Journal of Physical Education and Sport ® (JPES), Vol 20 (Supplement issue 5), Art 403 pp 2967 – 2975, 2020
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Effects of an eight-week walking program on adiposity, glycemia and lipid profile of university students and staff

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Published online: October 30, 2020
(Accepted for publication: October 22, 2020)
DOI:10.7752/jpes.2020.s5403

Abstract
Introduction: Obesity has become a public health crisis, and many developed and developing countries are struggling with this problem. In the same perspective, level of physical activity has been identified to be the prime risk factor for the increasing prevalence of overweight, obesity, and chronic metabolic diseases. **Objective:**The present study aimed to investigate the effects of an eight-week walking program on body adiposity, fasting blood glucose and lipid profile of university students and staff. **Method:**Twenty-three individuals participated in the study (8 men and 15 women), organized into three groups: without exercise (WE), low attendance (LA) and moderate to high attendance (MHA).For the intragroup analysis (pre *versus* post), the Wilcoxon Mann-Whitney test was used. For intergroup analyzes, the Kruskal Wallis test was used, adopting a significance level of $p<0.05$. **Results:** In both the intra- and intergroup analyzes, the walking program did not cause significant changes in adiposity and fasting glucose.Regarding lipid profile, the WE group presented a significant increase in total cholesterol (pre: 150.12 ± 46.63 mg/dL; post: 181.87 ± 33.24 mg/dL) and LDL (pre: 91, 62 ± 30.02 mg/dL; post: 117.12 ± 40.98 mg/dL) in the intra and intergroup analysis. In the MHA group, no significant changes were observed in any of the variables analyzed. **Conclusion:**The walking program had a protective effect on the lipid profile, but it had no effects on adiposity and fasting blood glucose.Despite the limitations identified in this study, it can be admitted that walking is a simple and easy strategy to execute, with low operational costs,and being effective for improved health among university community members.
Key Words: adiposity, lipid profile,exercise, walking program, university.

Introduction

Cardiovascular diseases represent a serious problem for public health in Brazil and worldwide. Globally, the World Health Organization estimates that 31% of annual deaths are due to cardiovascular diseases and/or events(WHO, 2020).In addition to being the leading cause of death, they are also important causes of morbidities(Ribeiro et al.,2016)and negatively affect the quality of life(Moryś et al., 2016). In this context, the modification of risk factors associated with cardiovascular events and diseases is of paramount importance in preventing problems of this nature.

Given the negative impact of excess bodyweight and hyperlipidemia on the cardiovascular system, it is estimated that a large number of deaths and morbidities can be avoided by controlling the amount of fat in circulation and deposited in adipocytes(Ma et al., 2017). The negative effects of excess bodyweight on health in general and the risk of developing cardiovascular diseases are largely explained by the action of adipose tissue on the metabolism. This tissue produces hormones and cytokines that directly affect energy homeostasis and predispose to hypertension, dyslipidemia, and diabetes (Kershaw,& Flier, 2004).

Regarding circulating lipids in the blood, their imbalance causes endothelial dysfunction, increasing cardiovascular risk associated with atherosclerosis (Gimbrone,& García-Cardeña, 2016).An abnormal lipid profile is an important risk factor for health, and it has been increasingly reported in young people, including university students (Zemdegs et al., 2011). Hyperglycemia is another blood disorder that affects cardiovascular health, characterized by an increase in circulating glucose in the blood, its presence favors, in the medium and long term, the onset of type 2 diabetes and, consequently, nephropathies, neuropathies, retinopathies and others (Sinnott et al., 2015).

In this context, measures that promote the reduction of body fat and/or adequate lipid and glycemic control have important effects on cardiovascular health. These are relevant reasons that explain the importance of physical activity for cardiovascular health. In addition to optimizing the functioning of the heart and blood

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vessels, it reduces the burden imposed on the cardiovascular system and the onset of acute cardiovascular diseases and/or events (Kraus et al., 2019). Physical activity can also promote a reduction in the amount of body fat and rebalance glycemic and lipid levels in the blood (Wood et al., 2019; Swift et al.,2018). For these and other factors, physically active people have significantly lower cardiovascular risk compared to inactive ones (Warburton & Bredin, 2016).

