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Original Article

Effects of high intensity aerobic training and circuit training on body composition in fitness men

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Abstract:
The aim of this study was to compare the effects of four weeks of high intensity aerobic training and circuit training on body composition in physically active men. The two groups were monitored with the use of Polar H7 heart rate sensors, connected with the Polar Team heart rate detection system (Polar electro Oy, Kempele, Finland), while for the evaluation of body composition the Tanita Analyser MC-780MA was used (Tanita, Tokyo, Japan). The results obtained showed that the aerobic training group (AT) showed significant differences in BMI (Table 2, Δ=0.2), body mass (Table 2, Δ=0.9), fat mass (Table 2, Δ=0.9), and fat mass percentage (Table 2, Δ=0.9), except in the lean mass (Table 2, Δ=0.0); the circuit training group (CT) also showed a significant reduction in all body composition parameters (Table 2), including lean mass (Table 2, Δ=0.3). There were no significant differences in body composition parameters between the AT and CT groups (Table 2) after the training program, except for lean mass, which increased significantly only in the CT group (Table 2, Δ=0.3). In conclusion, the present study suggests that high-intensity aerobic training or high-intensity circuit training produces similar benefits in improving the body composition in physically active men, even when their diet is not controlled.
Key words: weight loss, body fat, energy expenditure, exercises.

Introduction

It is widely known that a regular physical activity is the main factor responsible for the improvement of body composition (D'Isanto et al., 2019, Raiola, D'Isanto, 2016, Fett et al., 2009; Park et al., 2003). Aerobic training (AT) has been shown to increase energy expenditure and influence weight and body fat reduction, while endurance training influences the maintenance or the increase in lean mass (Park et al., 2003). Previous research suggests that AT is a powerful strategy for weight loss, particularly for body fat loss; increases the maximum oxygen consumption that is closely related to the body fat percentage (Donelly et al., 2013, Oda et al., 2014). Chaudhary et al. (2010) reported that AT increases energy expenditure and influences the reduction of body weight and body fat percentage. On the other hand, other researchers have shown that circuit training (CT) is very effective for increasing maximum oxygen consumption, maximum lung ventilation, functional capacity and strength, while improving body composition (Brentano et al., 2008; Harber et al., 2004). CT is an exercise mode designed to simultaneously stimulate the metabolic and muscular system. This type of training consists in a series of resistance exercises involving different muscle groups. For each exercise, 10-15 repetitions are performed, using a load between 40-60% of the maximum load (1-RM). Each exercise is usually completed within 30-40 seconds, then the participant quickly moves from one exercise to another with 15-30 seconds of recovery between stations. The circuit is repeated from one to several times, depending on the level of fitness, for an actual training duration of between 20-40 minutes (Romero-Arenas et al., 2013). Therefore, AT is normally used for weight control and for the reduction of body fat (Fett et al., 2009); while, CT implies mixed metabolic-muscular characteristics and produces good results in terms of body fat reduction, increased lean mass and improved fitness (Ross et al., 2000; Watts et al., 2004), however, it is not yet clear which of the two types of training is most effective. Therefore, the aim of this study was to identify the most beneficial mode of exercise to promote improvements in body composition in fitness men.

Materials and methods

Participants

Twenty-two men (28.6 ± 3.6 years, 181.1 ± 7.3 cm tall, 82.4 cm ± 11.4 kg of body mass) participated in the study, who regularly exercised 3-4 times a week for at least 1 year. Volunteers were randomly assigned to one of the two groups: Aerobic-training group (AT, n=11), and Circuit-training group (CT, n=11), and were instructed not to change their nutritional habits during the study period. Subjects who performed other types of training, with physical problems and who used weight loss medications and supplements for the nutritional

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supplement, were excluded from the study. Prior to the start of the study, all participants received a detailed explanation of the training program and tests and signed the written consent for participation in the study.

Variables

A Seca 206 stage meter (Seca, Hamburg, Germany) and a Tanita MC-780MA body composition analyzer (Tanita, Tokyo, Japan) were used to assess body composition. Treadmill Technogym Excite 1000 (Technogym, Cesena, Italy) were used for aerobic training and maximum heart rate measurement, while Technogym Selection machines (Technogym, Cesena, Italy) were used for circuit training and maximum load estimation. The two groups were monitored using Polar H7 heart rate sensors, which were connected to the Polar Team heart rate detection system (Polar Electro Oy, Kempele, Finland).

Experiment details and procedures

All subjects performed the tests in minimum clothing, before and after 4 weeks of training, and on two separate days. One day the body composition assessment and the maximum load test was carried out; another day the maximum heart rate was measured. The tests and training programs were carried out with the control of experienced operators inside the fitness center, where the air temperature ranged from 18 degrees to 20 degrees Celsius.

