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Training Program of Aerobic and Strength Exercise on Physical and Metabolic Health of Young Female Undergraduate Students

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Abstract

Background: Verify the efficiency of a compound training program on behavioral features related to both physical exercise and physical and metabolic health of young female undergraduate students.

Method: An intervention study was carried out with female undergraduate students from 18 to 25 years old. It was evaluated their anthropometric profile and body composition, physical activity level, physical and cardiovascular health. Besides that, it was analyzed Short-Chain Fatty Acids (SCFA) in faecal samples, and a compound physical exercise program (resistance and aerobic) was carried out during 8 weeks, three times a week.

Results: An 8-week compound training protocol promote positive effects on the behavioral, physical activity, anthropometric, body composition, hemodynamic, physical fitness and SCFA. The analysis of SCFA concentration in faeces identified detected an increase in acetic acids and in acetic/propionic ratio, as well as a decrease in butyric acids, formic acids and isovaleric acids.

Conclusion: The results showed that intervention in physical and metabolic health are efficient and it is also a potential mean of promoting behavioral changes, mainly regarding physical activities and motivational factors.

Keywords: Methodology; Physical training; Short-chain fatty acids; Health

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Introduction

Background

Physical inactivity has been identified as the fourth main risk factor to mortality worldwide [1], also epidemiological data from recent domestic research [2] show that 7 out of 10 Brazilian don't practice physical and sports activities, which prevails among young undergraduate students. To exemplify such statement, researches showed that the prevalence of sedentary behavior among these public ranges from 70 to 90% [3-5], which contributes to the early increase in NCDs risk factors.

College admission may influence the change of lifestyle and prevent the development of NCDs, osteoporosis, cancer and depression [6], especially in women, who have features that potentialize the increase of these diseases when associated to sedentary behavior, for this group presents smaller amount of fat-free mass, low aerobic capacity, high lipid accumulation and inflammatory cells [7]. According to this, young undergraduate students represent a share of the population important to consolidate the regular practice of physical activity for life, which may be considered a critical window in the educational process concerning healthy lifestyle [8].

There are interventions intended to promote the practice of physical activity to young adults, however, there is little knowledge on the methodology of study, the types of intervention, the evidence of effects and the outcomes to health, especially in undergraduate population. The most current recommendations [9,10] suggest the practice of moderate-intensity physical activities to adults during, at least, 150 to 300 minutes per week to prevent and control diseases as well as to reduce the prevalence of excessive body mass and obesity.

The physical activity prescription needs to be planned and structured. Its intensity and volume must be taking into consideration as well, which must be a progressive loading program, so that there are benefits. It is also important that there is periodization in the prescription, and there must also have varying activities on it, namely, aerobic, resistance and flexibility activities [10].

According to Bouchard [11], the training should also take into account the subject's phenotypic and health features, since adaptive mechanisms differ from person to person. The individual response to similar stimuli differs based on baseline modifications at the muscular, cardiovascular, pulmonary and hormonal levels, as well as on genotype, previous experience and technique of exercise performance [10].

From the understanding of the complexity related to both the prescription and implementation of a training method and the existing variability according to the assisted population, there is the need of thoroughly describing the intensity of the training routines [12] so that the researches are reliable, applicable and straightforward. Nevertheless, we note a substantial lack concerning the methodological description: has any training method been applied? Has any new procedure been implemented?

Ideally, the exercise prescription should be individual with specific load. However, we know that group activities as well as the moderate-intensity ones improve higher adherence, which makes collective circuit training an unlike strategy that may provide successful outcomes [13-15]. Currently, compound exercises of aerobic and strength components are considered the most adequate ones. Thus, it is important to verify whether the prescription methods inherent to this format can really deliver physical and metabolic benefits, supporting the professionals from this field during decision-making.

The aim of this study is to verify the efficiency of a compound training program on behavioral features related to both physical exercise and physical and metabolic health of young female undergraduate students.

Methods

Subjects

The subjects of this investigation were female students, admitted at undergraduate courses from a Brazilian public university, in 2016, ranging from 18 to 25 years old. The inclusion criteria selected were women with "regular" menstrual cycles [16] and who were not practicing physical activities for at least 6 months. Taking the inclusion criteria into consideration, the study started with 75 subjects and finished, after 8 weeks of training, with 60.

Ethical approval

The study satisfies the standards of Comitê de Ética em Pesquisa com Seres Humanos (Human Research Ethics Committee) from Federal University of Vicosa (UFV), according to the Opinion number 1.447.278 as well as to Certificado de Apresentação para Apresentação Ética – CAAE (certificate of presentation for Ethical Consideration) number 53452916.3.0000.5153. It is also in accordance with the demands from Ministry of Health and under Diretrizes e Normas Regulamentadoras de Pesquisas Envolvendo Seres Humanos (Guidelines and Standards Regulating Research Involving Human Subjects) (Resolution 466/2012 from National Health Council) [17].

