CIRCUIT TRAINING REDUCES CARDIOMETABOLIC RISK FACTORS IN WOMEN

TREINAMENTO EM CIRCUITO REDUZ OS FATORES DE RISCO CARDIOMETABÓLICOS EM MULHERES

EL ENTRENAMIENTO EN CIRCUITO REDUCE LOS FACTORES DE RIESGO CARDIOMETABÓLICO EN MUJERES

ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

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ABSTRACT

Introduction: Combined training is more effective than an isolated modality in reducing cardiometabolic risk indicators. Objective: To evaluate the effect of circuit training volume on anthropometric and biochemical risk indicators for cardiometabolic diseases in overweight women. Methods: Thirty-two participants underwent 24 weeks of circuit training with free weights combined with aerobic exercise. The training volume during the 24 weeks was used to distribute the women into moderate-volume physical activity (MVA), low-volume physical activity (LVA) and control (CON) groups. Anthropometric indices (body mass, body mass index (BMI), waist circumference (WC), waist-hip ratio (WHR)), blood glucose, insulin, insulin resistance (HOMA-IR), total cholesterol (TC), triglycerides, HDL-c, and LDL-c were evaluated at the beginning of the program and after 12 and 24 weeks. Results: There was no interaction between training volume and time for any of the variables studied, but the intervention time influenced body mass (p=0.013) and BMI (p=0.012), and there was a tendency for participation time to reduce body mass (p=0.063) and BMI (p=0.062) after six months of intervention. The volume of the physical activity affected HDL-c (p=0.037), being significant (p=0.030) in the comparison between the MVA and CON groups. Additionally, there was a downward trend in HDL-c after six months of intervention (p=0.073), with a smaller reduction observed in the MVA group, indicating a protective role of moderate physical activity in the reduction of this lipid fraction. The association between physical activity volume and participation time resulted in a clinical improvement in total cholesterol ($\chi 2 = 5.453$, $p = 0.02$), with a higher probability of reaching clinically adequate values in the MVA group (OR = 0.126; 95%CI 0.019 - 0.827). Conclusion: Training volume improved cardiometabolic risk factors in overweight women. ***Level of evidence II; Therapeutic Studies - Investigating the Results of Treatment.***

Keywords: Circuit-based exercise; Exercise; Resistance training; Abdominal obesity; Women's health.

RESUMO

Introdução: O treinamento combinado é mais eficiente do que a modalidade isolada com relação aos indicadores de risco cardiometabólico. Objetivos: Avaliar o efeito do volume de treinamento em circuito sobre indicadores antropométricos e bioquímicos com risco de doenças cardiometabólicas em mulheres com excesso de peso. Métodos: Trinta e duas participantes foram submetidas a 24 semanas de treinamento em circuito, com pesos livres combinados com exercício aeróbico. O volume de treinamento durante as 24 semanas foi utilizado para distribuir as mulheres nos grupos: atividade física de volume moderado (AVM), atividade física de baixo volume (AVB) e controle (CON). Os índices antropométricos massa corporal, índice de massa corporal (IMC), circunferência de cintura (CC), relação cintura-quadril (RCQ), glicemia, insulina, resistência à insulina (HOMA-IR), colesterol total (CT), triglicerídeos, HDL-c e LDL-c, foram avaliados no início do programa e depois de 12 e 24 semanas. Resultados: Não houve interação entre o volume de treinamento e o tempo para nenhuma das variáveis estudadas, mas o tempo de intervenção influenciou a massa corporal (p = 0,013) e o IMC (p = 0,012), e o tempo de participação tendeu a reduzir a massa corporal (p = 0,063) e o IMC (p = 0,062), depois de seis meses de intervenção. O volume de atividade física afetou o HDL-c (p = 0,037), sendo significativo (p = 0,030) na comparação entre AVM e CON. Adicionalmente, verificou-se tendência de redução HDL-c depois seis meses de intervenção (p = 0,073), sendo a menor redução observada no AVM, que indica o papel protetor de atividade física de volume moderado na redução dessa fração lipídica. A associação entre o volume de atividade física e o tempo de participação mostrou melhora clínica do colesterol total ($\chi^2 = 5,453$, $p = 0,02$), com maior probabilidade de atingir valores clinicamente adequados de AVM (OR = 0,126; IC de 95% 0,019 – 0,827). Conclusão: O volume de treinamento atenuou os fatores de risco cardiometabólico em mulheres com excesso de peso. ***Nível de evidência II; Estudos terapêuticos - Investigação dos resultados do tratamento.***

