.3 kg). We recruited middle-aged healthy and sedentary participants, who were classified as pre-menopausal according to their medical history. They reported no active participation of any kind in aerobic or resistance exercise programmes for the last 2 years prior to the training period. The women were working predominantly in a sitting position with occasional requirements to move. None of the subjects used regular pharmacological agents, tobacco or alcohol. All subjects were requested to continue their regular lifestyle and eating habits during the study. The subjects completed a medical examination and signed a consent form before beginning the study. The study was approved by the local ethics committee.

Procedures

Physical fitness tests

The participants were instructed to remain physically inactive one week prior to the test-period. Nutrition was standardized 2 days before the tests. Physical fitness tests during the test-period were carried out before and after the training period. In order to assess strength abilities of the core muscles the subjects underwent the „one minute half sit-up test of abdominal strength and endurance“, for testing dynamic strength of abdominal muscles (11) and the „lumbar trunk muscle endurance testing“ quantifying isometric strength of the autochthonous dorsal muscles (12). On a second day in the test period the subjects` endurance was assessed by a progressive incremental field test to exhaustion (IFT). The test took place on a 400 m track. All subjects participated at least 4 stages, starting at a speed of 1.5 $m{\cdot}s^{-1}$ at the first stage. With every stage, the speed was increased by 0.5 $m{\cdot}s^{-1}$. The average stage lasted 5:03 minutes, plus or minus 0:37 seconds. Between every stage there was an interception one minute at the most for collecting capillary blood lactate. In order to provide a constant speed we used pylons, which were placed every 50 m on the track. An electronic time transmitter provided an acoustic signal with constant delay time every 50 m, which was adjusted to the necessary speed. Heart rate (HR) was recorded continuously with Polar Vantage XL (Polar Electro, Kempele, Finnland). La was analysed from the ear-lobe (BIOSEN C line, EKF-diagnostic GmbH, Barleben, Germany). HR and La were measured prior to the test and at the end of every stage.

Body composition and lipoprotein determinations

For the estimation of body fat we used the skin fold thickness method, measuring skin fold thickness at 10 standardized sites modified according to Parizkova (1963). Anthropometric data and body composition were assessed prior to the blood collection. Venous blood samples were collected in EDTA vacutainers under standardized conditions after an overnight fast at the identical time of day in the pre and post test. Blood lipid concentrations were determined with a cholesterol reagent system (Abx Diagnostics, Montpellier France) using the Cobas Mira Plus System (Hoffmann La Roche, Basel, Switzerland) according to the manufacturers instructions. Levels of LDL were calculated by the formula of Friedewald (1972).

Training intervention

The AD was composed of 10 parts. The complete programme lasted 60 minutes. The 9-minute warm up consisted of light dynamic drills for mental and physical attuning for the upcoming load. Afterwards, six 5-minute interval bouts followed in the main section in which endurance and strength units altered systematically. The training was performed to special music in synchronisation with the programme. The beat in every part of the accompanying music was set at 124 to 134 bpm. Most of the movement drills were performed at low impact, whereas the subjects were allowed to choose high impact versions depending on their individual constitution. A 5 kg heavy neoprene tube (Soft Weights, Alex Athletics, Essen, Germany) and 1 kg heavy wrist cuff (Mini Weights, Alex Athletics, Essen, Germany) were used as training devices during the strength units. The strength section with weights for upper and lower extremities was conducted dynamically with at least 15 repetitions, according to recommendations for enhancing local muscular endurance (15). Dynamic abdominal strength exercise was predominantly performed in the last strength unit. A 10-minute passive relaxation period followed, which aimed to increase body perception by individual reflection on the accomplished training. Finally, a 9-minute active relaxation period was performed which consisted of active stretching and light dynamic movement (Cool-down).

The achieved training effects of a single unit of the AD were measured in a pre-examination, in which 35 middle-aged sedentary healthy women were separated into three homogenous groups. They performed a standardized unit of the AD on three following days at identical daytime in their fitness club. Heart rate was monitored continuously. La was measured immediately before the start of the programme and after every part (11 samples).