There is consensus in physical activity epidemiology on the inverse relationship between physical activities and chronic-degenerative diseases, such as diabetes, coronary heart disease and hypertension (Ramires et al., 2014).Although the importance of physical activity for cardiovascular health is indisputable, contemporary society has not found efficient solutions to deal with the high rates of physical inactivity in the population. In Brazil, recent data indicate that 61% of the adult population do not reach satisfactory levels of physical activity (Brazil, 2020),and68,5% have not practicedphysical or sports activitiesin the last three months (PNUD, 2017). These numbers indicate that programs to stimulate people of all ages to adopt a more active lifestyle are necessary for the public health of that country, as much as comprehension about barriers to physical activity in different phases and contexts of life.

The university is a potentially powerful scenario for applying tools to promote an active lifestyle. However, in Brazil, physical inactivity (Marcondelli, Costa, & Schmitz, 2008), and the consumption of food with low nutritional value is common among university students and staff (Bernardo et al., 2017).In the university community, the lack of time due to the work and/or study routine is often identified as a barrier to the practice of physical activities. In this sense, physical exercise on the university campus itself has the potential to positively impactcardiovascular risk in this population. Among the numerous types of physical activity, walking is one of the most widely recommended formsofcontrolling body weight and is the most popular in Brazil (PNUD, 2017),in large due to its accessibility and ease. It is an aerobic exercise that involves large muscle groups and does not require sophisticated equipment. Therefore,walking represents a simple and efficientpotential strategy to promote physical activity at university.

In specialized literature, there are no doubts about the positive effects of walking on cardiovascular health (Chen, Ismail, & Al-Safi, 2016). However,dose-response questions still need to bebetter understood.In a recent literature review and meta-analysis, Oja et al.(2018)reported that there is insufficient evidence regarding frequency, duration, intensity, and volume of walking required for benefits on the cardiovascular risk profile.For instance, when the association of anthropometric measures (body mass index, waist circumference and others) with the number of weekly sessions, total number of sessions,or time spent in each session was tested through regression analysis, no significance was found. Another interesting result from this study is that even when the walking activity was below the recommended 150 minutes a week, according to specific literature, there are still health benefits. Therefore, further research is required to elucidate how much walking is necessary to achieve health-related benefits.

Another gap in the literature, identified byOja et al. (2018),refers to the lack of research conducted in developing countries onthe topic of the dose-response relationship of walking.Only three out of 38studies were performed in non-developed countries,suggesting that this themeneeds to be assessed in developing countries.

Considering the need for specific research on cardiovascular risk management in the university community (Marcondelli, Costa, & Schmitz, 2008), and the gaps in scientific knowledge about the minimum dose of walking for cardiovascular health benefitsespecially in developing countries, the aim of the present study was to investigate the effect of an eight-week walking program on fasting blood glucose, lipid profile and adiposity of university studentsand staff at a public university located in northern Brazil.

Material & methods

Ethical aspects and sample

This study meets the requirements of the guidelines and regulating norms for research involving human subjects, and it was approved by the research ethics committee (REC) ofthe *Universidade Federal de Rondônia*(UNIR) under protocol number 1.954.535.It is characterized as quasi-experimental with a quantitative approach.The independent variable was the walking program and the dependent variables were body adiposity (body mass index [BMI], body adiposity index [BAI], fat percentage, waist and neck circumference and waist-to-hip ratio [WHR]), the lipid profile (total cholesterol, HDL-C, LDL-C, VLDL- C and triglycerides, and VLDL-C), and fasting blood glucose.

Sampling was non-probabilistic for convenience, composed of individuals of both sexes.Inclusion criteria were age between 19 and 59 years, any undergraduate or graduate student regularly enrolled at the Porto Velho Campus of UNIR or any public servant on the permanent staff of this institution.