Descritores: *Exercícios em circuitos; Exercício físico; Treinamento de força; Obesidade abdominal; Saúde da mulher.*

RESUMEN

Introducción: El entrenamiento combinado es más eficiente que la modalidad aislada en indicadores de riesgo cardiometabólico. Objetivo: Evaluar el efecto del volumen de entrenamiento en circuito sobre indicadores antropométricos y bioquímicos con riesgo de enfermedades cardiometabólicas en mujeres con sobrepeso. Métodos: Treinta y dos participantes se sometieron a 24 semanas de entrenamiento en circuito con pesos libres combinados con ejercicio aeróbico. El volumen de entrenamiento durante las 24 semanas se utilizó para distribuir a las mujeres en los grupos: actividad física de volumen

Associate Editor responsible for the review process: Patrícia Oliveira

moderado (AVM), actividad física de volumen bajo (AVB) y control (CON). Se evaluaron los índices antropométricos masa corporal, índice de masa corporal (IMC), circunferencia de la cintura (CC), relación cintura-cadera (RCC), glucemia, insulina, resistencia a la insulina (HOMA-IR), colesterol total (CT), triglicéridos, HDL-c y LDL-c al inicio del programa y después de las semanas 12 y 24. Resultados: No hubo interacción entre el volumen y el tiempo de entrenamiento para ninguna de las variables estudiadas, pero el tiempo de intervención influyó en la masa corporal (p=0,013) y en el IMC (p=0,012), y el tiempo de participación tendió a reducir la masa corporal (p=0,063) y el IMC (p=0,062), después de seis meses de intervención. El volumen de actividad física afectó al HDL-c (p =0,037), siendo significativo (p=0,030) en la comparación entre AVM y CON. Además, hubo una tendencia a la reducción del HDL-c después de seis meses de intervención (p=0,073), observándose la menor reducción en AVM, lo que indica el papel protector de la actividad física de volumen moderado en la reducción de esta fracción lipídica. La actividad física y el tiempo de participación mostraron una mejora clínica en colesterol total (χ2 = 5,453, p = 0,02), con mayor probabilidad de alcanzar valores clínicamente adecuados de AVM (OR = 0,126; IC95% 0,019 – 0,827). Conclusión: El volumen de entrenamiento atenuó los factores de riesgo cardiometabólico en mujeres con sobrepeso. ***Nivel de Evidencia II; Estudios terapéuticos: investigación de los resultados del tratamiento.***

Descriptores: *Ejercicios en circuitos; Ejercicio físico; Entrenamiento de fuerza; Obesidad abdominal; Salud de la mujer.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012020_0024 Article received on 03/20/2020 accepted on 05/24/2021

INTRODUCTION

Excess body fat is reported as a global concern,[1,2] because is associated with development of morbidities such as hypertension, dyslipidemias, insulin resistance and increased risk for the development of type II diabetes *mellitus*, all these related to cardiovascular disease (CVD) and coronary artery diseases (CAD).[3]

Traditionally overweight/obesity treatment includes changes in lifestyle, such as increased daily physical activity,[4,5] but despite various strategies, still a challenge for behavioral reeducation programs maintain high adherence of participants to physical exercise program.[4] Previous studies have proven associations between exercise programs on anthropometric and biochemical indicators,[6] body composition changes,[7,8] reduction in depressive symptoms,[9] improvements on quality of life scores[10] and muscle strength.[11]

In the field of health, studies have suggested that the supervision[12] of training and adherence[13] of participants to physical exercise programs influence the desired results. However, to the best of our knowledge they have not investigated the volume of training based on the frequency and hours of activities in combined circuit exercise programs performed by women with excess body weight.

Circuit-resistance combined with aerobic exercises is a strategy to change cardiometabolic risk indicators,[14-16] increase energy expenditure and exercise responses at each training session[17] as well as being well tolerated by people with body mass excess.[4] Despite the large number of studies evaluating the effects of physical exercise on obesity and cardiometabolic risk factors, few have used the circuit training method. Thus, the aim of study was to evaluate the effect of the training volume of a circuit exercise program on anthropometric and biochemical risk indicators for cardiometabolic diseases in women with excess body weight. We hypothesized that the volume of circuit training method promotes positive responses in anthropometric and biochemical risk indicators for cardiovascular disease. Furthermore, those participants that have more frequency of attendance present more beneficial effects.