Statistical Analyses

The statistical evaluation was performed with Statistica (Version 6.0, StatSoft, Tulsa, USA). Factorial analysis of variance was used to assess statistical differences with repeated measures (ANOVA, Newman-Keuls). Data is expressed as mean values (SD). The significance level for all analyses was set at p=0.05. HR and speed from the IFT were related to the blood lactate at the aerobic-anaerobic threshold at 4 $mmol \cdot l^{-1}$ La (La4) and at 2 $mmol \cdot l^{-1}$ La (La2) by interpolation.

RESULTS

The pre-examination of a single session of the AD showed a small increase ($p<0.05$) in HR during the warm-up period and a significant increase ($p<0.01$) in the six endurance and strength parts for the HR (between 142±17 and 157±20 bpm) and La (between 2.9±1.5 and 3.4±1.3 $mmol \bullet l^{-1}$). HR and La decreased ($p<0.01$) during the 10 minute relaxation period to baseline and increased slightly ($p<0.05$) during the stretching and cool-down (Figure 1). We measured these effects in all groups without any significant changes between the groups.

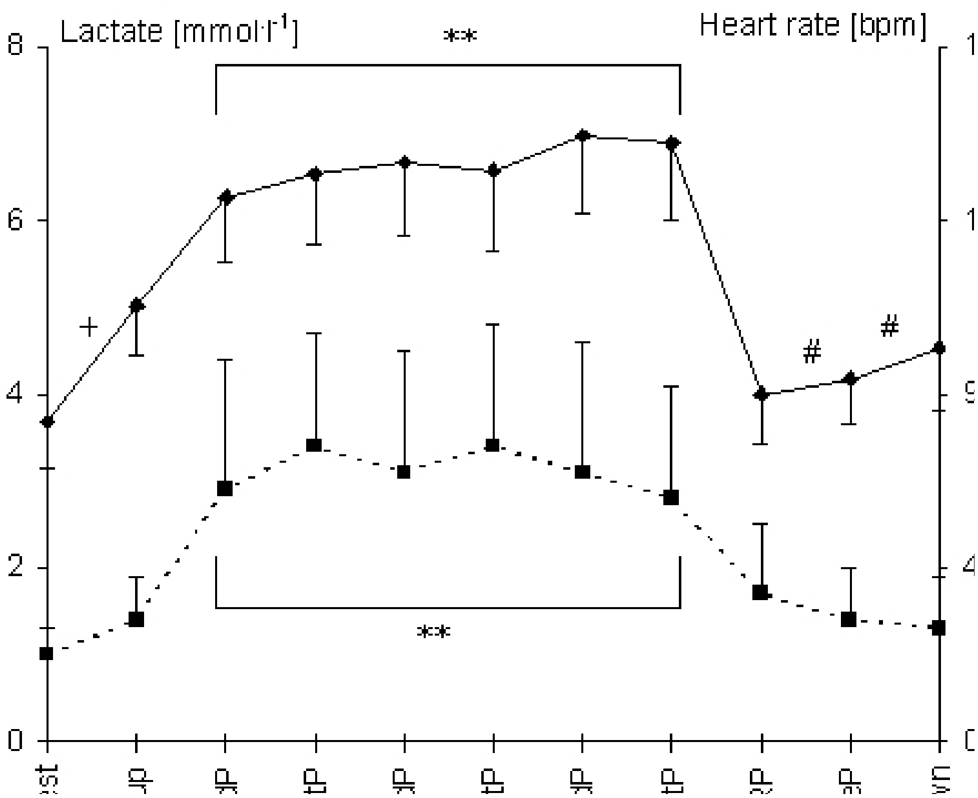

Figure 1. Data of the pre-examination of the aerobic dance and fitness programme. **Heart rate (—?—) and capillary blood lactate (--¦ --) (mean±SD) increased significantly (p<0.01) during the endurance (EdP) and the strengthening (StP) period compared with all other parts. +Significant increase of the heart rate after the warm-up. #Significant increases (p<0.05) of the heart rate after the passive relaxation period (PRP) with the

