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Acute response in glycemia and lipemia postprandial after resistance and concurrent training in overweight postmenopausal women

Respuesta aguda en la glucemia y lipemia posprandial posterior a entrenamiento de fuerza y concurrente en mujeres posmenopáusicas con sobrepeso

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Abstract: Introduction: In postmenopausal women, metabolic responses to lipids during postprandial periods following combined exercise training are unknown. Objective: To examine the acute effects of resistance training (RT) and concurrent training (CT) on postprandial lipemia and glycemia in postmenopausal women. Methods: This quasi-experimental, exposure response study, linked 27 women who were randomly divided into three groups and evaluated for anthropometry, physical fitness, and nutrition status. Two experimental groups did a session of different types of physical activities (RT or CT), and a control group did not do any training activities (only aerobic exercise). At 12 hours post-training, in fasting conditions, a hypercaloric nutritional compound equivalent to 50% of the basal metabolic rate (BMR) of each woman was supplied. Pre and post hypercaloric intake, biochemical markers (lipemia and glycemia) were determined and compared with the control group. Results: A reduction in total energy expenditure was observed due to RT and CT training ($p<0.005$). The changes are associated with decreased total cholesterol and low-density lipoprotein levels in the RT group, as well as decreased triglyceride levels and increased high-density lipoprotein levels in the CT and aerobic exercise groups. Conclusion: RT and CT performed 12 hours before the consumption of the hyper caloric nutritional compound can change postprandial lipid and glucose levels. Acute physical training could influence the reduction of energy expenditure and the improvement of glycaemia and lipemia in postmenopausal women.
Keywords: exercise; fitness; glycemia; lipemia; nutrition; postmenopausal; trainings.

Resumen: Introducción: En mujeres posmenopáusicas, se desconocen las respuestas metabólicas a los lípidos durante los períodos posprandiales posteriores al entrenamiento físico combinado. Objetivo: Examinar los efectos agudos del entrenamiento de resistencia (RT) y el entrenamiento concurrente (CT) sobre la lipemia y la glucemia posprandiales en mujeres posmenopáusicas. Métodos: Este estudio cuasiexperimental de respuesta a la exposición, vinculó a 27 mujeres que se evaluaron por antropometría, condición física y estado nutricional y se dividieron aleatoriamente en tres grupos. Dos grupos experimentales realizaron una sesión de diferentes tipos de actividad física (RT o CT), y un grupo control no realizó ninguna actividad de entrenamiento (solo ejercicio aeróbico). A las 12 horas post-entrenamiento, en condiciones de ayuno, se suministró un compuesto nutricional hipercalórico equivalente al 50% de la tasa metabólica basal (TMB) de cada mujer. Pre y post ingesta hipercalórica, se determinaron marcadores bioquímicos (lipemia y glucemia) y se compararon con el grupo control. Resultados: Se observó una reducción del gasto energético total debido a los entrenamientos RT y CT ($p<0,005$). Los cambios están asociados con disminución en los niveles de colesterol total y lipoproteínas de baja densidad en el grupo RT, así como disminución en los niveles de triglicéridos y aumento en los niveles de lipoproteínas de alta densidad en el grupo CT y ejercicio aeróbico. conclusión: Los RT y CT realizados 12 horas antes del consumo del compuesto nutricional hipercalórico pueden cambiar los niveles de lípidos y glucosa postprandiales. El entrenamiento físico agudo podría influir en la reducción del gasto energético y en la mejora de la glucemia y la lipemia en mujeres posmenopáusicas.
Palabras clave: ejercicios; aptitud física; glucosa en sangre; lipemia; nutrición; posmenopáusica; capacitaciones.

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Introduction

The mortality rate in young women with cardiovascular diseases (CVDs) is approximately six times lower than in young men with CVDs (Sales et al., 2011). However, this gender-related difference decreases after menopause, when the incidence of CVDs, particularly atherosclerosis, dramatically increases in women (Tibana et al., 2013; Gawryszewski & Souza, 2014). Mortality due to CVDs in the female population accounts for 23% of total deaths worldwide (Wooten et al., 2011), and CVDs are clearly the leading cause of death in postmenopausal women. Postmenopausal status is considered a non-modifiable risk factor for the development of chronic non-communicable diseases (Agrinier et al., 2010).