Body composition

The height was measured with a Seca 206 stage (Seca, Hamburg, Germany) with an approximation of 0.1 cm. BMI, body mass, fat mass, fat percentage and lean mass were detected with a Tanita MC-780MA body composition analyzer (Tanita, Tokyo, Japan). The body composition analyzer measures impedance on the legs, trunk and arms. Previous studies suggest that bioelectric impedance (BIA) analysis is a simple and accurate method for analyzing body composition (Kawakami et al., 1994). As described by Rech et al. (2008), participants were asked to avoid certain procedures before measuring body composition: do not to perform any exercise in the 12 hours before the test, not to eat or drink anything in the 4 hours before evaluation, urinate at least 30 minutes before the assessment, not to take any diuretics in the 7 days before the test, and not to consume alcohol in the 48 hours before the test.

Maximum load (1-RM)

The maximum load test (1-RM) was carried out only by the subjects of the circuit-training group and after the body composition assessment test. Before the test, participants performed 6 minutes of running on progressive-intensity treadmill and then 2-3 sets of 4-5 specific muscular preparation repetitions, during which weight was gradually increased. Each subject had a maximum of 5 tests to reach his load of 1-RM, with 3 minutes of recovery between tests (White et al., 2015). The maximum load was assessed on 8 exercises: leg press, shoulder press, deadlift, bench press, lat pulldown, smith sit-up, triceps pushdown and biceps cable curl. Throughout the procedure, each subject was followed and encouraged by the same operator.

Maximum heart rate (HRmax)

The maximum heart rate (HRmax) was measured in all subjects who participated in the study and 2 days after the 1-RM test. Before the test, participants run 6 minutes on a progressive-intensity treadmill; They then underwent a maximum incremental running test on treadmill MU-TT (Montreal university track test) (Ahmaidi et al., 1992). The starting speed was 8.5 km/h and was increased by 1 km/h every 2 minutes; the slope was fixed at 1%. The trial was protracted until it was effectively exhausted. During the test, each subject wore a heart rate sensor for maximum heart rate detection and was followed and encouraged by the same operator.

Training program

The week following the test procedures, participants performed aerobic training and circuit training twice a week for 4 weeks. All training sessions were supervised by experienced operators; no other activities were performed outside the study protocol. Aerobic training (AT) lasted 45 minutes. Each training session began with a 10-minute activation phase on progressive-intensity treadmill (70-80% HRmax) and 3 flexibility exercises, performed one after the other, lasting 30 seconds each repeated 3 times: 1 exercise for the upper limbs and 1 exercise for the spine. In the next phase, participants ran 30 minutes at constant intensity (80-85% HRmax). Both workouts were continuously monitored using Polar H7 cardio bands, connected with the Polar Team heart rate monitoring system (Polar Electro Oy, Kempele, Finland). The circuit training (CT) lasted 45 minutes. Each training session began with an activation phase that included 10 minutes of running on progressive-intensity treadmill (70-80% HRmax) and 3 flexibility exercises, performed one after the other, lasting 30 seconds each repeated 3 times: 1 exercise for the lower limbs, 1 exercise for the upper limbs and 1 exercise for the spine. Next, the subjects performed 30 minutes of resistance exercises for the main muscle groups, divided into 8 stations: leg press, shoulder press, deadlift, bench press, lat pulldown, smith sit-up, triceps pushdown and biceps cable curl. For each station, 10 repetitions were performed (at a rate of about 2 seconds per repetition) with 60% of the maximum load (1-RM). Recovery between stations and between circuits varied between 15-30 seconds, so that each subject was able to maintain a tendentially constant heart rate (80-85% HRmax). A detailed description of the training program is presented in Table 1.

Table 1. Description of 4 weeks of Aerobic Training and Circuit Training

	Aerobic training	**Circuit training**
Frequency	3 times / week	3 times / week
Duration	45 min (10 min warm-up; 5 min flexibility circuit; 30 min running)	45 min (10 min warm-up; 5 min flexibility circuit; 30 min resistance exercises: 10 reps 60% 1-RM for each exercise; rest 15-30 sec)
Intensity	~ 80-85% HRmax	~ 80-85% HRmax
Type of activity	Continuous running	Resistance exercises: leg press, shoulder press, deadlift, bench press, lat pulldown, smith sit-up, triceps pushdown e biceps cable curl

Data processing methods

Before proceeding with the statistical analysis, the normality of the distribution of the data was verified with the Shapiro-Wilk test and the homogeneity of the variance with the Levene test. The test-t for dependent samples was used to identify pre-post-workout differences within each group. For the pre-post-workout comparison between the two groups, the test-t was performed for independent samples. The data was reported as an average of SD, and the statistical significance level was set to $p<0.05$. SPSS 17.0 (SPSS Inc, Chicago, IL, USA) software was used for data analysis.