MATERIALS AND METHODS

Initially, seventy-one participants were recruited to participate in this study by health providers in a primary health care program and the following inclusion criteria were applied: women aged between 18 and 59 years old, who did not practice regular physical exercises more than one year old, who were authorized by the physician to practice regular physical exercises, excess body mass (BMI ≥ 25 kg/m^2), absence of orthopedic, neurological limitations or severe cardiovascular disease that prevented physical exercises practice. Thirty-nine participants were excluded from the study for the following reasons: health and family problems (n = 2), did not adapt to the exercises (n = 7), change of city (n = 2), did not attend the collection in one of the research steps (n = 23) and abandoned the program (n = 5). Thirty-two women completed all phases of the study. (Figure 1). The research was conducted in accordance with Declaration of Helsinki and resolution 466/2012 of the Brazilian National Health Council (Ethics and Research Committee, protocol number: 784.446/2014). Earlier assessments, participants answered a questionnaire to assess the physical activity level (IPAQ),[18] medication use and morbidities presence. At baseline and after 12 and 24 weeks, anthropometric data and blood samples were collected. Information regarding attendance frequency to exercise sessions, exercise time, and weekly activity volume (min/wk) were recorded.

PARTICIPANTS ALLOCATION

It was not stipulated a minimum number of sessions that were required to meet. Alternatively, participants were allocated into three groups according to the weekly volume of activities resulting from exercise program, which is indicative of exercise program adherence.[19] Women with a frequency greater than 60% (≥75 min./wk) were allocated to moderate volume physical activity (MVA group, n = 11; age = 42.9 ± 10.5 yrs; BMI = 33.5 ± 8.3 kg/m^2, six overweight and five obese), women

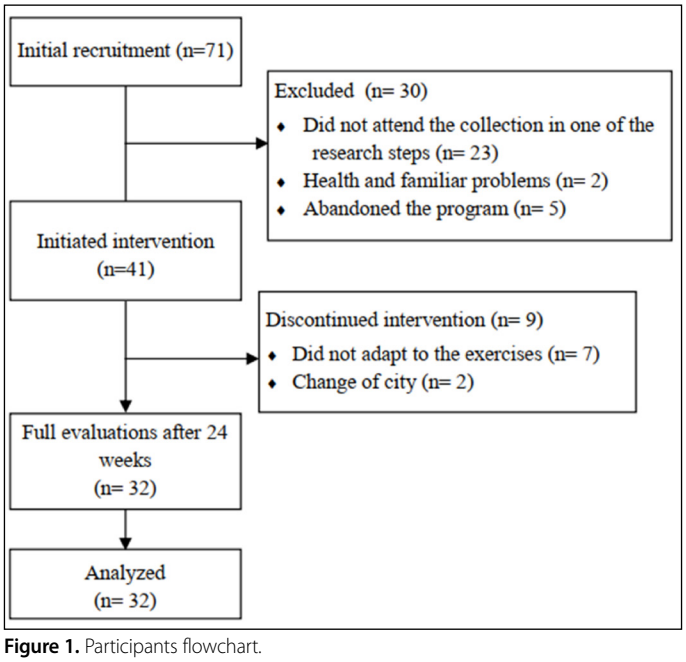

Figure 1. Participants flowchart.

with frequency between 40-60% were allocated to low volume physical activity (LVA group, n = 11; age = 42.3 ± 7.0 yrs; BMI = 32.7 ± 6.4 kg/m^2, five overweight and six obese), and women with frequencies lower than 40% were allocated to control group due to the very low adherence to the training program (CON group, n = 10; age = 43.1 ± 9.8 yrs; BMI = 35.4 ± 5.2 kg/m^2, two overweight and eight obese).

Assessments

The participant's body mass (Digital Scale Plenna-TIN 00103, São Paulo/Brazil) and height (Stadiometer Sanny, ES2060, São Paulo/Brazil) were verified to calculate body mass index (BMI).[1] Waist circumference (WC) was taken at the midpoint between the last palpable rib and the upper border of the iliac crest, the hip circumference (HC) was the largest diameter of the gluteal region to calculate the waist-to-hip ratio (WHR).[20] To this end, was used a non-elastic and inextensible tape (TR4012, São Paulo/Brazil).