Design

The intervention program had 3 steps.

Steps 1 and 3: Initial and Final Evaluations

Anamnesis: The anamnesis considered socio-demographic, academic, physical activities and health situations. We also applied the summarized version of International Physical Activity Questionnaire (IPAQ) validated in Brazil by Matsudo et al. [18] and collected data on regular physical activity and we calculated the index of labor, sports and leisure [19].

The risk of coronary diseases was calculated by applying variables of existing cardiovascular compromises in the family, smoking and physical activity practice, body mass, blood pressure, age and sex [20], which had already been applied by Pitanga et al. [21] to evaluate adults.

In order to evaluate the reason that led the female volunteers to practice physical activities or not, we applied the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2) [22].

Anthropometric and body composition evaluation measures: All the anthropometric procedures satisfied the guidelines and recommendations from International Society for the Advancement of Kinanthropometry (ISAK) [23].

Body mass was measured in kilograms, deploying a Kratos-cas® scale (with maximum capacity of 150 kg and subdivision of 50 g). The height was taken in centimeters, deploying a vertical portable stadiometer (Alturexata®, Belo Horizonte, Brazil), and for taking the circumference abdominal, hips and neck circumferences, it was deployed a flexible and not elastic measuring tape. After collecting the measures, we calculated Body-Mass Index (BMI), Waist-Hip Ratio (WHR) [24], Conicity Index (CI) [25] and Waist-to-Height Ratio (WHtR) [26].

Were carried out deploying the device dual-energy X-ray Absorptiometry (DXA) (Lunar Prodigy Advance DXA System® – analysis version: 13.31, GE Healthcare, Madison, WI, USA), which provided values of lean body mass, fat mass, bone mass, and fat-free mass.

Hematologic and short-chain fatty acids evaluation measures: Blood samples were collected from 7 a.m. to 9 a.m., after the subjects fasted for 12 hours, it was evaluated uric acid, lipid profile, creatinine, creatinine phosphokinase (CPK), Growth Hormone (GH), fasting glucose level, complete blood count, platelets, C-reactive protein and Thyroid-Stimulating Hormone (TSH). The normal range was based on Sociedade Brasileira de Análises Clínicas (Brazilian Society of Clinical Analysis) [27].

The measurement of Short-Chain Fatty Acids (SCFA) was carried out in Laboratório de Bioquímica Nutricional – LABIN (Laboratory of Nutritional Biochemistry) and Laboratório de Análises Clínicas – LAC (Laboratory of Clinical Analysis) from Department of Nutrition and Health in UFV. A ten microgram (μg) faeces sample

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(frozen at -80°C) was weighted, which was dissolved in 1990 microliter (μL) of Milli-Q water, and the protocol for extracting the fatty acids followed the techniques adapted by Smiricky et al. [28] and Zhao et al. [29] for HPLC analysis of organic acids. The fatty acids identified were acetic, propionic, butyric, formic, isobutyric, and isovaleric, which were measured in μmol/g. The acetic/propionic ratio was calculated.

Tests and measures for physical condition evaluation: The cardiorespiratory capacity was evaluated by applying Robergs et al. [30] submaximal protocol in a treadmill during 8 minutes, divided in two stages of 4 minutes each.

The schedule applied was developed by Laboratório de Performance Humana (Laboratory of Human Performance) from Department of Physical Education in UFV. The physical evaluation form used is available in AvaEsporte® software.

It was used an EX CAFIX® ergometer (treadmill), model EG700X, without incline, in order to perform the effort activities; an Oregon heart rate monitoring system (model SE211/SE232) in order to measure and control Heart Beat (HB) per minute; and a Wan Med® mercury sphygmomanometer with wheels.

The blood pressure was measured right, with the subject in sitting position, satisfying the recommendations from American Heart Association (AHA) and VII Diretrizes Brasileiras de Hipertensão Arterial [9] (VII Brazilian Guideline of Arterial Hypertension) in order to do it adequately.

The hemodynamic and metabolic parameters calculated were: Predicted and Calculated Maximal Oxygen Uptake (VO2 MAX); Functional Aerobic Impairment (FAI); Double Product (DP); maximum Metabolic Equivalent of Task (MET); maximum Kilocalorie (kcal); and Maximum Heart Rate (MHR) [31].

To evaluate the muscular endurance, carried out through Modified Push-ups and Sit-ups, and flexibility, Pollock et al. [32] protocol and classification were applied.

Second stage: Training program

The intervention was made up of a compound physical activity program (strength and aerobic) during 8 weeks (from September to November, 2016), satisfying both ACSM [10,33,34] and World Health Organization (WHO) recommendations [15].

During the activities, the volunteers used the Oregon heart rate monitoring system (model SE211/SE232) to verify the HB behavior. In case the maximum values obtained were higher than those estimated by the Training Heart Rate equation [35] and by the submaximal test, the volunteers were oriented to reduce the exercise intensity.