Exclusion criteria were: a) presence of cardiovascular, metabolic or osteoarticular diseases that could interfere with the results of the study or whose clinical condition required special care for physical exercise such as systemic arterial hypertension, diabetes, pulmonary diseases, osteoarthritis, osteoporosis, among others; b) inability to exercise as identified in cardiac examinationor non-attendance; c) presence of regular physical activity in the three months prior to the beginning of the study; d) disagreement with any of the stages of the study; and/or e) failure to sign the informed consent form.

Data was collected before the interventionin April 2017; during the exercise program from April to June 2017; and at the end of the program in June 2017. Due to the large differences in attendance between the participants in the experimental group, after the exercise program, this group was stratified according to attendance in the exercise program: the low attendance (LA) group: individuals who participated in 10 to 45% of the sessions; and the moderate to high attendance (MHA) group: individuals with an attendance of 50% and above.

Blood samples were collected from a total of 23 participants before and after the intervention.Of these, five did not show up for physical evaluation at the end of the exercise program, which is why the number of individuals with data on adiposity is lower than that of those with data on fasting blood glucose and lipid profile.

The walking program

The walking training program was performed at the *José Ribeiro Filho Campus* of UNIR and lasted for 8 weeks, at a three-times-weekly frequency.The sessions lasted from 30 to 60 minutes and included three moments: warm-up (5 to 10'), walking (20 to 40') and cool down (5 to 10').The walk was done at moderate to vigorous intensity.Moderate intensity is defined as 40 to 59% of heart rate reserve (HR reserve) and/or values from 12 to 13 on the Borg scale.Vigorous intensity consists of 60 to 84% of the HR reserve and/orvalues from 14 to 16 on the Borg scale. Training HR and HR reserve were calculated according to the following mathematical equations: [training HR = resting HR + (HR reserve x training intensity)]; [HR reserve = maximum HR –resting HR].

Resting HR was obtained by measuring the lowest heart rate with the participant in a sitting position, in which the patient had remained for 10 minutes of rest in a calm and quiet environment. During the training sessions, intensity was controlled by measuring the HR through palpation of the radial artery by the participants themselves and informed to the instructor-in-charge. In addition, the adapted Borg's subjective perception of effort scale was used.During the walk, participant activity was classified as moderate or vigorous intensity, depending on the training stage, in both criteria. Training progression was carried out according to the recommendations of the ACSM (2003).

Dependent variables

The Body Mass Index (BMI) was calculated using the following mathematical equation: BMI = [Total body mass / $(\text{Height})^2$].Body mass was measured in kilograms, using electronic scales (Líder, São Paulo, Brazil) with a capacity of 200 kg and an accuracy of 50 g. For this measurement, volunteers were weighed using light clothing.Height was measured in meters, using a mobile stadiometer (Alturexata, Minas Gerais, Brazil) with a maximum height measuring capacity of 213 cm in 1 mm increments.To perform the measurement, the participant stood in a completely upright position, on a horizontal resting plane bare footed, and the back of the head in contact with the wall (Frankfurt horizontal plane).This measurement was performed twice.

The circumferences of the neck, hip, and waist were measured with the subject standing in a completely upright position, using a measuring tape (Sanny, São Paulo, Brazil) with a total length of 1.5 meters in 1 mm increments. The measurement of neck circumference was obtained by positioning the measuring tape just below the prominence of the larynx, perpendicular to the long axis of the neck (Fitch et al., 2011).The waist circumference measurement was taken with the tape placed horizontally at the midpoint between the last rib and the iliac crest at the end of a normal expiration. Hip circumference was taken as the widest protrusion of the hip (Monteiro, & Lopes 2005).

The body adiposity index (BAI) was calculated using the mathematical equation: BAI = [(hip circumference) / (height) 1.5) - 18).The BAI has been previously used as a measure to predictthe percentage of body fat in adults, showing a strong association with the values of body fat obtained from Dual Energy Absorptiometry – DEXA (Bergman et al., 2011).