Blood sample and laboratory analysis

Fasting blood samples were collected to evaluate total triglycerides, HDL-c, LDL-c, total cholesterol, glycaemia, insulin and HOMA-IR. Participants were previously instructed to maintain 12 hours fasting, avoiding intense physical exercises and alcohol consumption 72 hours previous. Analyses were running on the Laboratory of Clinical Analysis of the Pontifical Catholic University of Goiás (Brazil).

Physical exercise program

Physical exercise program consisted of free weights circuit training method using low-cost equipment, combined with aerobic exercise (walking/jogging), supervised by two experienced sport and exercise professionals (average of 8.2 participants per supervisor). Twenty-four weeks of exercises were performed, with recommended frequency of three times a week on non-consecutive days, totaling 72 sessions. The sessions were composed of 1) low intensity dynamic stretching exercises for lower and upper limbs, to avoid stretching influence in strength values[21] and warm-up; 2) circuit with weights; 3) walking/jogging; and 4) cooling down. The volume of resistance exercises and walking/jogging was controlled by time execution. Volume and load of the exercise circuit was adjusted along the program, while the time of walking/jogging remained constant with distance increase. Table 1 shows details of exercise program. For exercises accomplishment were used washers, dumbbells, elastics, medicine ball, Swiss balls, and mats. Exercises adopted in circuit with free weights were supine, direct and alternating thread, paddling, arm flexion, lateral elevation, squats, plantar flexion, step, developments, back-and-forth racing, and sit-ups, all exercise sessions were accompanied by music.

The intensity was verified with Borg's subjective perceived exertion scale,[22] the participants were instructed to maintain intensity in all resistance exercises and in walking/jogging between scores 13 to 16. At the end of each session the participants made an overall assessment of training intensity. All sessions were held between 16:00 and 18:00 PM at the Municipal Sports Gym.

Quantification of volume exercises

Exercise duration was recorded in each session. To calculate the exercise weekly volume (min./wk), accumulated time of each participant was

Table 2. Effects of circuit training on cardiometabolic risk factors.

Risk factors		MVA (n=11)	LVA (n=11)	CON (n=10)	p Effect of time	p Effect of physical activity volume	p Effect of time*volume of physical activity
Body mass (kg)	Baseline	84.4±20.5	82.0±16.3	87.2±14.8	0.013[a]	0.974	0.708
	3 months	82.6±18.0	82.0±16.3	82.8±13.8			
	6 months	81.8±18.6	81.4±1..6	83.4±13.6			
BMI (kg/m2)	Baseline	33.6±8.3	34.4±8.3	34.4±8.3	0.012[b]	0.936	0.730
	3 months	32.9±7.4	33.3±6.3	33.3±6.3			
	6 months	32.6±7.7	33.2±6.8	34.1±4.3			
WC (cm)	Baseline	102.0±16.3	98.5±14.7	104.0±10.3	0.155	0.734	0.309
	3 months	97.8±14.4	97.7±13.7	100.0±12.0			
	6 months	95.3±12.5	98.2±15.5	102.0±9.7			
WHR	Baseline	0.87±0.07	0.89±0.09	0.90±0.08	0.602	0.167	0.630
	3 months	0.85±0.07	0.88±0.08	0.90±0.06			
	6 months	0.84±0.06	0.89±0.07	0.90±0.06			
TG (mg/dl)	Baseline	121.0±64.4	164.0±83.2	147.0±71.7	0.155	0.273	0.296
	3 months	130.0±67.0	211.0±100.0	158.0±89.5			
	6 months	139.0±82.4	151.0±58.5	151.0±58.5			
HDL-c (mg/dl)	Baseline	43.9±7.2	41.5±6.9	40.0±5.6	0.073[d]	0.037[c]	0.144
	3 months	44.7±8.6	43.6±7.0	36.7±4.3			
	6 months	43.6±6.2	40.1±5.4	35.8±4.2			
LDL-c (mg/dl)	Baseline	154.0±46.9	122.0±36.7	133.0±35.7	0.084[e]	0.543	0.404
	3 months	123.0±51.6	127.0±26.6	118.0±41.8			
	6 months	125.0±26.6	118.0±30.7	118.0±16.0			
TC (mg/dl)	Baseline	222.0±55.6	196.0±37.5	203.0±39.1	0.098[f]	0.619	0.175
	3 months	194.0±53.9	213.0±29.4	186.0±32.3			
	6 months	197.0±41.5	190.0±33.8	184.0±18.1			
Glycemia (mg/dl)	Baseline	93.5±5.05	102.0±25.3	140.0±106.0	0.717	0.249	0.251
	3 months	90.5±7.74	106.0±42.2	148.0±119.0			
	6 months	95.2±7.53	109.0±61.2	109.0±61.2			
Insulin (µUI/ml)	Baseline	18.2±9.4	16.6±9.9	18.1±9.4	0.826	0.963	0.902
	3 months	15.8±9.0	17.4±7.3	17.2±7.1			
	6 months	17.6±9.1	16.6±4.8	17.6±6.9			
HOMA-IR	Baseline	4.2±2.23	4.6±2.0	4.3±2.6	0.212	0.948	0.603
	3 months	3.5±1.9	4.5±2.1	3.6±1.8			
	6 months	4.1±2.2	3.8±1.4	5.2±2.6			