Training program duration, intensity and monitoring

In the strength training, the intensity load control was done based on weight, movement speed, interval between series, interval between the exercises, RPE, strength threshold, and exercise position in the circuit. Additional files **(Appendix 1)** fully presents the actions related to intensity control fully.

The volume control in strength training was performed based on the number of exercises, number of series, number of repetitions, weekly frequency and training session total duration. Additional files **(Appendix 2)** fully presents the actions related to volume control.

In aerobic training, the intensity load control was performed based on HB and RPE. The exercises performed covered bicycle, jumps, ropes, jogging, and bench. Additional files **(Appendix 3)** describe the aerobic training intensity control.

The volume control in the aerobic training was performed based on the number of exercises, number of series, number of repetitions, weekly frequency and the accumulated total duration. Additional files **(Appendix 4)** indicate the aerobic training volume control.

Statistical Analyses

The normality of the quantitative variables was analyzed by applying the Shapiro-Wilk test. In addition, the intervention impact was analyzed by applying the Wilcoxon test. The delta (time 2-time 1) was calculated in order to measure the Confidence Interval, with its upper and lower limits. Every investigated variable present power of study from 0.9 a 1.0 [36]. In all the tests, $\alpha \leq 5\%$ was applied. The results are presented as median and interquartile range. The statistical software SPSS version 20 and Stata version 13 were used in order to elaborate the database and its analysis.

Results

Table 1 presents the behavioral features related to physical activity in young female undergraduate students taking into consideration motivation, sedentary behavior and regular practice of physical activity. Their motivation to practice physical activity increased because there was a considerable statistical increase in self-esteem scores (interjected regulation); they understood the goals, values and the rules (identified regulation); they were interested in the activity and enjoyed it (intrinsic motivation); and they understood the benefits provided by the activity and internalized them (self-determination) [22]. On the other hand, although the time spent sitting during the weekdays reduced 90 minutes, it was not enough because this amount of time was offset on the weekends [36].

In this study, it was verified that there was the labor index decrease and the sport index increase [19], which has positive impact to both health and changes in the lifestyle **(Table 1)**.

Regarding the anthropometric indexes, there was a decrease in waist circumference, neck circumference, WHR index, WHtR RCE and conicity index, variables related to the decrease in risk factors for cardiovascular diseases [26,37]. These changes may be related to the increase in lean body mass and fat-free mass, as well as the decrease in fat mass and, consequently, on the coronary risk **(Table 2)**.

Regarding the hemodynamic parameters, there were not great changes in RHR, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP). However, it was identified an increase in Basal Metabolic Rate (BMR) and in all the physical fitness variables: flexibility, upper limbs strength, abdominal strength, VO2 MAX

Table 1 Behavioral and physical activities features of young women, expressed as median and interquartile interval.

	Before	After	p*
Behavioral (Scores motivation)			
No motivation	-	-	-
External Regulation	-	-	-
Introjected Regulation	0.33 (0.00-1.00)	1.00 (0.00-1.67)	<0.001
Identified Regulation	2.00 (1.19-2.75)	2.75 (2.25-3.31)	<0.001
Intrinsic Motivation	2.00 (0.75-3.00)	2.50 (2.00-3.25)	<0.001
Self-determination	7.54 (12.06-2.73)	10.50 (14.08-9.56)	<0.001
Sedentary behavior (minutes)			
Time spent sitting (weekdays)	600.00 (480.00-840.00)	510.00 (420.00-720.00)	0.336
Time spent sitting (weekends)	600 (360.00-840.00)	600.00 (420.00-900.00)	0.959
Regular physical activity (Scores)			
Labor Index	17.00 (14.00-19.00)	2.38 (2.13-2.63)	<0.001
Sport Index	1.75 (1.50-2.31)	2.50 (2.25-2.81)	<0.001
Leisure Index	9.38 (6.44-12.75)	10.88 (7.25-16.38)	0.139
*Wilcoxon test			

Table 2 Parameters, anthropometric index and coronary risk in young women expressed as median and interquartile interval.

	Before	After	p
Anthropometry			
Body mass (kg)	58.83 (51.89-65.78)	59.05 (51.66-65.56)	0.164
WC (cm)	76,38 (69,31-83.75)	76.00 (68.56-83.50)	0.024
Neck circumference (cm)	30.75 (29.81-31.43)	30.00 (29.50-31.19)	<0.001
Hip circumference (cm)	97.88 (90.81-101.44)	98.13 (90.75-100.88)	0.149
Anthropometric indexes			
BMI (kg/m^2)	22.42 (19.41-24.85)	22.22 (19.69-25.13)	0.149
WHR (cm)	0.79 (0.75-0.84)	0.79 (0,74-0.83)	0.003
WHtR (cm)	0.47 (0.44-0.52)	0.46 (0.43-0.52)	0.027
Conicity index	1.18 (1.10 -1.22)	1.13 (1.06-1.18)	0.004
Body composition			
Lean Body Mass (kg)	35.76 (32.46-38.90)	36.98 (33.27-39.39)	<0.001
Fat Mass (kg)	20.24 (14.90-24.24)	18.94 (14.43-23.62)	<0.001
Bone Mass (kg)	2.24 (1.99-2.51)	2.23 (2.00-2.56)	0.216
Fat-Free Mass (kg)	38.02 (34.34-41.43)	39.36 (35.36-41.83)	<0.001
Coronary Risk	12.00 (11.00 -15.00)	11.00 (9.00-14.00)	<0.001
Value of p obtained based on Wilcoxon Signed-Rank Test (before x after). WC=Waist Circumference.			