CVDs and other chronic disorders, such as type II diabetes mellitus (DM2), have their origin in the postprandial periods (Pirillo et al., 2014). Eating food with high fat and simple carbohydrates concentrations increases the availability of lipid and blood glucose; the higher the quantity and length of lipid and glucose concentrations, the greater is their influence on the pathophysiological mechanisms underlying the development of disorders such as ischemic heart disease and DM2, respectively (Lee et al., 2009; Campbell et al., 2009). These phenomena, known as postprandial lipemia (PPL) and postprandial glycemia (PPG), are characterized by the return of lipid and glucose concentrations to normal values hours after food consumption. However, for the great majority of people in developed or developing countries, intervals between meals do not exceed 4–6 h, which means that food-derived fat and carbohydrate levels are above the recom-

mended concentrations, implying that people are in an almost permanent state of postprandial hyperlipemia and hyperglycemia (Kolovou et al., 2011; Moreau et al., 2013). These phenomena are especially concerning in populations with relative cardiometabolic vulnerability, such as in postmenopausal women.

Hormonal deficiency in middle-aged women significantly increases the damaging and pathogenic capacity of postprandial periods as a result of the disproportionate intake of high fat and simple carbohydrates foods (Lee et al., 2009; Kolovou et al., 2011). This intensification in vulnerability is related to the decrease in the levels of estrogen, a hormone that has a protective role against cardiometabolic disorders. The health impact of postmenopausal status exponentially raises the risk of premature deaths in overweight women with low levels of physical activity (PA) (Bucciarelli et al., 2021; Enriquez-Reyna et al., 2019). Sedentary postmenopausal women have a higher prevalence of abdominal obesity, dyslipidemia, and fasting hyperglycemia (Russo et al., 2014), which are associated with increased secretion of proinflammatory cytokines, high-expression adhesion molecules (CAMs and VCAM-1), fibrinogen, and the activity of pro-oxidants.

PA is a non-pharmacological strategy for metabolic regulation (Bond et al., 2015) and is considered as the cornerstone for a healthier lifestyle. Regular PA contributes to prevention and treatment of chronic disorders (Durstine et al., 2002; Kraus & Slents 2009). Aerobic exercise sessions may decrease the plasma levels of lipids, such as low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL), as well as increase the activity of high-density lipoproteins (HDL), which play a key role in the systemic regulation of excess cholesterol (Gilmore et al., 2013). However, only few studies have assessed the acute or chronic effects of resistance training (RT) associated primarily with muscle strength and endurance adaptations (Rebolledo-Cobos et al., 2014; Castro et al., 2019; Fernandez et al., 2020), on postprandial metabolic markers in postmenopausal women (Zotou et al., 2010; Kolovou & Ooi 2013).

To date, lipid metabolic responses during postprandial periods, following specific sessions of RT or a combination of aerobic and anaerobic exercises in the same session (known as concurrent training (CT)) are unclear in postmenopausal women. Therefore, the aim of this study is to examine the acute effects of RT and CT sessions on postprandial lipemia and postprandial glycemia in postmenopausal women.

Materials and Methods

This quasi-experimental, random-sampling, exposure response study, determined acute changes in 2 experimental groups, stratified by 2 different types of physical activities, regarding specific blood biochemical markers compared with a control group without training activity. A total of 27 postmenopausal women volunteered to take part in this study. The inclusion criteria were as follows: women with at least 1 year since last menstruation and those who had not undergone hormone replacement therapy. The exclusion criteria included women who had participated in some type of physical training program in the last 6 months and those with medical records of metabolic, cardiac, or musculoskeletal disorders. We obtained informed consent from participants and the study followed the ethical guidelines of the Declaration of Helsinki and was approved by the Ethics Committee on Human Research (reference number: 012-03312016).

Prior (at least 5 days before the PA intervention starts) and right after to the completion of the experimental protocol with exercises, all participating women were tested for blood analysis, anthropometry, physical fitness and nutrition.

Lipid profile and initial glycemia. After at least 12h of fasting, 5 ml of blood was drawn at the clinical laboratory for determining serum glycemia and total cholesterol (TC), triglyceride (TG), HDL, LDL, and VLDL levels.

