Original Article (short paper)

Influence of menopause on body fat induced by aerobic training

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Abstract — Aims: to compare the influence of menopause on body fat, induced by a physical training program. **Methods**: Twenty-one sedentary women, 10 postmenopausal (MN; 54.6 ± 5.1 years, 42.9 ± 4.1 % body fat) and 11 in the ovulatory state (OS; 35.1 ± 5.4 years, 44.1 ± 5.5 % body fat), performed a training program with aerobic exercise (12 weeks, five times / week, 60 minutes per session). Before and after this program, the following measurements were taken: sum of skin fold (∑D), body fat percentage (%F), waist-hip ratio (WHR) and abdominal circumference (AC). **Results:** MN and OS significantly reduced ΣD (38.5 ± 25.1 mm and 27.7 ± 19.4 mm, respectively), but without differences between the groups. MN group women obtained relative reduction in the suprailiac fold, significantly greater than OS (25 ± 10 vs. 11.5 ± 12 mm), and also a greater reduction in the %F (13.5 ± 8% vs. 6.6 ± 6%). There were very slight reductions in WHR in both groups (0.009 ± 0.02 and 0.005 ± 0.03 in MN and OS, respectively), as well as AC (reduction of 3.5 ± 3 cm and 3.9 ± 2.9 cm for MN and OS), with no differences between groups. **Conclusion**: The postmenopausal women responded to a training program with a greater reduction of body fat, but in only one of four evaluated body composition variables.

Keywords: menopause, exercise, body composition, aerobic exercise.

Introduction

Scientific evidence shows that overweight / obese individuals tend to choose exercise as one of the first intervention options for weight loss[1,2]. In spite of this phenomenon, protocols involving interventions with aerobic training alone have demonstrated a very discrete weight loss, with an average fat loss of up to 2 kg in adults[3,4] or even a gain of body weight[5].

With women in the ovulatory state (OS), understood as having a normal reproductive and menstrual cycle, Kostrzewa-Nowak et al.[6] verified a 3.0% body fat loss and Foster-Schubert et al.[7] found a reduction of 1.6% of body fat in postmenopausal women (MN). In these same studies, individual analyses revealed that in the same training program, some participants gained body fat, thus indicating a variability in weight loss induced by training programs, which is confirmed in other studies[1,8]. As a result, recent research has investigated factors that explain greater weight loss in some and only modest results in others.

Negative metabolic changes promoted by menopause, such as increased systemic inflammation and increased insulinemia are factors that stimulate adipogenesis and inhibit lipolysis[9-11] and have been identified as factors that make it difficult to lose weight when induced by physical training[12]. However, in previous studies, greater weight loss may occur in people with higher initial body mass[13,14], which may be the case for MN women in relation to OS.

Although the status of ovulatory capacity may be a variable involved in weight loss induced by physical training, and there are studies in which the researchers were careful to adopt the status of menopause as an inclusion criterion[15], neither of the two populations were compared in the same program training.

The evident metabolic differences between women in OS and MN allow us to hypothesize that menopause may exert a greater resistance to the effects of physical training on body composition. Thus, the objective of this study was to evaluate the influence of menopause on the magnitude of changes in anthropometric measures directly associated with body fat: skinfolds, fat percentage, waist-hip ratio and waist circumference.

Methods

Participants

The number of subjects calculated to compose each group was based on the effect size. For this, we adopted previous data in our pilot study on the alteration of one of the main dependent variables of the present study. The percentage of fat was chosen. The effect size was 0.88. Adopting a statistical power of 0.85 and a confidence level of 0.05, it was estimated that the minimum size of each group would be 11 women.

21 women who were physically inactive based on IPAQ[16], for at least three months participated in this study recruited from visits to a Family Health Program. Of these, 11 were in normal OS (35.1 ± 5.4 years) and 10 were MN (54.6 ± 5.1 years). To be included in the study, MNs menstrual cycles needed to have ceased at least one year prior to the study. The exclusion criteria were: to statistically modify the dietary pattern during the study; to perform hormonal replacement during the study; to use supplements and / or hypoglycemic drugs or exogenous insulin, or medication for cholesterol or triglyceride and antiarrhythmics; to become pregnant; or to have an attendance rate of < 70% in the program training.