After the training period HR decreased ($p<0.05$) during the stages 1.5, 2 and 2.5 $m \cdot s^{-1}$ of the IFT significantly in the training group (Fig. 2) during the incremental field test, while there were no significant changes in the control group. Resting HR before and after the training remained unchanged. In pre-post tests there were no significant changes in La. There was no inter-group difference or speed of movement at La2 and La4 (Table 1). For the training group HR was lower ($p<0.05$) at La2 in the post test (141±19 bpm) as compared to the pre test (156±14 bpm). There was a significant change ($p<0.01$) in abdominal strength endurance in the training group after the training period (See Tab. 1) as measured in the one minute half sit-up test. Isometric strength of autochthonous dorsal muscles did not change significantly after training. Table 2 shows that there were no changes in triglycerides, total cholesterol, LDL, HDL, LDL/HDL and the body composition.

DISCUSSION

The combination of strength and endurance training in AD failed to improve blood lipid concentrations in premenopausal middle-aged inactive women, but improved their abdominal strength and submaximal running performance. The improved submaximal running performance is comparable to results from classical aerobic exercises (16) and other AD studies (17-18). Even though classic aerobic exercise is efficient for improving blood lipoprotein concentrations in women (19), there is only sparse information to be found on the effect of AD on blood lipoprotein concentrations. The review performed by Kelley et al. (20) on aerobic exercise and lpids and lipoproteins in women includes only 4 AD studies. The data of this review and other studies that looked at overweight (21) women, healthy college students (18,22) or heterogenous (23) groups are in accordance with our data. Studies and data are especially lacking for the group of premenopausal healthy women.

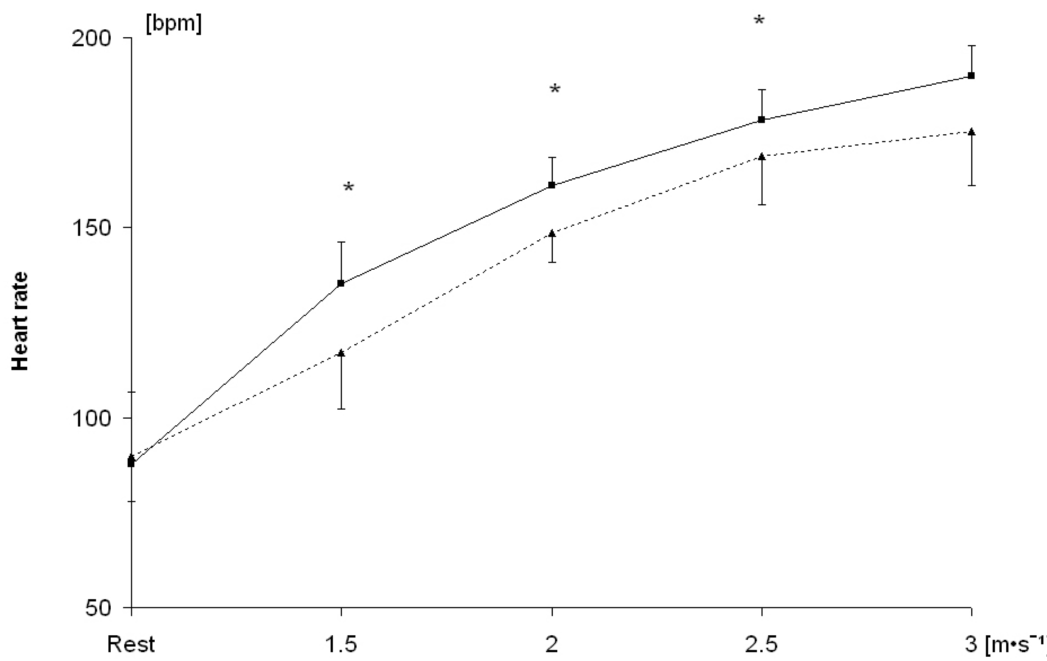

Figure 2. Heart rate (mean±SD) of the training group increased in the pre and the post incremental field test from stage to stage (p<0.01). *Significant lower (p<0.05) heart rates in step 1.5, 2 and 2.5 ms^{-1} after the training (--? --) compared with pre training values (—¦ —).