Anthropometry

The weight and height of participants were determined using an electronic weighing scale (Balance Industrielles, Montreal, Canada) and a wall-mounted stadiometer (Perspective Enterprises, Portage, USA), respectively. Body mass index (BMI) was calculated. Abdominal circumference, between the 10th rib and the iliac crest, was measured using a Gulick tape. Body composition was determined using a bioelectrical impedance (Tanita, model TBF-300WA Wrestling Body Composition Analyzer) to determine the percentage of body fat and lean body mass.

Muscular strength

Maximum dynamic strength. Tests of 1 maximum repetition (1RM) were used for muscle groups that would participate in RT (i.e., quadriceps, hamstrings, biceps, and triceps), which was used for performing the resistance section of both experimental groups (RT and CT). The maximum load of each muscle was determined and comprised no more than 5 sets with 4-min intervals between sets.

Cardiorespiratory fitness

Peak oxygen uptake. The Submaximal Rockport 1-mile Walk Test was used to calculate an approximation for peak oxygen uptake. It required participants to walk 1.6 km as fast as possible. Heart rate was monitored at the end of the test, and the total time needed to complete the distance was also recorded. The formula used was as follows: VO2 Peak (ml/kg−1/min−1) = 132.6 − (0.17 × body mass) − (0.39 × age) + (6.31 × sex) − (3.27 × time) − (0.156 × heart rate).

Nutritional behavior monitoring

A self-record format was provided to record the feeding behavior of participants for 2 days following the initial

testing until the day of experimental protocol implementation. This was aimed at counteracting biases in lipid and glucose values derived from atypical nutritional patterns.

Nutritional targeting

On the day of experimental protocol implementation, food intake was controlled by standardizing caloric intake prior to training at 60% of the basal metabolic rate (BMR) along with PA factor for each participant. The strategy included one breakfast (cereals and fruits), one snack (cereals), and one lunch (chicken meat, potatoes, vegetables). All intakes were provided and controlled by a nutritionist. This procedure ensured that at the time of the training session, plasma lipids and glucose levels were influenced by similar nutritional behaviors and in specific amounts for each individual participant. The last food intake for each participant was scheduled at least 3 hours prior to the training activity, encouraging participants to stay hydrated.

Experimental protocol

All women (n = 27) were randomly categorized into 3 groups (Microsoft Excel software data randomization function). Of the 2 experimental groups, one underwent a session of RT (n=9), and another underwent a session of CT (n=9); the control group (CG) underwent only flexibility training (n=9). For all experimental groups (i.e., RT and CT) a familiarization session was implemented for learning the correct procedure of the exercises that were applied into the sessions. All the sessions were performed by sport professionals, and the intensity of the sessions for RT and CT was monitored.

Training Sessions: Women from all groups were summoned at 5:00 p.m. to the gym to undergo their respective training sessions. After each training session, women were instructed to have just water without any caloric components, until the next morning.

The RT group underwent a 10-min warm-up (walking and joint mobilization), followed by a total of 8 resistance exercises in the following order: 1. leg press; 2. knee extension with machine; 3. knee flexion with machine; 4. elbow flexion with dumbbells; 5. elbow extension with dumbbells; 6. shoulder adduction with dumbbells from abduction in the supine position; 7. unilateral bent-over dumbbell row; and 8. unweighted abdominal training. A total of 3 series with 15 repetitions in each series at 75% of 1RM intensity and a 45-s rest interval between series and exercises were performed. The approximate total duration of this training session was 40 min.

The CT group initially underwent a 10-min warm-up consist of a walk (5 min) and general joint mobilization (5 min) and then underwent the same training exercises as the RT group, except that each exercise comprised only one series with 15 repetitions at 65% of 1RM. Subsequently, they underwent 20 min of continuous pedaling on a cycle ergometer at an intensity of 70%–80% of the maximum heart rate. The approximate total duration of this training session was 40 min.

The CG underwent a training session with insignificant energy expenditure. The session comprised a 10-min warm-up (walking and joint mobilization) and 20-min directed stretching sessions.

Biochemical Analysis

The day after the training session (12h post training, in fasting conditions), women attended the clinical laboratory, where blood samples were drawn for determining baseline glycemia. Subsequently, a hypercaloric nutritional compound prepared by a nutritionist, equivalent to 50% of BMR with PA factor of each woman, containing 50% lipids, 35% carbohydrates, and 15% proteins, was supplied. BMR for each woman was calculated using the Harris–Benedict formula {BMR = [655,0955 + (9,5634 × height) + (1,8449 × height) − (4,6756 × age)]} and was modified using the PA factor (+20%). After the consumption of nutritional compound, glycemia and lipid profile were determined at 1 every hour. A heparinized catheter was placed in all women, from which blood samples were drawn by an expert bacteriologist, samples were centrifuged for 5 min at 4000 g, and the serum stored at −20°C for the determination of biochemical parameters.