The research was approved by the Committee of Ethics in Research with Human Beings of the Federal University of Ceará (number 42111/2011). The risks and benefits involved in this study were informed and all the women signed a free and informed consent form, according to Resolution 466/12 of the National Health Council.

Study Design

The women performed an intervention through an aerobic training program in the walk / run modality[17]. Prior to the start of the program, and at the end of the intervention, an aerobic capacity test (1 mile), body weight measurements, sum of skinfolds, fat percentage estimation, waist circumference and waist-rip ratio were performed.

Aerobic Training Protocol

One week before and 48 hours after the end of the training protocol, the one-mile test (1,609 km) was applied to assess aerobic capacity and to prescribe adequate walking and / or running intensity[17].

A two week adaptation period with three weekly sessions lasted from 20 to 30 minutes with a maximum heart rate of 50% was performed. Then, from the first to the fourth week of protocol training, women maintained three weekly sessions, lasting 40 minutes each session and having an intensity of 60% of their maximum heart rate. From week 5 to week 12, the program progressed to five weekly sessions lasting 60 minutes each session and the intensity progressed from 60% to 70% of their maximum heart rate. The sessions were monitored with cardiofrequencymeters (Polar®, RS800cx, ElectroOy, Kempele, Finland) and aided by Borg's subjective exertion scale of 6 to 20 points[18] maintaining the exercise so that the women reported between 11 and 14 throughout the whole training program.

Anthropometric Measurements and Percentage of Fat

Height and body mass were performed using a stadiometer with a precision of 0.1mm (Sanny, São Bernardo do Campo - São Paulo, Brazil) and a Filizola® brand digital scale . The circumferences of the abdomen, waist and hips were measured with an anthropometric steel tape, with 0.1 cm of precision (Sanny, São Bernardo do Campo - São Paulo, Brazil). Abdominal circumference was measured at the height of the umbilical scar. Waist was measured in the area of the lower body perimeter between the lower ribs and the iliac crests and the reading was performed exactly at the time of expiration. Hips were measured from the highest gluteal prominence. For these measures, the protocol proposed by Sousa[19] was followed. Five skinfolds (triceps, subscapular, suprailiac, abdominal and thigh) were evaluated using an adipometer (CESCORF / 0.1mm / CARDIOMED) following the procedures proposed by Sousa[19]. To estimate the percentage of fat, the proposal of Pollock et al.[20] was followed.

Control of food intake

Participants were instructed to maintain their usual eating habits. To verify if this guideline was met, volunteers underwent nutritional assessments immediately prior to the start and end of the training protocol. One nutritionist applied the 24-hour inquiry[21], in triplicate, being two representative of week days and one day of weekend. Avanutri Revolution software, version 4.0 (Avanutri Informática Ltda, Rio de Janeiro, Brazil), was used to analyze the reminders.

Statistical analysis

Data were processed using the Statistical Package statistical program for the Social Sciences (SPSS 20.0). Data are the mean and the standard deviation of the mean. The assumptions of normality and homogeneity were tested through the Shapiro-Wilk and Levene test, respectively. In order to analyze the changes in the variables of the pre and post intervention body composition, two-way ANOVA was used, one factor being the moments and the other the groups. Additionally, the training effect was analyzed by comparing the magnitude of the changes occurred in the variables of each group (absolute and percentage delta) by one way ANOVA. The level of significance was set at $p < 0.05$.

Results

The initial characteristics of the volunteers are presented in table 1. There was significant difference only in age (35.1 ± 5.4 years versus 54.6 ± 5.1 years for OS and MN, respectively). Women in both groups maintained a dietary pattern with no significant changes in total caloric intake or macronutrients between the assessments made at the beginning and end of the training program. The aerobic training protocol significantly increased the participants' VO2 from 26.1 ± 0.9 mL/kg/min to 33.3 ± 2.4 mL/kg/min (OV) and 22.2 ± 0.9 mL/kg/min to 34.1 ± 2.8 mL/kg/min (MN).