(ml) and MET. Furthermore, there was a decrease in FAI, DP, MHR and maximum measured SBP **(Table 3)**.

The analysis of SCFA concentration in faeces identified detected an increase in acetic acids and in acetic/propionic ratio, as well as a decrease in butyric acids, formic acids and isovaleric acids. This is the first study, up to our knowledge, that approaches theses acids regarding the longitudinal impact in young female undergraduate students **(Table 4)**.

Regarding inflammatory and blood parameters, there was a decrease in glucose levels, High-Density Lipoprotein-Cholesterol (HDL), creatinine, CPK and monocytes. There was also an increase in red blood cell levels, hemoglobin, hematocrit, Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Volume (MCV) **(Table 5)**.

Discussion

The activity program implemented in 8 weeks, in a closely similar to "real" situations seen in environments for practicing physical activities, positively changed the subjects' physical and metabolic health and some specific aspects of their behavior related to their physical activity practice, which enhances the findings in Plotnikoff et al. [6].

Regarding the motivations to practice physical activities, it is observer that there was an increase in the motivational levels related to self-esteem and to the understanding of the benefits of having active life habits. According to Nahas [38] to several people, start practicing physical activities and keeping the healthy life to achieve a good physical fitness is a hard task, for it demands individual struggle. Thus, adhering and implementing

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Table 3 Hemodynamic and physical fitness parameters in young women expressed as median and interquartile interval.

	Before	After	p
Hemodynamic			
SBP (mmHg)	110.00 (110.00-120.00)	110.00 (110.00-120.00)	0.895
DBP (mg/dL)	80.00 (80.00-80.00)	80.00 (80.00-80.00)	0.083
RHR (bpm)	73.00 (65.00-79.50)	71.00 (66.00-79.00)	0.556
BMR	1241.50 (1145.00-1319.50)	1248.00 (1178.50-1338.00)	<0.001
Physical fitness			
Flexibility	26.40 (18.88-31.10)	29.30 (25.15-33.38)	<0.001
ULS	12.50 (8.25-18.00)	21.00 (16.00-25.00)	<0.001
Abdominal Strength	19.00 (14.25-22.00)	22.50 (19.25-26.00)	<0.001
VO2 MAX (ml)	30.46 (27.79-22.47)	32.21 (29.43-34.75)	<0.001
MHR	185.50 (181.00-193.75)	180.50 (172.25-186.75)	<0.001
SBP maximum measured	150.00 (142.50-150.00)	140.00 (140.00-150.00)	<0.001
MET	8.70 (7.91-9.58)	9.20 (8.41-9.93)	<0.001
FAI	18.52 (9.39-25.52)	13.96 (6.16-21.29)	<0.001
Double Product	27750.00 (26587.50-29212.50)	25635.00 (24462.50-27015.00)	<0.001
BEO	1360.73 (1258.75-1462.89)	1364.04 (1255.44-1459.77)	0.137
ULS=Upper Limb Strength; FAI=Functional Aerobic Impairment; BEO=Basal Energy Output. Value of p obtained based on Wilcoxon Signed-Rank Test (before x after).			

Table 4 SCFA Concentrations (mmol/L) in faeces of young women recently admitted to a Brazilian public university before and after a compound physical exercise program during 8 weeks expressed as median and interquartile interval.

	Before	After	p
Acetic	80.14 (43.81-116.93)	89.53 (48.66-171.94)	0.032
Propionic	11.65 (8.65-14.44)	11.33 (9.40-15.54)	0.489
Butyric	32.03 (7.79-119.51)	30.60 (7.73-65.98)	0.038
Total FA*	153.69 (84.29-250.94)	153.34 (90.73-238.16)	0.889
Acetic/propionic Ratio	5.96 (3.50-10.25)	8.36 (3.95-14.55)	46
Formic	3.75 (0.00-7.83)	0.00 (0.00-0.99)	<0.001
Isobutyric	8.79 (6.24-56.13)	6.88 (5.48-16.64)	0.09
Isovaleric	11.97 (4.58-18.51)	7.08 (0.00-12.79)	0.033
*Value of p obtained based on Wilcoxon Signed-Rank Test (before x after).			

policies and actions in undergraduate environment to promote health is relevant, since active lifestyles help to prevent NCDs [6].