MVA: moderate volume physical activity; LVA: low volume physical activity; CON: control group; BMI: body mass index; WC: waist circumference; WHR: waist-hip ratio; TG: triglycerides; HDL-c: high density lipoprotein; LDL-c: low density lipoprotein; TC: total cholesterol; HOMA-IR: homeostatic model assessment – insulin resistance. a p-value obtained by the two-way repeated measures ANOVA test, regarding to the effect of time on BW. Tukey's post hoc test indicated a value of p= 0.063 for comparison between baseline and six months of intervention. b p-value obtained by the two-way repeated measures ANOVA test, regarding to the effect of time on BMI. Tukey's post hoc test indicated a value of p= 0.062 for comparison between baseline and six months of intervention. c p-value obtained by the two-way repeated measures ANOVA test, referring to the effect of physical activity volume on HDL-c levels. Tukey's post hoc test indicated p=0.030 for comparison between the moderate physical activity volume and control groups. d p-value obtained by the two-way repeated measures ANOVA test, regarding to the effect of time on HDL-c levels. Tukey's post hoc test did not indicate significant p values when comparing intervention time groups. e p- value obtained by the two-way repeated measures ANOVA test, regarding to the effect of time on LDL-c levels. Tukey's post hoc indicated a value of p= 0.069 for comparison between baseline and six months of intervention. f p-value obtained by the two-way repeated measures ANOVA test, regarding to the effect of training time on TC levels. Tukey's post hoc indicated a value of p = 0.058 for comparison between baseline and six months of intervention.

added to the end of 72 exercise sessions, and then divided by 24, which represents the amount of program weeks. Result of minutes per week was used to stratify the sample into tertiles: MVA group, LVA group and CON group. We considered only activities performed in training program.

Statistical Analysis

All women who had complete evaluations regardless of attendance frequency were included in the statistical analysis. The two-way repeated measures Anova test was used to assess the effect of time and training volume (adherence to the program) on anthropometric and biochemical variables. For significant p values, Tukey's post hoc test was used for comparison between groups. The Chi-square test was used to associate clinical changes in biochemical parameters with the frequency of women's participation in the circuit training program. For this purpose, a 2x2 contingency table was constructed containing the number of women with adequate and inadequate biochemical variables in the moderate and low volume physical activity groups. For statistical significance $p < 0.05$ was considered. Data are presented in absolute (mean and standard deviation) and relative (frequency) numbers. For two-way repeated measures Anova the Jamovi software version 2.0.0 was used and the other analyzes were performed using the IBM® SPSS® 21.0 software (USA).

RESULTS

As expected, frequency of attendance (% freq.) and the weekly volume (min./wk) was significantly different between the groups ($p < 0.001$), MVA (71.3 ± 7.5% freq; 105.0 ± 9.9 min./wk.), LVA (47.5 ± 6.6% freq; 69.9 ± 8.9 min./wk.), CON (21.2 ± 12.7% freq.; 27.7 ± 16.1 min./wk.).

The results of the two-way repeated measures analysis showed that there was no interaction between training volume and intervention time for any of the studied variables. However, the results showed a significant effect of the intervention time on body mass (p=0.013) and BMI (p=0.012), although it was not possible to accurately detect in which period the reduction in body mass and BMI occurred, since Tukey's post hoc test showed only a trend for the time of participation to reduce body mass (p=0.063) and to reduce BMI (p=0.062), in the comparison between baseline and after six months of intervention.