Table 1 - Initial values of the variables of age, weight and anthropometry of volunteers in ovulatory and postmenopausal status.

VARIABLES	OS (n=11)	MN (n=10)
	Mean ± SD	**Mean ± SD**
Age (years)	35.1 ± 5.4	54.6 ± 5.1[#]
Weight (kg)	77.2 ± 13.6	72.2 ± 7.9
AC (cm)	102.8 ± 6.9	100.1 ± 6.2
ΣD (mm)	230.1 ± 51.8	216.7 ± 27.6
WHR	0.85 ± 0.1	0.90 ± 0.0
%F	44.1 ± 5.5	42.9 ± 4.1

Data are: mean and standard deviation of the mean. SD: standard deviation; ΣD sum of folds; % F: Percentage of fat; WHR: Waist-hip Ratio; AC: Abdominal Circumference. [#] Differences between ovulatory and postmenopausal status ($p<0.05$).

Change in body composition

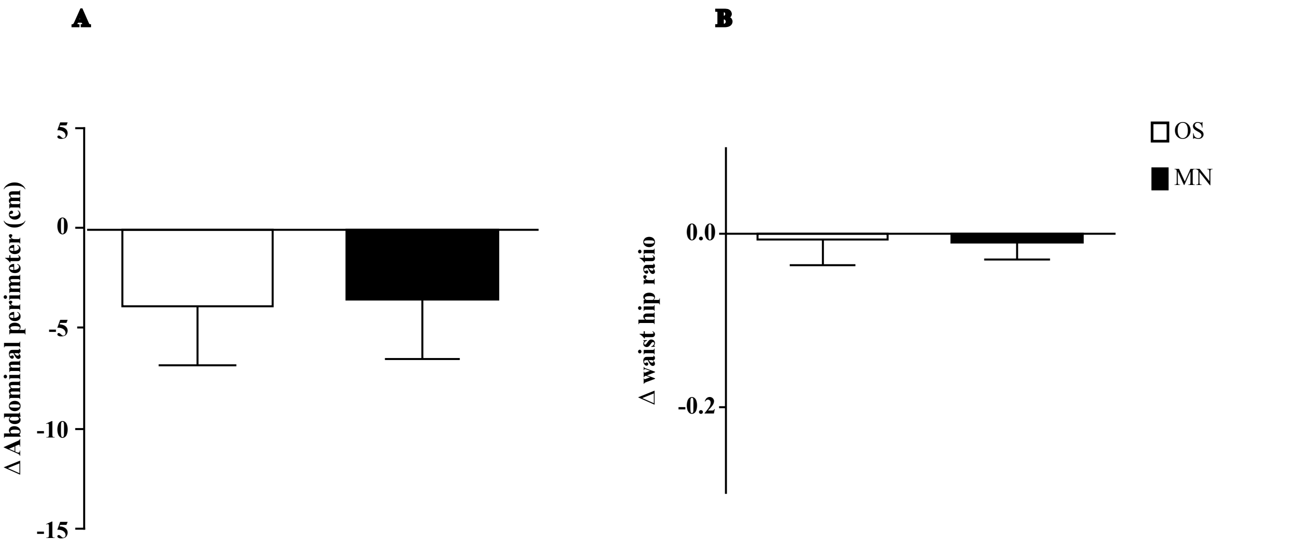
There was a significant reduction in all variables related to skinfolds and percentage of fat in OS (table 2). MN women presented reductions in the supra iliac, abdominal and thigh folds, as well as in the sum of the folds and percentage, but the reductions in triceps and subscapular folds were not significant. When the groups were compared in relation to the percentage variation post versus pre-intervention, it was observed that the MN women showed a greater decrease in the supra iliac fold and in the percentage of fat, in relation to the OS group. But this difference was not confirmed by absolute delta. Regarding the perimeter of the abdomen and WHR, there were no significant changes for either group (Figure 1).

Table 2 - Effect of aerobic training on body fat in ovulatory and postmenopausal women.