The exercise practice provided change in the regular physical activities, reversely changing both labor and sport indexes **(Table 1)**. Weinstock [39] claims that practicing exercises in the undergraduate environments provides countless benefits to physical and mental health. He states that students who engage in regular physical activities are less likely to drink alcoholic beverages and present positive results related to body mass reduction [6].

Hence, engaging in group classes may promote the adherence to the physical activity practice and lifestyle changes, consequently preventing diseases associated with inactivity. It was observed in the current study, e.g., that the regular physical activity practice decreased coronary risk factors score **(Table 2)**. Therefore, physical training may be applied as a non-pharmacological way of improving strength and increasing muscle mass, which results in body mass loss.

Regarding the subjects' body mass and body composition, there was a decrease in the anthropometric indexes of abdominal adiposity (waist circumference, conicity index and WHtR) [25] as well as of fat mass. There was also an increase in lean body mass and fat-free mass **(Table 2)**, confirming the meta-analyses made by Pattyn et al. [12], which identified physical activities positive effects compared to most of the metabolic risk factors.

The changes in the indexes and in the body composition may also be associated with the BMR increase [40], likely resulting from the body mass gain greater than 1 kg **(Table 2)**. Before the intervention, the subjects were classified according to their physical fitness level ranging from week to regular [41] regarding flexibility (53.3%), cardiorespiratory capacity (63.3%), abdominal strength (91.7%) and upper limbs strength (21.7%). After training during 8 weeks, there was an increase in the proportion of subjects classified as having from medium to excellent physical fitness regarding flexibility (68.3%), cardiorespiratory capacity (63.3%), abdominal strength (30.0%) and upper limbs strength (78.3%).

The improvement in physical fitness and cardiorespiratory levels in the study **(Table 3)** may result from the increase in cardiac contractility [42], skeletal muscle buffering capacity, mitochondrial biogenesis, and oxidative capacity [43]. There was also an increase in the significant oxidative adaptations in the exercising muscle as well as in the maximum oxygen intake [44].

Table 5 Blood and inflammatory parameters of young women expressed as median and interquartile interval.

	Before	After	p
Blood			
Glucose (mg/dL)	80.00 (75.00-83.00)	76.00 (71.00-81.00)	0.018
Insulin (μ U/ml)	6.30 (4.35-9.40)	7.10 (4.60-9.50)	0.592
Triglyceride (mg/dL)	76.00 (60.00-111.00)	70.00 (55.00-100.00)	0.693
Cholesterol	153.00 (140.00-173.00)	151.00 (137.00-169.00)	0.45
HDL (mg/dL)	55.00 (51.00-62.00)	54.00 (50.00-62.00)	0.038
LDL	82.00 (65.00-97.00)	83.00 (66.00-93.00)	0.852
Uric Acid (mg/dL)	3.10 (2.70-3.70)	3.10 (2.50-3.90)	0.806
Creatinine	0.82 (0.78-0.90)	0.79 (0.73-0.86)	0.002
TSH	1.74 (1.30-2.51)	2.00 (1.41-2.60)	0.437
GH	1.54 (0.61-5.54)	2.81 (0.54-4.74)	0.821
CPK	105.00 (75.60-163.00)	83.40 (68.30-119.50)	0.003
Blood count			
Red Blood Cell	4.39 (4.14-4.60)	4.54 (4.35-4.78)	<0.001
Hemoglobin	12.65 (12.08-13.20)	13.40 (12.78-13.83)	<0.001
Hematocrit	38.40 (36.30-40.03)	40.55 (38.28-41.80)	<0.001
MCV	87.70 (84.40-90.98)	88.85 (84.98-92.88)	0.003
MCH	29.15 (27.98-30.33)	29.65 (28.38-30.63)	0.004
MCHC	33.00 (31.60-33.70)	33.10 (32.80-33.30)	0.79
RDW	13.20 (12.70-13.96)	13.20 (12.70-13.90)	0.436
Platelets	241500.00 (213750.00-274500.00)	251000.00 (205750.00-296750.00)	0.315
Inflammatory			
Leukocytes	6450.00 (5200.00-7325.00)	6300.00 (5575.00-7325.00)	0.63
Eosinophils	102.00 (56.75-181.25)	97.00 (55.50-181.25)	0.935
Monocytes	327.50 (273.00-387.75)	376.00 (315.00-473.00)	0.002
Lymphocytes	2299.00 (1953.00-2816.25)	2417.00 (2006.25-2700.00)	0.481
PCR	0.80 (0.40-2.20)	0.90 (0.50-2.20)	0.877

Value of p obtained based on Wilcoxon Signed-Rank Test (before x after).

In the study, the parameters were not controlled. However, they might have influenced the positive result.