To measure the lipid profile and fasting blood glucose, the volunteers were instructed to fast for 12 hours.Approximately 8 ml of blood was collected from subjects via antecubital vein puncture using a vacuum system.Blood lipids and glucose levels were determined using enzymatic-colorimetric test kits from Bioclin®, Belo Horizonte, Brazil, following the manufacturer's instructions and recommendations.The tests were performed by a trained and experienced professional. To perform the tests, the following equipment was used: a water bath (at 37° C), ultraviolet-visible spectrometer, a centrifuge, p100 and p1000 automatic pipettes, test tubes for reactions and polyethylene cubes to read the samples.

Data analysis

Data were analyzed quantitatively using descriptive and inferential statistics, with the ActionStat® software.For comparisons of values between the pre- and post-training moments, the paired Wilcoxon Mann-Whitney test was used. The Kruskal Wallis and the Bonferroni pos hoc tests were used to compare the groups using the deltavalues.These were calculated by subtracting the post-training values from the pre-training ones. Statistical significance was set to a value of $p<0.05$.

Results

The present study aimed to investigate the effects an 8-week guided walking program on blood glucose, lipidogram (triglycerides, total cholesterol and its fractions HDL, LDL and VLDL) and the markers of body adiposity (BMI, BAI, WHR, and waist and neck circumferences) of university students and staff. Tables 1 and 2 show the pre- and post-intervention values found in the sample, according to the study groups.

Table 1. Mean and standard deviation of adiposity markers of university students and staff before and after the intervention (n=18)

	Mean and standard deviation		
Variables	WE(n=6)	LA(n=6)	MHA(n=6)
BMI Pre	21.83 ± 3.41	23.62 ± 4.56	25.82 ±4.13
BMI Post	21.99 ± 3.22	23.55 ± 4.29	25.75 ± 4.51
BAI Pre	26.33 ± 3.72	26.50 ± 4.23	28.17 ± 6.46
BAI Post	26.33 ± 3.26	26.33 ± 5.00	28.83 ± 6.43
WHR Pre	0.76 ± 0.07	0.77 ± 0.08	0.80 ± 0.07
WHR Post	0.76 ± 0.06	0.76 ± 0.07	0.77 ± 0.06
Waist Circumference Pre	72.52 ± 9.25	75.67 ± 12.87	81.41 ± 10.80
Waist Circumference Post	72.04 ± 8.12	75.24 ± 11.46	79.60 ± 12.26
Neck Circumference Pre	32.48 ± 3.27	34.54 ± 4.05	36.07 ± 3.05
Neck Circumference Post	32.40 ± 3.19	35.93 ± 2.87	35.93 ± 2.88

BMI: body mass index; BAI: body adiposity index; WHR: waist-to-hip ratio

By observing the mean values presented in Table 1, it is noted that the groups were similar at the pre-intervention moment. Statistical difference was observed between the WE and MHA groups for only the BMI variable, which was higher in the MHA group. After 8 weeks of intervention, these differences disappeared. None of the groups underwent significant changes in adiposity markers after the eight-week period. These results indicate that the walking program did not promote significant changes in adiposity.

Table 2. Mean and standard deviation of the biochemical variables of university students and staff before and after the intervention (n=23)

	Mean and standard deviation		
Vriables	WE(n=8)		MHA(n=7)
Triglycerides Pre	77.87 ± 34.80	73.62 ± 37.78	90 ± 43.85
Triglycerides Post	86.37 ± 40.43	103.50 ± 75.66	90.14 ± 43.91
Cholesterol Pre	150.12 ± 46.63	143.37 ± 42.27	176.57 ± 30.43
Cholesterol Post	181.87 ± 33.24 +	157.50 ± 44.81	160.14 ± 21.54
LDL Pre	91.62 ± 30.02	90.25 ± 38.07	115.71 ± 30.62
LDL Post	117.12 ± 40.98 +	99.75 ± 31.33	103.28 ± 20.68
HDL Pre	57.75 ± 29.11	38.75 ± 8.10	43 ± 7.42
HDL Post	47.37 ± 14.88	37.12 ± 6.58	38.71± 3.90
VLDL Pre	15.12 ± 6.49	14.87 ± 7.64	17.86 ± 8.74
VLDL Post	17.25 ± 7.94	20.62 ± 15.23	18.14 ± 8.61
Glucose Pre	78,5 ± 18,83	77 ± 4	76,43 ± 2,82
Glucose Post	76,12 ± 5,64	78,5 ± 9,26	83,43 ± 13,46

+Statistically different when compared to the pre-training moment ($p < 0.05$) - paired Wilcoxon test.