VARIABLES	OS			MN		
	Before	**After**	**△/(△%)**	**Before**	**After**	**△/(△%)**
Tricipital (mm)	42.8 ± 10.6	38.9 ± 7.7*	−3.8 ± 5.4 (−7.2 ±12%)	33.2 ± 4.9	30.8 ± 7.3	−2.9 ± 3.7 (−8.0 ± 12%)
Subscapular (mm)	39.0 ± 11.7	36.4 ± 11.8*	-2.6 ± 3.7 (−6.9 ±10%)	35.9 ± 7.9	32.8 ± 8.5	−3.2 ± 5.8 (−8.4 ± 17%)
Suprailiac (mm)	39.1 ± 10.1	33.7 ± 6.3*	−5.4 ±5.9 (−11.5±12%)	39.9 ± 8.6	29.9 ± 8.3*	−9.9 ± 5.1 (−25.0 ± 10%)#
Abdominal (mm)	52.8 ± 12.48	45.2 ± 12.8*	−6.8 ± 6.2 (−13.5 ± 12)	54.0 ± 3.2	44.4 ± 5.9*	−9.6 ± 5.1 (−17.8±10)
Thigh (mm)	57.2 ± 14.8	48.1 ± 109*	−9.1 ± 8.6 (−14.6±12%)	53.7 ± 13.8	40.3 ± 9.6*	−13.4 ± 10.9 (−22.8 ±15%)
Σ skin folds (mm)	230.1 ± 51.8	202.3 ± 44.2*	−27.7 ± 19.4 (−11.6±7%)	216.7 ± 27.6	178.2 ± 30.8*	−38.5 ± 25.1 (−17.6 ±10%)
% Fat	44.1 ± 5.5	41.0 ± 4.4*	−3.1 ± 2.6 (−6.6 ± 6%)	42.9 ± 4.1	37.1 ± 5.1*	−5.8 ± 3.6 (−13.5±8%)#

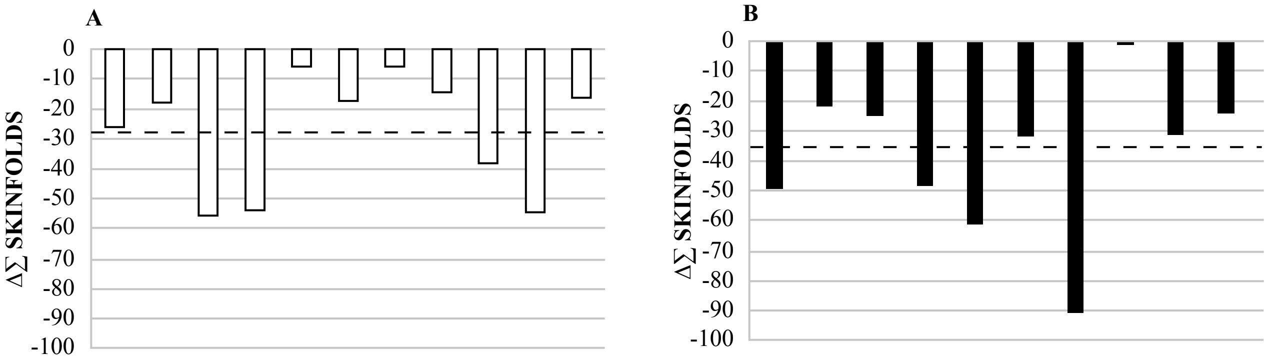
Data are OS = ovulatory state; MN = postmenopausal; * Differences between pre-intervention and post-intervention (ANOVA TWO way) #differences between OS and MN groups ($p<0.05$).

Figure 1 - Effect of the training program on the variation (delta) of abdominal circumference (figure 1A) and waist-hip ratio (figure 1B) in ovulatory (OS) and postmenopausal (MN) women. Data are mean and standard deviation of the mean.



Significant variability was observed in the changes in body composition of the participants, in response to aerobic training (figure 2). While some women in the OS and MN groups had a reduction of the sum of skin fold of 55.70 mm and 91 mm, respectively, others reduced only 5.65 mm and 1.30 mm.

Figure 2 - Single subject analysis of aerobic training summation responses in ovulatory (OS) women (Figure 2A) and postmenopausal (MN) (Figure 2B). Data are individual descriptive values of the absolute magnitude of the reduction obtained with the training.