Another aspect to which physical fitness is related is the hormonal issues that may range due to quantity or lack of physical activity. In this study, TSH and GH hormonal alterations were not detected. It was observed in the subjects that the neuromuscular adaptations (lean body mass increase) may promote reduce this leakage and may be linked to the duration and intensity of the exercise, as well as to the individual physical fitness level [45].

Physical training also contributed to reduce the inflammatory levels related to the high levels of C-reactive protein, white blood cells or fibrinogen [46]. The current study identified the monocyte level increase after the intervention. The mechanism that prevents physical activity to prevent or reduce inflammation may result from muscular injuries that increase inflammation. Thus, the monocytes act repairing the muscle, especially removing damaged tissue [47], fact that may be related to the increase of these parameters.

Abramson et al. [46] stated that practicing physical activity from 4 to 21 time per month (physical activity was practiced 16 times per month in the current study) is associated with a lower chances of having high level of C-reactive protein (Odds Ratio=0.63; IC 95% 0.58 to 1.02) and leukocytes. It also decreases fibrinogen levels in healthy adults, resulting in a lower of developing coronary disease.

Regarding HDL, it was decreased after the intervention. It is believed that changes are not related to the intensity of the physical activity program [48], but it volume of exercises needed in order to increase HDL and LDL levels should probably be greater, since the result does not rely on the exercise intensity or on the physical conditioning improvement [48].

Another possible explanation to the HDL decrease is the changes resulting from intra individual variation of plasma lipids deriving from environmental factors, such as dietary and seasonal variation [49]. In short, the current study points out that this type of "compound" activity can also positively improve lipid profile, for the parameters were considered normal in accordance to those recommended by health organizations [27].

Another important disease predictor are SCFA, metabolic products from the gut microbiota, present in the intestine and positively or negatively related to obesity and/or excessive body fat, for they are associated to the synthesis of neurotransmitters and to the food satiation control. Besides that, they affect the metabolism of lipids, glucose and cholesterol in several tissues [50]. **Table 4** shows that the exercises program had a significant impact in 5 to 8 acids.

According to Estak et al. [51], the improvement in the cardiorespiratory capacity is associated with variations in genes linked to the fatty acids biosynthesis, resulted from the increase in faecal butyrate production. In opposition to that, the current study identified decreases in the levels of this metabolic in the total amount of samples. However, when classified according to the level of physical fitness as good (medium to excellent) or bad (weak to regular) [32,41], in the beginning of the intervention, it was observed that there was an increase in the levels of the subjects classified as having good physical fitness (Right before: Median=23.20; P25=7.11; P75=113.22. Right after: Median=43.26; P25=7.96; P75=77.61) when compared to the subjects classified as having bad physical fitness (Right before: Median=45.51; P25=10.04; P75=125.62. Right after: Median=29.73; P25=7.66; P75=60.32).

Estak et al. [51] states that the abundance of butyrate is associated with neutrophil chemotaxis. Therefore, it is believed that physical fitness promotes an immune response compared to physical activity, for individuals with bad physical fitness present high inflammatory levels [52].

It was not found any scientific evidence relating the other SCFA (acetic, formic, isovaleric and acetic/propionic ratio) which also presented changes to the physical training. It is believed that physical fitness promotes the production of butyrate, and consequently of the other SCFA, which promotes health in general. Thus, the prescription of physical activity is indicated as adjuvant therapy to prevent dysbiosis-related diseases [51].

One of the limitations of the study is the absence of a control group, for the effect without training is unknown in the evaluated subjects. However, there is scientific evidence about the NCDs risk when there is physical inactivity/sedentary behavior, promoting the increase in body mass and/or fat, which prejudices physical and metabolic health [53,54].

Conclusion

Finally, the effectiveness of a compound training program was investigated, implemented to young female undergraduate students, with specific behavioral, hemodynamic, blood, inflammatory, anthropometric and body composition, physical activity, physical fitness and SCFA parameters. The findings enable to infer that the implemented program, even during only 8 weeks, can promote positive changes in physical and metabolic health in young women, especially regarding physical fitness. Thereby, it is believed that the compound training programs promote the decrease of risks for cardiovascular and coronary diseases resulting from the improvement of physical fitness.

Therefore, public health interventions targeting young undergraduate students in order to decrease modified risk factors for NCDs are essential. To this end, the methodological description helps to guide the professionals in carrying out collective public police actions through physical exercises.

References

1 World Health Organization (2011) Global status report on noncommunicable diseases 2010, Geneva.

2 United Nations Development Program - UNDP (2017) National Human Development Report - Movement is Life: Physical and Sporting Activities for All People: 2017, Brazil.

3 Haase A, Steptoe A, Sallis JF, Wardle J (2004) Leisure-time physical activity in university students from 23 countries: Associations with health beliefs, risk awareness, and national economic development. Prev Med (Baltim) 39: 182-190.