Intensity in aerobic dance and lipoproteins

Blood lipoproteins remained unchanged in this study, although AD interventions partially stress anaerobic pathways, which are known to cause decrease HDL (9). A reason for anaerobic metabolic

Table 1. Changes in strength and heart rate at fixed lactate values of 2 $mmol \cdot l^{-1}$ (La2) and 4 $mmol \cdot l^{-1}$ lactate (La4).

Variable	*AD*		*Control*	
	Pre	*Post*	*Pre*	*Post*
Half sit-up test (repetitions)	21±11	30±12*	28±13	27±17
Lumbar trunk muscle endurance test (seconds)	114±70	143±40	152±80	147±38
Heart rate at La2 (bpm)	156±14	141±19*	142±16	151±14
Heart rate at La4 (bpm)	174±10	165±14	163±7	167±8

Note: *Significantly different from the pre test values. Data are means ± SD.

pathways in AD is a mixture of varying exercise patterns, high impact styles, high intensity exercise, and the use of weights for resistance exercise (24-25). Data from De Angelis et al. (26) showed that to meet the body's energy demands in AD it is also necessary to utilise anaerobic lactic pathways. Our data in combination with the data from our pre-examination indicate that at identical heart rates higher blood lactate concentrations are reached during "aerobic dance" compared to the incremental field test pointing at relatively high involvement of anaerobic metabolism in AD. Heart rates of 140-156 bpm at lactate concentrations of 2 mmol•l^{-1} during the incremental field test are confronted with lactate values of 2.9-3.4 mmol•l^{-1} at almost identical heart rates (142-157) in the subjects of the pre-study during their AD session. This is certainly lower than the data in DeAngelis (26) and even lower than OBLA. It is certainly clear that AD is not predominantly anaerobic, but nevertheless within an hour training session anaerobic parts occur. However, explanations for the absence of improvements of the blood lipoproteins in AD are in parts speculative. For continuous cycling exercise elevated plasma lactate (La) levels are known to inhibit lipolytic enzymes (10), which could be mediated by decreased pH as a result of increased La. Aellen et al. (9) showed a positive correlation for the LDL

Table 2. Changes in blood lipoproteins and body composition of the subjects for the aerobic dance intervention group (AD) and the control group without significant changes.

Variable	*AD*		*Control*	
	Pre	*Post*	*Pre*	*Post*
Triglycerides (mg · dl^{-1})	101±52	116±64	94±31	104±37
Total cholesterol (mg · dl^{-1})	206±37	199±36	194±32	205±37
LDL (mg · dl^{-1})	127±31	118±32	116±21	122±30
HDL (mg · dl^{-1})	60±12	59±13	59±15	62±12
LDL/HDL	2.1±0.7	2.0±0.7	2.0±0.5	2.0±0.5
Fat (%)	21.3±2.4	20.0±2.2	17.7±2.6	17.1±2.4
Fat free mass (kg)	50.1±5.6	51.0±6	49.8±7.3	49.8±8
BMI (kg m^{-2})	22.2±2.1	22.3±.27	21.8 ±1.5	22.0±1.6

Data are means ± SD

to HDL ratio with the training intensity after 9 weeks of continuous endurance training. Causal for this effect on the LDL to HDL ratio was a significant decrease of HDL in a high intensity training group compared with a low intensity training group. There is also evidence for intensity dependent adaptations of blood lipoproteins during AD (27). However, contrary to the results during continuous endurance exercise they reported an increase of HDL after participating in an interval step programme (subjects performed intermittent step patterns and various dance movements of classic AD) compared with no changes in HDL in a group participating in a continuous step programme. According to their described methods Mosher et al. (27) used high impact AD figures, which are known to produce relatively high La. Even though La was not measured, the authors assumed that the increasing HDL concentrations were possibly because of the greater exercise intensity in the interval exercise group.