Statistical analysis

Descriptive statistics was presented as a measure of means and respective standard deviations. For determining homogeneity, the Shapiro–Wilk and Levene normality tests were used. The analysis of variance (ANOVA) was used to determine the influence of covariates such as age, sex, or BMI on the model between the groups. To examine the acute effect of the intervention in the outcomes examined, we used an ANOVA. Bonferroni test was used as a post hoc test. All the analyses were performed using the SPSS Statistics for Windows, version 24.00 (IBM Corp, Armonk, NY, USA). The level of significance was set at $p < .05$.

Results

For the initial assessment conducted prior to experimental protocol implementation, no significant differences were observed in the resulting anthropometric, biochemical, and functional characteristics as a *p*-value of .05 was observed within or between the groups, indicating homogeneity in the records (Table 1).

The means ± standard deviations of energy need of women are shown in (Table 2). It can be observed that BMR and BMR adjusted for PA factor were homogeneous among each group. As variables associated with NC energy composition contribute to BMR, the subsequent results show no difference; however, similarities were noted in the proportions of fats, carbohydrates, and proteins. The average total NC volume for each group did not show a variation of >5 ml.

Table 1
Initial characteristics of women categorized into different groups

Variable	Experimental groups			P[3]
	RT group (n = 9)	CT group (n = 9)	CG (n = 9)	
Age (years)	55.44 ± 3.21	54.44 ± 4.80	54.22 ± 4.60	.95
Anthropometric features				
Weight (kg)	70.17 ± 9.05	71.25 ± 11.22	72.23 ± 9.28	.91
BMI (kg / m^2)	27.31 ± 2.57	28.67 ± 4.03	28.80 ± 3.35	.64
Body fat (%)	36.90 ± 4.06	36.08 ± 4.20	36.46 ± 6.32	.96
Lean body mass (%)	44.43 ± 3.44	42.43 ± 9.41	45.79 ± 3.74	.41
Abdominal perimeter (cm)	94.41 ± 7.60	97.11 ± 9.60	97.31 ± 7.51	.77
Strength and aerobic capacity				
1RM knee extension (kg)	22.56 ± 4.77	24.44 ± 3.97	23.00 ± 5.41	.84
1RM elbow flexion (kg)	11.56 ± 4.33	10.22 ± 2.73	11.00 ± 4.12	.53
30" sit-to-stand test (reps)	10.11 ± 3.10	10.44 ± 2.60	11.67 ± 1.87	.73
VO_2 Peak (ml • kg^{-1} min^{-1})	22.23 ± 4.10	21.88 ± 4.14	20.82 ± 3.70	.52
Lipid profile and glycemia (mg/dl)				
Total cholesterol	207.67 ± 17.10	217.30 ± 32.93	217.33 ± 40.40	.47
Triglycerides	152.89 ± 55.21	167.44 ± 48.83	173.78 ± 54.58	.21
LDL	132.58 ± 15.27	138.69 ± 18.86	136.63 ± 34.37	.84
VLDL	29.73 ± 15.11	30.87 ± 10.25	34.33 ± 12.98	.27
HDL	42.56 ± 7.87	47.22 ± 4.57	44.59 ± 7.05	.79
Glucose	92.11 ± 10.36	93.33 ± 7.97	94.14 ± 11.24	.82

Mean ± standard deviation of the variables analyzed in each group. Repetitions (reps); milliliter per kilogram per minute (ml • kg−1 min−1).