4 Bion FM, Chagas MHDC, Muniz GDS, de Sousa LGO (2008) Nutritional status, anthropometrical measurements, socio-economic status, and physical activity in Brazilian university students. Nutr Hosp 23: 234-241.

5 Udo T, Mun EY, Buckman JF, Vaschillo EG, Vaschillo B, et al. (2013) Potential side effects of unhealthy lifestyle choices and health risks on basal and reactive heart rate variability in college drinkers. J Stud Alcohol Drugs 74: 787-796.

6 Plotnikoff RC, Costigan SA, Williams RL, Hutchesson MJ, Kennedy SG, et al. (2015) Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: a systematic review and meta-analysis. Int J Behav Nutr Phys Act 12: 45-55.

7 Lorenzo A De, Martinoli R, Vaia F, Renzo L (2006) Normal weight obese (NWO) women: an evaluation of a candidate new syndrome. Nutr Metab Cardiovasc Dis 16: 513-523.

8 McCracken M, Jiles R, Blanck HM (2007) Health behaviors of the young adult U.S. population: behavioral risk factor surveillance system, 2003. Prev Chronic Dis 4: A25.

9 Brazilian Society of Cardiology (BSC) (2016) 7th Brazilian Guidelines of Hypertension. Arq Bras Cardiol 107: 1-83.

10 Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, et al. (2011) American College of Sports Medicine American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc 43: 1334-1459.

11 Bouchard C, Rankinen T (2001) Individual differences in response to regular physical activity. Med Sci Sports Exerc 33: S446-451.

12 Pattyn N, Cornelissen VA, Eshghi SRT, Vanhees L (2013) The effect of exercise on the cardiovascular risk factors constituting the metabolic syndrome. Sport Med 43: 121-133.

13 Thompson WR (2017) Worldwide survey of fitness trends for 2018: The CREP Edition. ACSM's Heal Fit J.

14 American College of Sports Medicine (ACSM) (2014) ACSM testing guidelines of Effort and Your Prescription, 9a. Guanabara Koogan, Rio de Janeiro

15 World Health Organization (WHO) (2010) Global recommendations on physical activity for health.

16 Tsampoukos A, Peckham EA, James R, Nevill ME (2010) Effect of menstrual cycle phase on sprinting performance. Eur J Appl Physiol 109: 659-667.

17 Brazil (2012) Resolution 466/2012/CNS/MS/CONEP that deals with research on human beings and updates Resolution 196. Diary Of Union 12: 59.

18 Matsudo S, Araujo T, Matsudo V, Andrade D, Andrade E, et al. (2012) International Physical Activity Questionnaire (Ipaq): Validity and Reproducibility Study in Brazil. Rev Braz Physical Activity Health 6: 5-18.

19 Sardinha A, Levitan MN, Lopes FL, Perna G, Esquivel G, et al. (2010) The Physical Activity Questionnaire of Translation and Cross-Cultural Adaptation. Rev Psiq Clin 37: 16-22.

20 McArdle WD, Katch KI KV (2009) Exercise physiology: Nutrition, energy, and human performance (7thedn).

21 Gondim FJ, Francisco C, Gondim J, Luiz PA (2005) Anthropometric indexes of obesity as an instrument of screening for high coronary risk in adults in the city of Salvador-Bahia. Arq Bras Cardiol 85: 26-31.

22 Markland D, Tobin V (2004) A modification of the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. J Sport Exerc Psychol 26: 191-196.

23 Stewart AD, Marfell-Jones M, Olds T, Ridder JH De (2011) International standards for anthropometric assessment. The International Society for the Advancement of Kinanthropometry, New Zealand.

24 World Health Organization (WHO) (2003) Diet, nutrition and the prevention of chronic diseases.

25 Vasques ACJ, Priore SE, Rosado LEFP, Franceschini S (2010) The use of anthropometric measures to assess visceral fat accumulation. Rev Nutr 23: 107-118.

26 Ashwell M, Mayhew L, Richardson J, Rickayzen B (2014) Waist-to-height ratio is more predictive of years of life lost than body mass index. PLoS One 9: e103483.

27 Laboratory Determination of Brazilian Society for Clinical Analysis (SBAC), Brazilian Society of Diabetes (SBD), Brazilian Society of Cardiology (SBC), Brazilian Society of Endocrinology and Metabology, Brazilian Society of Clinical Pathology (2016). The Lipid Profile. pp: 1-5.

28 Smiricky-Tjardes MR, Grieshop CM, Flickinger EA, Bauer LL, Fahey GC (2003) Dietary galactooligosaccharides affect ileal and total-tract nutrient digestibility, ileal and fecal bacterial concentrations, and ileal fermentative characteristics of growing pigs. J Anim Sci 81: 2535-2545.

29 Zhao G, Nyman M, Jonsson JA (2006) Rapid determination of short-chain fatty acids in colonic contents and faeces of humans and rats by acidified water-extraction and direct-injection gas chromatography. Biomed Chromatogr 20: 674-682.