Table 2 shows the pre- and post eight-week values of the biochemical variables.For all variables, the groups were statistically similar, in the before and after comparison.In the intra-group comparisons, that is, each group being compared with itself (pre *versus* post moments), statistically significant differences were found only in the WE group: a significant increase in total and LDL cholesterol.These results indicate that in the group that did not exercise there was a worsening/increase in the values of total and LDL cholesterol.The exercise program had a protective effect on these changes. Table 3 presents the delta values for the adiposity variables. No differences were observed between the groups.

Table 3. Mean and standard deviation of the deltas calculated for the adiposity variables of university students and employees (n=18)

	Mean and standard deviation			
Variables	**WE (n=6)**	**LA (n=6)**	**MHA (n=6)**	**p value**
BMI	0.14 ± 0.40	-0.07 ± 0.40	-0.07 ± 0.62	0.61
BAI	0 ± 0.89	-0.16 ± 1.17	0.66 ± 1.96	0.76
WHR	-0.003 ± 0.01	-0.01 ± 0.03	-0.02 ± 0.02	0.32
Waist circumference	-0.48 ± 2.03	-0.44 ± 2.47	-1.81 ± 2.61	063
Neck circumference	-0.08 ± 0.44	0.03 ± 0.53	-0.13 ± 0.56	0.83

BMI: body mass index; BAI: body adiposity index; WHR: waist-to-hip ratio.

Table 4 shows the deltas for the biochemical variables. It is observed that differences were observed between the deltas for thetotal and LDL cholesterol variables. These differences were between the WE and MHA groups.

Table 4. Mean and standard deviation of the deltas calculated for the biochemical variables of university students and staff (n=23)

	Mean and standard deviation			
Variables	**WE (n=8)**	**LA (n=8)**	**MHA (n=7)**	**pvalue**
Triglycerides	8.5 ± 33.38	29.87 ± 38.76	0.14 ± 21.22	0.16
Total cholesterol	31.75 ± 31.38	14.12 ± 42.80	-16.43 ± 21.91	0.04*
LDL cholesterol	25.5 ± 23.45	9.50 ± 40.13	-12.43 ± 19.05	0.03*
HDL cholesterol	-10.37 ± 22.65	-1.62 ± 5.34	-4.28 ± 4.64	0.51
VLDL cholesterol	2.12 ± 6.24	5.75 ± 7.74	0.28 ± 4.53	0.33
Fasting Glucose	-2.37 ± 14.54	1.50 ± 9.83	7 ± 12.20	0.33

* Significant difference between WE and MHA.

Discussion

The present study aimed to investigate the effects of an eight-week walking program on adiposity, fasting glucose and lipid profile of university students and staff. The most expressive result was the protective effect of exercise on total cholesterol and LDL.In the WE groupthese variables increased significantly, while in the MHA group these variables did not increase.

The main aspect to be noted in this study is that the sample was made up of subjects from the university community.In Brazil, with the objective of reducing both the amount of time and the costs of eating, it is common for university students and staff to consume fast foods (Bernardo et al., 2017).Furthermore,difficulties in engaging in physical activity programs is common in this group (Marcondelli, Costa, & Schmitz, 2008).These habits have a potentially negative impact on the lipidic profile. Interestingly, in a sample of 154 students from Aveiro's University, Portugal (Brandão, Pimentel, & Cardoso, 2011),similar results were found. The researchers showed that older university studentspresented a higher proportion of dyslipidemia(44.0% *versus* 28.6%), overweight (16.3% *versus* 12.5%) andsmoking (19.3% *versus* 0%) when compared to freshman students. Therefore, exposition to university life was associated with increased LDL and marginally with total cholesterol levels.