Table 2
Energy needs and composition of the NCs among different groups

Variable	RT group (n = 9)	CT group (n = 9)	Control (n = 9)	P[3]
Energy needs (kcal)				
BMR	1,354.26 ± 97.25	1,338.84 ± 116.11	1,364.91 ± 110.61	.84
BMRAF	1,625.12 ± 116.70	1,606.60 ± 139.33	1,637.89 ± 132.73	.84
CNH total energy	812.56 ± 58.35	803.30 ± 69.66	818.95 ± 66.37	.84
Fat	406.28 ± 29.17	401.65 ± 34.83	409.47 ± 33.18	.84
Carbohydrates	284.40 ± 20.42	281.16 ± 24.38	286.63 ± 23.23	.84
Protein	121.88 ± 8.75	120.50 ± 10.45	122.84 ± 9.95	.84
CNH composition (g)				
Fat	45.14 ± 3.24	44.63 ± 3.12	45.50 ± 3.35	.93
Carbohydrates	71.10 ± 5.11	70.29 ± 4.91	71.08 ± 5.98	.83
Protein	30.47 ± 2.19	30.12 ± 2.10	30.71 ± 2.05	.96
CNH volume (ml)	485,23±34,84	479.71 ± 33.52	484.59 ± 28.38	.95

Average composition of the hypercaloric nutritional compound. Column P[3] shows the statistical values obtained when comparing the average values of variables in the three groups. BMR: basal metabolic rate; CNH: hypercaloric nutritional compound; BMRAF: basal metabolic rate with PA factor.

Results for PPL and PPG in each group can be observed (Figure 1), which shows the average and standard deviations of serum fasting TC, TG, HDL, LDL, and blood glucose levels as well as pre and post consumption values (7:00 am) of CNH in the postprandial periods one, two, three, four, and five with a time interval of 60 min in between determinations (8:00 am, 9:00 am, 10:00 am, 11:00 am, and 12:00 pm). In TC and TG curves, significant differences were observed at moments 1A in favor of the RT group and 1B in favor of the experimental groups, respectively. Similarly, statistical differences were observed in the moment 3E in the experimental groups and the moment 4E in the CT group, during the determination of postprandial glycemia. No differences were found at any times in the postprandial concentrations of HDL and LDL.

Table 3 shows the average magnitudes of the postprandial lipemic and glycemic curves. Statistically significant differences were observed in all biochemical variables studied. The average TC and LDL concentrations were significantly lower in the RT group than those in the CG ($p3 < .05$), being 9.08% lower. Conversely, the concentrations of TG were significantly lower in the CT group ($p3 < .05$), showing 24.98% below the CG average. Moreover, HDL levels were higher in the CT group than in the RT and CG groups ($p3 < .05$), showing 8,80% and 10,89% higher, respectively. It is also observed that the average LDL cholesterol was 17.32% lower in the RT group compared to the CG group ($p3 < .05$). Finally, the average value of postprandial glycemia was significantly lower in the experimental groups (RT and CT) than in the CG ($p3 < .05$).

Table 3
Comparison of the average and standard deviation values of biochemical variables in the postprandial period among the experimental groups and the CG

PP marker levels (mg/dl)	RT group (n = 9)	CT group (n = 9)	Control (n = 9)	P[3]
Total cholesterol	192.42 ± 35.82[a]	204.98 ± 38.06[ab]	211.64 ± 37.02[b]	.0468
Triglycerides	210.62 ± 74.05[ab]	181.42 ± 63.68[a]	241.86 ± 100.36[b]	.0025
HDL	49.77 ± 12.06[a]	54.15 ± 12.25[b]	48.29 ± 11.59[a]	.0095
LDL	113.24 ± 37.78[a]	126.70 ± 45.13[ab]	136.97 ± 49.49[b]	.0426
Glycemia	89.94 ± 16.42[a]	87.24 ± 19.26[a]	102.95 ± 21.19[b]	.0003

Average values of postprandial determinations of the variables studied. P3 <.05, indicate statistical significance. Values that do not share the same superscript letter are statistically different. RT: resistance training; CT: concurrent training; PP: postprandial period.