30 Robergs RA, Roberts SO (2002) Fundamental principles of exercise physiology for fitness, performance, and health (20thedn), McGraw-Hill Higher Education.

31 Marins JCB, Giannichi RS (2003) Assessment and Prescription of Physical Activity: A Practical Guide (3rdedn), Shape, Rio de Janeiro.

32 Pollock ML, Wilmore JH (1993) In Health and disease exercises: Prevention and rehabilitation for assessment and prescription (2ndedn), Rio de Janeiro.

33 Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, et al. (2007) Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc 39: 1423-1434.

34 Donnelly JE, Blair SN, Jakicic JM, Manore MM, Rankin JW, et al. (2009) Appropriate physical activity intervention strategies for weight loss and prevention of weight regain for adults. Med Sci Sports Exerc 41: 459-471.

35 Karnoven MJ, Kentala E, Mustala O (1957) The effects of training on heart rate; a longitudinal study. Ann Med Exp Biol Fenn 35: 307-315.

36 Martinez-Gonzalez MA, Sanchez-Villegas A, Atucha ET, Fajardo JF (2009) Friendly Biostatistics, 2nd. Diaz de Santos, Madri.

37 Ashwell M, Hsieh SD (2005) Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. Int J Food Sci Nutr 56: 303-307.

38 Nahas MK (2013) Physical activity, health and quality of life: an active lifestyle for concepts and suggestions (6thedn).

39 Weinstock J (2010) A review of exercise as intervention for sedentary hazardous drinking college students: Rationale and issues. J Am Coll Heal 58: 539-544.

40 Broeder CE, Burrhus KA, Svanevik LS, Wilmore JH (1992) The effects of either high-intensity resistance or endurance training on resting metabolic rate. Am J Clin Nutr 55: 802-810.

41 Herdy AH, Caixeta A (2016) Brazilian Cardiorespiratory Fitness Classification Based on Maximum Oxygen Consumption. Arq Bras Cardiol 106: 389-395.

42 Helgerud JH, Ydal K, Wang E, Karlsen T, Berg P, et al. (2007) Aerobic high-intensity intervals improve VO2max more than moderate training. Med Sci Sport Exerc 39: 665-671.

43 Gibala MJ, McGee SL (2008) Metabolic adaptations to short-term high-intensity interval training: a little pain for a lot of gain? Exerc Sport Sci Rev 36: 58-63.

44 Harmer AR, Chisholm DJ, McKenna MJ, Hunter SK, Ruell PA, et al. (2008) Sprint Training Increases Muscle Oxidative Metabolism During High-Intensity Exercise in Patients With Type 1 Diabetes. Diabetes Care 31: 2097-2102.

45 Silva CC, Goldberg TBL, Capela RC, Kurokawa CS, Teixeira AS, et al. (2007) Acute post-exercise blood lactate and creatin phosphokinase levels responses in young athletes. Rev Bras Med Esporte 13: 381-386.

46 Abramson JL, Vaccarino V (2002) Relationship between physical activity and inflammation among apparently healthy middle-aged and older us Adults. Arch Intern Med 162: 1286.

47 Silva FOC, Macedo DV (2011) Physical exercise, inflammatory process and adaptive condition: an overview. Rev Bras Cineantropometria e Desempenho Hum 13: 320-328.

48 Kraus WE, Houmard JA, Duscha BD, Knetzger KJ, Wharton MB, et al. (2002) Effects of the Amount and Intensity of Exercise on Plasma Lipoproteins. N Engl J Med 347: 1483-1492.

49 Xavier HT, Izar MC, Faria Neto JR, Assad MH, Rocha VZ, et al. (2013) Dyslipidemias and Prevention of Atherosclerosis for V Brazilian Guideline. Arq Bras Cardiol 101: 01-22.

50 Bermon S, Petriz B, Kajeniene A, Prestes J, Castell L, et al. (2015) The microbiota: an exercise immunology perspective. Exerc Immunol Rev 21: 70-79.

51 Estaki M, Pither J, Baumeister P, Little JP, Gill SK, et al. (2016) Cardiorespiratory fitness as a predictor of intestinal microbial diversity and distinct metagenomic functions. Microbiome 4: 42.

52 Lira FS, Rosa JC, Pimentel GD, Souza HA, Caperuto EC, et al. (2010) Endotoxin levels correlate positively with a sedentary lifestyle and negatively with highly trained subjects. Lipids Health Dis 9: 82.

53 Must A, Tybor DJ (2005) Physical activity and sedentary behavior: a review of longitudinal studies of weight and adiposity in youth. Int J Obes 29: S84-S96.

54 Sassen B, Cornelissen VA, Kiers H, Wittink H, Kok G, et al. (2009) Physical fitness matters more than physical activity in controlling cardiovascular disease risk factors. Eur J Cardiovasc Prev Rehabil 16: 677-683.