After six months of intervention, body mass showed a mean relative loss of 3.0%, 0.7% and 4.3% for the MVA, LVA and control groups respectively, while the BMI reduced on average 2.9% in the MVA, 3.5% in the LVA and 0.9% in the control.

The time of participation in the circuit training program also seemed to influence LDL-c values (p=0.084). The post hoc result showed a tendency of the time of participation in the physical exercise program (p=0.069) to reduce LDL-c when the comparison was between baseline and six months of intervention. At the end of six months, there was an average reduction of 18.8% in LDL-c in the MVA group, 3.3% in the LVA and 11.1% in the control group.

Likewise, there was a tendency for the duration of the intervention to reduce TC values (p=0.098), and in the post hoc test a p-value of 0.058 was obtained when comparing the groups at the beginning and after 6 months of intervention. Despite the p-value being indicative of a trend towards reduction of values, TC values decreased on average by 11,3%, 3% and 9,3%, in the MVA, LVA and control groups, respectively.

Another important result was the beneficial and significant effect (p=0.037) of the volume of physical activity or the frequency of participation in the circuit exercise program on HDL-c values, with a significant effect also being observed when comparing volume groups of moderate physical activity and control (p=0.030). Additionally, there was an average reduction of 10.5% in the values of HDL-c in the control group, 3.4% in the LVA and 0.7% in the MVA after the end of the training period with circuit exercises. As seen, although there was only a trend in the reduction of HDL-c values (p=0.073), after six months of intervention, the smallest reduction was observed in the MVA group, indicating a protective role of the moderate volume physical activity, against the reduction of this lipid fraction.

(Figure 2) shows clinical homeostasis values and absolute levels of TC and LDL-c levels for participants of each group, at baseline, after three and six months. Regardless of the group, women who had normal levels of TC (TC < 200 mg/dl; MVA = 27.3%; LVA = 45.5%; CON = 50% participants) and LDL-c (LDL-c < 150 mg/dl; MVA = 45.5%; LVA = 63.6%; CON = 70% participants) maintained their homeostasis. After intervention, MVA group was the unique that presented the greatest decrease in absolute values ΔTC (MVA = - 25.0 ± 38,7 mg/dl; LVA = - 3.8 ± 44,1 mg/dl; CON = - 12.1 ± 34.7 mg/dl) and ΔLDL-c (MVA = - 29.3 ± 38,1 mg/dl; LVA = - 4.3 ± 48.1 mg/dl; CON = - 10.6 ± 28.8 mg/dl).

The Chi-square test indicated an association between physical exercise and clinical improvement of TC levels ($\chi^2 = 5.453$, $p = 0.02$). The Odds Ratio indicated that MVA had a higher probability of achieving clinically healthy values of TC when compared to the other two groups (OR = 0.126; IC95% 0.019 – 0.827). For calculation, the CON and LVA were considered as a single group compared to MVA.

DISCUSSION

The aim of current study was to evaluate the effect of 24-week of a circuit exercise program with the use of low-cost equipment on anthropometric and biochemical risk indicators for cardiometabolic diseases in excess body weight women attended by a basic health care program and evaluate the influence of the training volume based on the frequency of attendance to exercise session on over mentioned variables. The main findings were: 1) the duration of participation in the physical exercise program promoted a significant reduction in body mass and body mass index and showed a tendency to reduce LDL-c and TC levels, 2) the lower volume of physical activity or the lower frequency of participation in the program induced a greater reduction in HDL-c values after the six months of intervention, and 3) clinical homeostasis biomarkers remained unchanged regardless of exercise participation.

Volume and intensity of exercises are two variables considered a key factor to physical exercises prescription. When the low volume of exercise is associated with insufficient intensity, the effects are minimal,[23] but at moderate-to-vigorous or intense it is possible to perceive improvements, even when the weekly volume of exercises is less than 150 min/wk.[19] The weekly exercise volume in our study was similar to that found in the ALPHA[19] study, which reached 106 to 138 min/wk, and resulted in a decrease in total body fat, abdominal and subcutaneous fat, BMI, WC and WHR. Although not significant in our study, there was an average reduction of about 3.0% in body mass and BMI and over 6.0% in WC.

In the DREW study,[23] different volumes of exercise (75 min/wk; 150 min/wk; 300 min/wk) at moderate intensity (50% VO_2 peak) were compared, and was not found differences between the exercise groups, but when comparing the individuals who exercised with sedentary individuals, the authors verified a significant decrease in WC and an increase in VO_2 peak.