In this sense, it is relevant to point out that in this study pre-intervention measurements were collected during the first month (April) of the academic semester while post-intervention measurements were collected at the end of semester (July). The end of semester is a time that is usually full of commitments, like assessments, project deadlines, research reports and other kinds of academic activities. Probably, during this period students and professors face their greatest demands, academic activities become priority and healthy habits are put in second place

This study suggests exposure to the academic environment tends to negatively influence lipid profile, therebyincreasing cardiovascular risk. Furthermore, walking is seen to be a simple strategy tocounterbalance the negative alterations in total and LDL cholesterol found in WE group. Previous research has evidenced the negative impact increased cholesterol levels have on cardiovascular risk (LaRosa et al., 2013).Thus, the WE group was negatively impacted in this aspect, which did not occur in that group of people whose attendance in exercise sessions was 50% or more.

In this sense, attendance is an aspect that deserves attention. In this study, attendance in MHA group was 64.30%, ranging from 50 to 85%. Previous studies,in which aerobic exercise significatively reduced lipid profile parameters, included only subjects with an attendance rate of 75% or more (Costa et al., 2018; Slentz et al., 2007;O'Donovan et al., 2005).Attendance levels in our study probably prevented more expressive results on lipid profile, blood glucose and adiposity.Therefore, future studies should include moremotivational factors.

In addition to the specificities of the academic environment and participant attendance, it is possible that the exercise variables, such as intensity, program and session duration influenced the results. In 2014, Mann, Beedie and Jimenez (2014) published a review on the impact of physical exercise on lipid profile. Six original studies exclusively analyzingaerobic exercise were included; another two compared different intensities of exercise; therefore, there was a total of eight intervention protocols in thisreview. For total cholesterol, six studies did not resent a significant reduction. Protocols that caused significative improvement in this parameter had interventions that lasted for 24 weeks or more and used higher intensity exercise (80% of the VO_2max and 50 to 85% of theheart rate reserve) than what was applied in the current study(40 to 84% of cardiacreserve) when considering the lower limit of intensity.

Concerning LDL cholesterol, in the afore cited review of 2014,[34] five aerobic exercise protocols were unable to modify this parameter, while three presented significant reductions.All the exercise inventions in these studies lasted 24 weeks, with three weekly sessions and minimal intensity of 50% of VO2peak/VO2max.

Therefore, it is possible to affirm that the results from our study corroborate with previous publications, which report that interventions with intensity below 50% of the heart rate reserve, and with a duration of less than 24 weeks are insufficientto obtain expressive results on total and LDL cholesterol.

An important differential of the present study should be highlighted: the academic context. Throughout the academic semester, university students and staff are exposed to distinct levels of assignments, which can influence their health habits and consequently their blood lipids.

The mechanisms that explain the effects of physical exercise on lipid profile, including total and LDL cholesterol, have not yet been fully elucidated (Enkhmaa et al., 2018), but they are possibly related to: 1) decreased triglyceride levels through reduced hepatic VLDL secretion (Marinangeli, Varady, & Jones, 2006); 2) increased ability of skeletal muscles to utilize lipids as opposed to glycogen (Marinangeli, Varady, & Jones, 2006; Earnest et al., 2013), 3) greatercapacity of lecithin cholesterol acyltrans (LCAT), enzyme responsible forcholesteryl ester transfer to HDL (Calabresi, & Franceschini 2010); 4) reduction of the enzyme responsible for transferringcholesteryl estersto other lipoproteins (Lira et al., 2010);and 5) increased lipoprotein lipase activity (Marinangeli, Varady, & Jones, 2006; Harrison, Moyna, & Zderic, 2013),.Effects of exercise intensity and length of intervention on each of these mechanisms are not fully understood. In this sense, more studies are needed for better comprehension. Through existing evidence up to date, vigorous exercise, compared to moderate, has been shown to be more efficient when the lipid profile is in focus (Silva et al., 2016).