Strength effects in aerobic dance and lipoproteins

The intermittent nature of our study consisted of an alternating pattern of endurance and strength units which resulted in improved abdominal strength. Resistance exercise is also known to increase La (28). Thus, according to the impact of La on blood lipoproteins, there should be no positive effects after resistance training on HDL or LDL. Data from LeMura et al. (29) and Manning et al. (30) appear to substantiate this conclusion. Regarding the effects of resistance training on blood lipoproteins in young and in obese women they measured no changes of LDL or HDL after a 3-4 month training period with 2-3 sets of 60-70% of 1RM and 8-10 repetitions (29-30). In contrast to these studies there are reports of improved HDL after hypertrophy resistance training in older women (31) and improved

LDL in young women (32). Strength endurance training with intensities comparable to our study design showed no changes in HDL and LDL in postmenopausal women (33) and slightly improved LDL in postmenopausal women with type 2 diabetes (34). Our data, for premenopausal women confirm data from Boyden et al. (35) concerning HDL. On the other hand, we could not reconfirm their positive results for LDL (35).

Exercise variables in aerobic dance and lipoproteins

Apart from the relatively high intensity of the exercise, the lack of effect of AD on lipoproteins could be related to an insufficient duration and length of the programme. Current studies on the influence of AD on blood lipoproteins in women cover an examination period of 8 to 16 weeks (21-23,27,36). The length of aerobic exercise sections in AD studies was 20-30 minutes (21-22,36). Warm-up and cool-down sections were performed in addition to stretching and strength sections to round out the rest of the 40 to 50 minute long programmes (21,22,27,36). The actual aerobic exercise time is short compared to classic aerobic intervention studies. The relatively slim amount of 2-3 training sessions per week in AD compared to 5 sessions per week in aerobic conditioning programmes (4) seems to be a further factor in the missing positive effects on blood lipoproteins. However, given that the evaluated programme in this study is typical for many of the commercially offered AD it seems that the number of training sessions per week or the duration of a single session is too short to be an efficient stimulus to increase the HDL/LDL ratio and provide a cardiovascular health benefit.

Considering that AD is one of the most popular sports among middle-aged premenopausal women desiring health benefits, there are relatively few studies on the effects of AD. Unfortunately, previous studies on AD did not measure oxygen-uptake, lactate and heart rates during the single sessions to evaluate the effects of the training sessions. De Angelis et al. (26) and with a lesser content our data indicate that the subjects in AD chose intensities during their sessions, which involve anaerobic metabolism pathways additionally to aerobic sources for their energy supply. Nevertheless also classical endurance disciplines like running, walking, swimming and cycling may lead to intensity dependent lactate increases. Future studies on the effects of AD on blood lipoproteins should include an evaluation of the individual sessions and alter the conditioning parameters to include an increased duration, a decreased intensity, and an increased frequency of the programmes.

CONCLUSIONS

The duration, length and frequency of the evaluated aerobic dance and fitness program have no cardiovascular health benefits based on the blood lipoprotein profile. This indicates that it is necessary to increase either intensity, duration or frequency of the exercise conditions in aerobic dance and fitness programs if health benefits are desired. Independent from health benefits participating in an aerobic dance and fitness program is useful for achieving a better strength of the core muscles and for decreasing the heart rate during a given submaximal running intensity as an indirect parameter for aerobic fitness in sedentary healthy middle-aged women. Although aerobic dance and fitness programmes are often perceived as a kind of moderate intensity exercise these programmes also include intensive anaerobic metabolic demands. Thus, medical examinations are advisable before engaging in AD just as it has been suggested for other endurance sports.

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