Results

Twenty-two physically active men completed the study (AT, n.11; CT, No.11). The age of the volunteers was 29.4 ± 3.4 years for the AT group and 27.9 ± 3.8 years for the CT group. The other features are presented in Table 2. Prior to the training program, no significant differences were found between the two groups. This data reassure the homogeneity of the chosen sample. At the end of the 4-week training session, the AT group showed significant differences in BMI (Table 2, Δ=0.2), body mass (Table 2, Δ=0.9), fat mass (Table 2, Δ=0.9), and fat mass percentage (Table 2, Δ=0.9), except in the lean mass (Table 2, Δ=0.0). After 4 weeks of training, the CT group also showed a significant reduction in all body composition parameters (Table 2), including lean mass (Table 2, Δ=0.3). There were no significant differences in body composition parameters between the AT and CT groups (Table 2) after the training program, except for lean mass, which increased significantly only in the CT group (Table 2, Δ=0.3).

Table 2. Body composition parameters for fitness men before (Pre) and after (Post) 4 weeks of Aerobic Training and Circuit Training

	Aerobic Training			**Circuit Training**		
Variables	PRE	POST	Δ	PRE	POST	Δ
BMI (kg/m^2)	25.1±2.6	24.9±2.5#	-0.2±0.2	24.8±1.5	24.6±1.5#	-0.2±0.1
Body mass (kg)	82.8±13.4	81.9±13.0#	-0.9±0.4	81.9±9.7	81.2±9.4#	-0.7±0.4
Fat mass (kg)	13.6±4.2	12.7±4.0#	-0.9±0.4	12.3±4.4	11.3±4.1#	-1.0±0.4
Fat mass (%)	16.4±3.6	15.5±3.7#	-0.9±0.3	14.8±3.8	13.7±3.7#	-1.1±0.4
Lean mass (kg)	68.6±11.0	68.6±11.0	0.0±0.1	66.8±7.4	67.1±7.4#	0.3±0.1*

Means ± SD; comparison in each group were for PRE vs. POST; between groups were at baseline (PRE) and for variations Δ=POST-PRE
# significant difference versus baseline; * significant difference of variations, Circuit Training vs. Aerobic Training
BMI = Body Mass Index

Discussion

The present study aimed to compare the effects of 4 weeks of aerobic training and high-intensity circuit training on body composition in physically active men. Although the study did not foresee changes in eating habits, BMI, body mass, fat mass and fat mass ratio showed a marked reduction in both groups after the training program, with no significant differences between the Groups. The results are similar to those of other authors who have seen improvements in body composition, in different subjects, as a result of an aerobic or high-intensity circuit training, even in the absence of caloric restriction (Chiu et al). , 2017; Fett et al., 2009; Ibaeez et al., 2005; Miller et al., 2014; Paoli et al., 2010, 2013; Romero-Arenas et al., 2013; Shaw et al., 2016; Strasser & Schobersberger, 2011). Consistent with other studies, the observed changes in lean mass are influenced by the type of exercise. Previous studies, in fact, suggest that aerobic training does not cause significant changes in lean mass (Chiu et al., 2017), while circuit training involves a modest improvement in lean mass (Harber et al., 2004; Hunter et al., 2000). According to our results, the two protocols produce similar effects on body composition, probably due to the high intensity of exercise. This is in accordance with a study by Paoli et al. (2010), which suggests that a medium-high intensity workout is more effective for improving body composition than a low-intensity workout of the same working duration. A review by Steele et al., (2012) also shows that acute metabolic and molecular responses to high-intensity resistance training (i.e. performed at momentary muscular failure) are similar to those of traditional aerobic training. In fact, both aerobic training and circuit training, performed at high intensity, can significantly reduce body mass and body fat (Irving et al., 2008; Lee et al., 2012). The possible explanations of the effect of exercise intensity on control of body composition are that high-intensity exercise can increase the release of catechim and growth hormone (Boutcher, 2011), as well as expenditure activity and consumption of oxygen post-exercise (Mann et al., 2014). In addition to the benefits of this work, some limitations should be highlighted. First, the sample of participants was small and was male only; In addition, the subjects did regular training and the study was only 4 weeks during which the volunteers were not subjected to a controlled diet. Therefore, further studies could provide more accurate results regarding the effects of an aerobic or high-intensity circuit training on body composition.

Conclusion

In conclusion, this study suggests that, an aerobic or high-intensity circuit training program produces similar benefits if you want to improve body composition in physically active men, even when their diet is not controlled. However, further investigation will be useful in understanding whether the observed improvements in body composition are related to intensity and not to the type of exercise.

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