Comparing this study with others that used circuit training, the results were similar for lipoprotein levels, body mass and BMI, although we did not control for caloric intake and the highest intensity of exercise was moderate. Fett et al.[4] investigated caloric restriction combined with resistance exercise in circuit or aerobic exercise and found a reduction in body mass, BMI, and body fat percentage in both groups, but those who did circuit training also presented a reduction in the levels of TC and TG. Paoli et al.[24] compared the effects of high intensity versus low

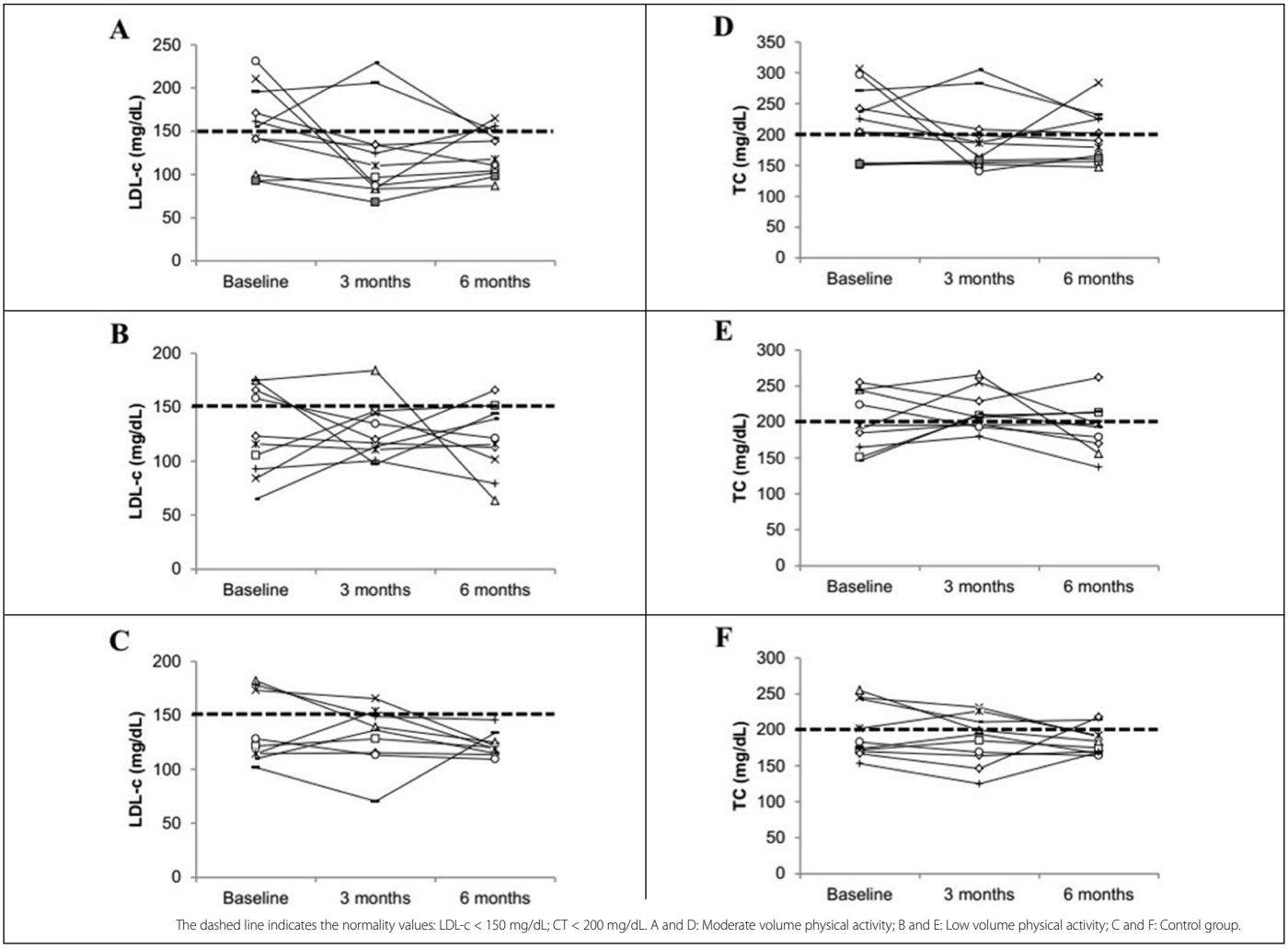

Figure 2. Absolute values variation of LDL-c and TC for each individual within the groups.