Specifically considering the effects of walking on cardiovascular risk, according to a review and metanalysis study (OJA et al., 2018),there is not enough evidence to establish exactlyhow frequency, duration, intensity, or volume in this type of exercise impacts cardiovascular risk. In this review, 37studies measuring one or more variable from the lipid profilewere included (triglycerides, total, HDL, and LDL cholesterol).In thismetanalysis, none of these were affected with walking in a significatively way.

One of the most unexpected results of the present study was that there were no alterations in the HDL cholesterol levels in the MHA group. This is because in previous publications, this variable has been positively changed in a representative manner(Costa et al., 2018; Banz et al., 2003; LeMura et al., 2000). However, in the present study, this outcome was not identified; and the main hypothesis for this is related to food intake, since diet was not controlled or guided. Previous research shows that food intake influences both HDL quantity as well as its antiatherogenic function (Wiseman, 1997; Andersen, & Fernandez, 2013).

It is possible that the participants'dietschanged over the academic semester, becoming less nutritious and richer in fatty and sugar foods. This hypothesis, however, cannot be verified. Further studies in university context should include this aspect. This hypothesis is also the casewhen trying to explain the fact that no changes occurred in adiposity, since this variable is influenced by food intake quantity and quality (Matovu et al., 2017; Hooper et al., 2015).

Regarding no changes in blood glucose,the fact that the volunteers were normoglycemic is a possible explanation. In 2014, Appuhamy et al. (2014)studied the effects of one year of combined exercise and diet on blood glucose and other risk factors for diabetes in a sample of adults without this pathology. In a metanalysis, the researchers concluded that thoseabnormalities in blood glucose, insulin or lipids benefittedmore from the mentioned interventions comparedto those with normoglycemic variables.It is also important to point out that individuals with normal fasting blood glucose do not have benefits on cardiovascular risk when reducing this variable (Seshasai et al., 2011).

Recently Oja et al. (2018)reported in a metanalysis that fasting glucose is positively influenced by walking. In this publication, however, no significative associations were found between the amount of walking (program and session duration, weekly sessions, or intensity) and fasting blood glucose response. Thus, in contrast to lipid profile variables, it is unlikely that the effect of no exercise on glucose level would be different by changing the exercise characteristics. Thus, more sensitive measures, such as glycosylated hemoglobin, glucose tolerance or insulin resistance, should be used to assess the effects of exercise on glucose metabolism in healthy subjects.

The present study has the following limitations: total intervention time (eight weeks), small sample size, no control or orientation on dietary intake, and an especially low attendance to sessions. It is relevant to highlight that there was no intention, at the beginning of the study, to separate the participantsinto separate groups according to attendance. However, this was done as some volunteers presented exceptionally low attendance. From this reality also derives another analysis: even when attendance is below the recommended level for greater benefits, walking can prevent some of the negative effects of the university lifestyle during the academic semester. This comprehension is in sense with conclusion presented by Oja et al. (2018)as they consider that evenaminimal amount of walking can have positive effects on health

Conclusion

The present study aimed to investigate if an eight-week walking program was able to promote alterations on adiposity, fasting blood glucose and lipid profile among university students and staff. While no effects were achieved in the first and second parameters, elevation of two variables in the lipid profile (total cholesterol and LDL), were seen in the WE group,but not in the MHA group. Therefore,even though mean adherence to the exercise sessions was less than 65%, the walking program had a protective effect on the lipid profile.

Considering that participants in MHA group walked, on average, twice a week and that this was sufficient to prevent the worsening for total and LDL cholesterol levels seen in the WE group, the main contribution of this study,to current literature in the area of physical exercise, is evidence that even when walking doesnot directly cause positive changes on some variables, it can help prevent the negative cardiovascular impacts of a sedentary and/or stressing lifestyle. Regarding the absence of positive results on adiposity and blood glucose,this studyreinforces the need for higher doses to obtain them.

Despite the limitations, this studyprovides an important practical contribution: walking must continue to be recommended as a strategy to promote health, especially as it is an easy type of exercise to execute,with low costs, and proved efficiency for the primary prevention of cardiovascular outcomes. In this sense, it is also recommended that university managerspromote physical activity promotion programs.

There are no conflicts of interest

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