Discussion

This study showed that a program of 12 weeks of aerobic training promotes reduction of some body composition parameters: sum of skinfolds and percentage of fat. However other parameters (waist circumference and waist-hip ratio) remained unchanged in MN women and OS. Women MN presented no advantage advantage in reduction of body fat, based on the five skinfolds analyzed, they obtained a greater reduction in the suprailiac compared to those of the OS group, as well as a greater reduction in the percentage of fat, but without differences for the sum of the skin folds. A large individual variability in training-induced body fat was noted, which was independent of ovulatory status.

There was a reduction in the sum of skin folds and in the percentage of fat. The suprailiac was the only fold that had greater reduction between groups, favoring the postmenopausal. On the other hand, women in the ovulatory state obtained intragroup reduction in all the folds, reinforcing the idea that differences between the groups are discrete and inconsistent.

The aerobic training-induced reduction of body fat found in the present study accompanies other evidence that aerobic exercise decreases not only body mass but also the percentage of body fat[22-24]. While in our data the magnitude of the reduction in body composition was between - 27.7 mm to - 38.5 mm of sum skinfold or - 3.0% and - 5.8% of fat percentage for women in OS or MN, respectively, previous studies have shown values between 0.91% and 2.93% of body fat in populations not stratified into ovulatory state and / or where other measurement techniques were used (DXA or bioimpedance) [25]. Despite these methodological differences, there is a slight reduction in body fat in response to aerobic training programs in all studies.

Researchers have pointed out that despite the low magnitude of weight loss, there are people with high rates of body fat reduction, while others have no results or show an increase in weight after training programs[5]. Our data confirmed this large individual variability in the responses of the women investigated. This assumption leads to the need to investigate which factors explain the high variability in body fat response to exercise training.

Among these factors, insulinemia, systemic inflammation[26] and oxidative stress[27] have been pointed out as possible limiters in the process of weight loss. The inferior metabolic condition known to be found in postmenopausal women[9,10] led to the hypothesisthat MN women would respond less effectively to the training program. However, our data showed a greater reduction in fat percentage in MN, although of no difference in the sum of skin folds, which refutes our initial hypothesis. Greater fat percent reduction in MN women could be explained by less favorable initial values of body composition. In fact, there is a consensus that individuals starting from higher values of fat percentage show greater changes in response to training[28]. However, these women had the same body composition of women in OS for all variables investigated in the present study. This similarity in characteristics before the intervention made it possible to isolate the state of menopause as the single factor differentiating the two groups.

In the database researched (Pubmed), found only a study by Deibert et al.[15] which investigated differences in MN and OS in the weight-loss response to physical training program. They found that MN are as responsive to exercise for weight loss as women in OS, which differs from our data, which demonstrated a modest advantage for MN. Considering the differences between these two studies now available, it would be interesting to seek a better understanding of this subject. Metabolic differences between MN and OS women could influence exercise-induced weight loss, as pointed out by Marin et al.[29] , which indicate higher insulinemia, oxidative stress[30], and systemic inflammation in postmenopausal women. It has been shown that these factors negatively influence the weight loss responses to exercise. physical training[12]. Therefore, it is proposed that future studies consider not only the ovulatory state, but also the metabolic and hormonal profile as a possible influencing factor in the success of training programs.

The limitation of this study was the use of skin folds to measure body composition. To minimize this, we evaluated not only the fat percentage, since equations for this vary according to the population, but also the sum of the folds, which do not depend on the population equation. Another limitation is that we evaluate only the ovulatory state, but not the biochemical and hormonal parameters that characterize this state.

Contrary to our hypothesis, postmenopausal women presented a marginally better ability to reduce body fat percentage than pre-menopausal women. The practical implication of this is that we have no reason to propose that training programs need to be different because of the ovulatory state. In terms of research, the practical implication is that it is still necessary to investigate the factors that make it difficult to reduce body fat by adopting other isolated circumstances beyond menopause.

Conclusion

It was concluded that women in MN responded to a training program with greater reduction in fat percentage than women in OS, although with no differences in sum of skinfolds, waist-hip ratio and abdominal circumference.

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