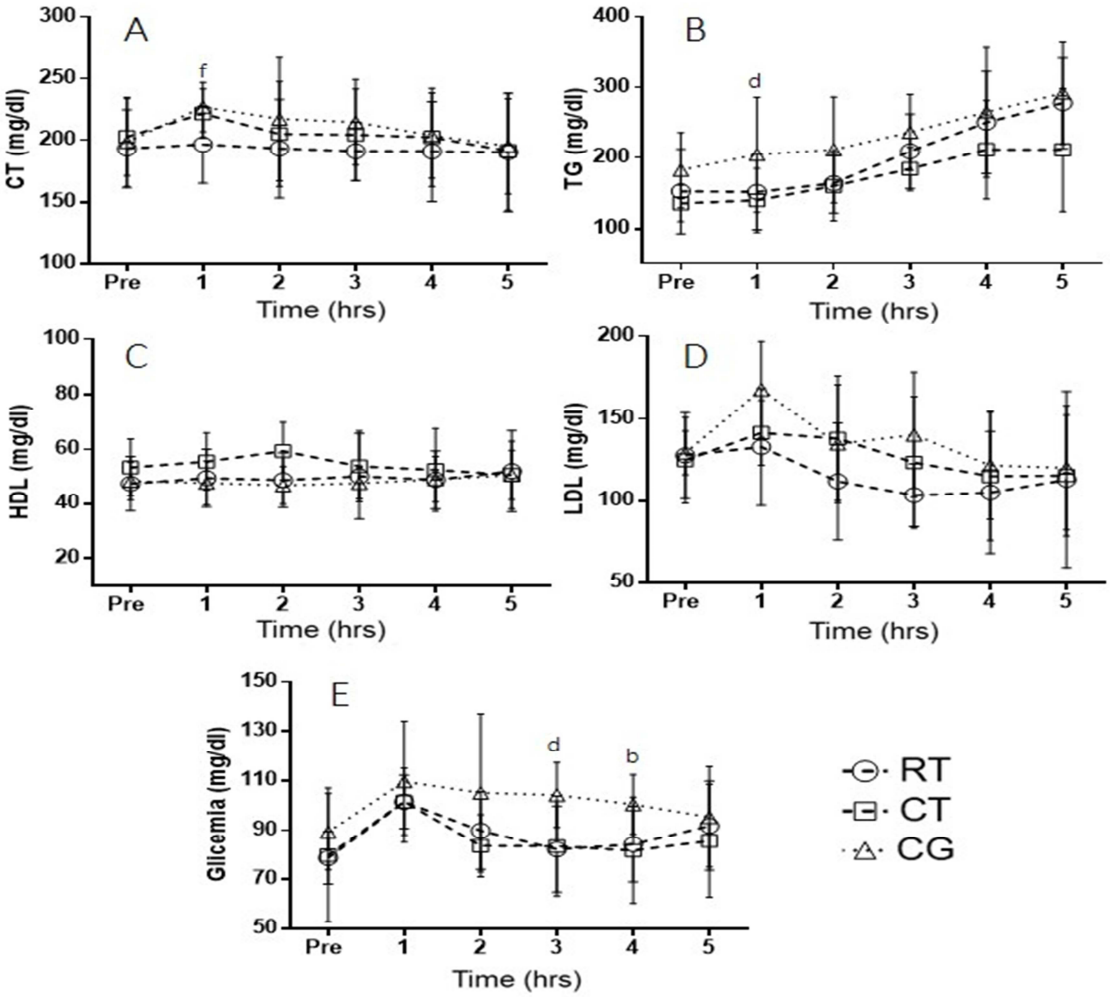

Figure 1. Postprandial lipemia and glycemia curves for the serum determinations of A) total cholesterol, B) triglycerides, C) HDL, D) LDL and E) glycemia. Statistical differences were determined by the following conventions: a, difference between the RT group and CG; b, difference between the CT group and CG; c, difference between the RT group and CT; d, difference between the RT group and the CT group with CG; e, difference between the RT group and CG with the CT group; f, difference between the CT group and the CG group with RT; g, difference among all study groups. CG: control

Discussion

The main results of the study were: one) significant reduction in the total daily energy expenditure due to different trainings, RT and CT, in postmenopausal women, evidencing that the decrease in PA prolongs and aggravates the postprandial management of energy substrates, which increases the cardiometabolic risk; and two) RT and CT, performed approximately 12h before hypercaloric nutritional compound consumption can dramatically change the average postprandial lipid and glucose levels in postmenopausal women. The primary changes are associated with a decrease in total cholesterol and low-density lipoprotein levels in the RT group as well as a decrease in triglycerides level and an increase in high-density lipoprotein level in the group that underwent RT and aerobic exercise.

Previous scientific literature has adequately described that the postmenopausal physiological aggravating factors, which are associated with sedentary lifestyles, reduce life expectancy and the quality of life in women (Sales et al., 2011). Wooten et al., 2011, and Zotou et al., 2010, demonstrated that regular physical exercise is a determining factor in lipoprotein metabolism. Moreover, Moreau et al., 2013, proved an association of regular PA with the reduction of systemic inflammation and oxidative stress. Azarbal, et al., 2014, have reported that PA has a protective role in the cardiac function in postmenopausal women.