intensity circuit training and continuous aerobic training. The authors found a reduction in body mass, fat mass, systolic and diastolic blood pressure, TC, TG, LDL-c, and ApoB/A1 in all exercise group, however, they verified that only high intensity circuit training induced an increase in HDL-c levels. In our study, women who achieved a greater volume of training during the 6 months of exercise participation were those who did not have a reduction in HDL-c, which may suggest a protective effect of the higher frequency of participation in the program, since the participants with less participation showed a reduction of 3.0 to 10.0%.

Studies show that high BMI or body mass alone are not good predictors of CVD, but after adjusting for age, SBP, TC, HDL-c and smoking, the associations become non-significant.[20,25] On the other hand, elevated WC and WHR are indicators of easy accessibility,[1] in line with the study purpose to use low-cost methods. These indicators are strongly associated with mortality from CVD or CAD, even after statistical adjustments.[20] When visceral obesity occurs without presence of other morbidities, it is not associated with a significant increase in the risk of stroke or CVD, but when accompanied by some metabolic dysfunction the risk of developing CAD or heart attack increases by approximately 2 to 5 times over a period of eight years.[25]

Aerobic exercise, resistance and the combination of both generate different effects on risk indicators, when resistance exercises are performed singly, there are an increase in strength and cross-sectional muscle area, but not change body mass, BMI, WC, glycemia, insulin, TG, TC, HDL-c and LDL-c.[14,16,26] However, when combined resistance and aerobic exercise, WC, blood pressure, lipoprotein level, metabolic syndrome *z-score*, and inflammatory markers are reduced, even when there is no decrease of total body mass.[5,14,16] Studies indicate that when are performed only physical exercises, it is necessary to perform high-intensity exercises to increase HDL-c levels and to reduce body mass significantly.[24,27,28] Probably, in our study, we did not observe the same results because the exercises were at moderate intensity. In addition, other factors such as sex, age, and presence of comorbidities such as diabetes, hypertension and dyslipidemias influence the effects of exercise on TC, HDL-c, LDL-c plasma levels and fasting insulin.[7]

Finally, our results indicated that HDL-c levels became significantly lower in the CON group in compared to other groups with a higher volume of physical activity.

Considering that HDL-c plays a protective role on the endothelium[28] and has an inverse association with CVD risk, this result reinforces the need to encourage the population to engage in regular physical exercise programs.

Present study was planned to be developed as part of a basic health care program, with use low-cost equipment and public areas. Some limitations should be considered as the reduced number of participants, limiting the exercise effects magnitude, especially on indicators that show great biological variability. Lack of diet control also is a variable that must be considered, since it also influences the indicators analyzed.

Further studies are needed that also adopt the circuit training method as an alternative to traditional aerobic and resistance training methods, allowing their effectiveness evaluation in the population of women with excess body mass. Likewise, more studies are needed to assess the intention to treat (intention-to-treat approach), to verify if the exercise program is effective in non-optimal conditions.

Our results showed the importance of adherence and participation in activity programs to promote health benefits. We believe that motivation is important for participants to attend exercise programs, a fact that has also been reported in studies with the elderly.[29]

In conclusion, the volume of training based on the frequency of participation in the training program is a key factor for the improvement of anthropometric and biochemical risk factors in women with excess body weight. Although in our study, women exercised with a volume of participation less than 150 min/week, those who participated more frequently, or performed a greater volume of physical activities during the week, showed clinical improvement in TC and LDL-c levels. In contrast, the group that had very low participation in the exercise program presented worsening in HDL-c levels.

Fundings source

This study was supported by Fundação de Amparo à Pesquisa do Estado de Goiás (FAPEG/Brazil) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES/Brazil).

ACKNOWLEDGEMENTS

We would like Municipal Health and Education Secretary of Santo Antônio de Goiás and all the participants who volunteered their time to participate in this study.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTION: Each author made significant individual contributions to this manuscript: GOZ: study concept and design, data analysis and interpretation, writing; LAG: data interpretation and article review; PANP: writing, study concept and design; FMA: writing, study concept and design; AMC: study design, article review; MSS: study concept and design, data interpretation, article review, and approval of the final version.

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