The experimental design of this study was based on the theoretical premise that relates PA with a significant increase in total energy expenditure, subsequently causing a general energy deficit that can be compensated with a greater use of energy substrates in the nearest postprandial period (Zotou et al., 2010). These phenomena described by Pinto et al., 2011, indicated that in PA sessions with resistance exercises, the volume of the session is the main factor determining subsequent metabolic stress, thus increasing energy expenditure for >18 h, which directly influences lipid mobilization and the activation of energy replacement metabolic pathways in the postprandial period.

Systemic lipid metabolism for each person is dependent on many factors, including diet, physical health, and daily energy expenditure. The present study attempted to

assess the influence of RT and a combination of RT with aerobic exercise as determining factors in postprandial metabolism. The design of the training sessions was based on those reported in the studies involving populations with similar characteristics (weight, BMI, and BMR) (Rebolledo-Cobos et al., 2014; Correa et al., 2014). In some specific moments of the lipemic and glycemic curves, statistical differences were higher in favor of the experimental groups compared with the CG. Nevertheless, as the primary finding of this study, RT and its combination with aerobic exercises significantly decreased the average values of the postprandial systemic concentrations of TC, TG, LDL, or glucose in overweight postmenopausal women. Nonetheless, the RT group showed a reduction in TC and LDL levels, which were only found in this group, suggesting the influence of high muscle recruitment while performing strenuous resistance exercises.

Although, we have observed that a single training session can induce the mechanisms underlying muscle energy use. Currently, to the best of our knowledge, there is only one study that have demonstrated the acute effects of a PA session on postprandial lipid and glucose managements (Correa et al., 2014). Differences between studies could be due to the different experimental approaches, characteristics of the population and the experimental training program.

One high-intensity RT session (10 exercises, three series at 70% of a maximum repetition) has been found to significantly reduce the disposition of postprandial TGs (Petitt et al., 1985). Unlike other studies that examined the influence of three different volumes of RT (one, three, and five sets of 10 repetitions) on postprandial lipemia, no significant differences were noted in relation to postprandial lipid markers in any group after the session but in this study the experimental group consumed more energy and fat-containing foods compared with the CG the night before the fat tolerance test; thus, the change in the diet may have increased the possibility of masking the real effect of RT on the lipemic response (Shannon et al., 2005). Zafeiridis et al., 2007, studied the effect of an RT session on TG levels in the postprandial period; these levels reduced over a period of 6h after the RT session. They also have examined the effect of an aerobic exercise protocol and RT protocol with an average, total energy expenditure of 5.1 MJ and observed a decrease of 12% and 18% in postprandial lipemia, respectively, obtaining a greater attenuation of lipid concentrations in the RT group than in the aerobic exercise group (Zafeiridis, et al., 2010).

This study presents several limitations: one) the low sample size does not allow us to generalize the findings; and two) the no examination to the chronic effects of a physical activity intervention. The strengths of this study were: one) the novelty of the study examining the acute effect of different exercise trainings in postmenopausal women and two) the use of a variety measurements for controlling blood analysis, body composition, physical fitness, and nutrition.

The results of this study show that RT and CT performed approximately 12h before hypercaloric nutritional compound consumption can significantly reduce energy expenditure and change the average postprandial lipid and glucose levels in postmenopausal women. The primary changes are associated with a decrease in TC and LDL levels in the RT group as well as a decrease in TG level and an increase in HDL level in the group that underwent RT and aerobic exercise. Postprandial glycemia was significantly reduced in the PA groups compared with the CG. Future studies with a larger sample size should be conducted to contrast or corroborate our results.

Practical Applications

The present study may offer new methodological conceptions in the prescription of exercise in special populations from a scientific and clinical point of view and, consequently, in professional practice. Initially, understanding that the total amount of physical exercise and the combination of specific modalities tested do not necessarily generate unique responses and that they induce a wide metabolic variability, the authors propose to consider the combination of high-volume RT with aerobic exercises of moderate duration and intensity to possibly amplify the impact on the regulation of cardiometabolic risk markers in postmenopausal women from session one. Likewise, it is possible that the periodic weekly performance (3 to 5 sessions) of ER or EC may have adaptations that enhance the use of lipids in the medium and long term. The findings of a single session are just an initial notion of the responses acquired physiology.

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