Anthropometric and Lipid Profile in Medical Students. Influence of a Physical Exercise Program

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Abstract: *Introduction:* Most students in health programs do not practice physical exercise due to the high level of stress involved in their curriculum, a condition that makes them a population at high cardiovascular risk.

Objective: Determine the influence of an exercise program on anthropometric and lipid profile of medical students.

Methods: Acommunity trial type quasi-experimental study, through a 12-week exercise intervention, was made. Athletes and people doing regular exercise, or with altered lipid profile results were excluded. The anthropometric assessment was performed as directed by the International Society for the Advancement of Kinanthropometry.

Results: We studied 50 subjects, distributed in 33 women, 17 men, and average age 20 ± 2.7 years. Weight, waist circumference, bone percentage, residual percentage and BMI were not significantly different after exercise. While the waist-hip ratio, muscle percentage, skin percentage and fat percentage were significantly different after exercise. High-density lipoproteins decreased and other profile variables increased significantly.

Conclusion: This study showed that the exercise program positively influences physical structure, given that it increased muscle percentage and decreased fat percentage, but not enough to positively change the lipid profile of the studied population. Further it suggests the need for intervention programs on healthy habits (healthy foods, appropriate rest and sleep intervals) for medical students.

Keywords: Physical activity, Anthropometry, Medical students, Lipids.

INTRODUCTION

The World Health Organization (WHO) states that between 60% and 85% of the world population, including developed and developing countries, is characterized by a sedentary lifestyle. In Colombia different studies show that the university student population does not practice physical exercise, leading to future problems such as obesity, a present global problem reflected in the high impact on chronic noncommunicable diseases (NCD), which are at the top of the most important public health issues in recent decades. In 2005, the WHO estimated that 1600 million people are overweight or obese. Therefore physical inactivity and obesity are often associated with other factors such as hypertension, dyslipidemia and hyperglycemia [1].

The lifestyle of certain groups of people, especially young people, can lead to eating and physical activity habits identified as risk factors for NCDs; these include cardiovascular disease, stroke, cancer, chronic respiratory diseases and diabetes mellitus. The main risk factors for these diseases are overweight, poor diet, sedentary lifestyle, alcoholism and tobacco, which are modifiable factors [2].

The WHO indicates that physical activity should not be confused with exercise [3]; this is a planned, structured, repetitive variety of physical activity done with the objective of improving or maintaining one or more components of physical fitness. Physical activity encompasses exercise, but also other activities involving body movement, and is conducted as part of playtime, work, and active forms of transportation, household chores and daily activities. The American College of Sports Medicine found that exercise acts as a protective factor for many chronic degenerative diseases, as this has a particularly beneficial effect on

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the cardiovascular system, decreasing heart rate at rest, increasing heart vascularization, increasing cardiac output, decreasing peripheral resistance and better oxygen utilization [4].

As is known lipids are essential nutrients for the development and proper functioning of the body; but the consumption of unbalanced diets, rich in lipids and carbohydrates, lead to an accumulation of triglycerides and cholesterol in fat cells, and largely on the artery wall, thickening and decreasing its elasticity contributing to the development of atherosclerosis [5].

On the other hand the body composition estimate is of interest in various areas such as nutrition, medicine, anthropology and sports science [6]. Its importance lies in determining the nutritional status, both in conditions of health or sickness [7]. Exercise affects the body structure as the morph structure influences performance. This physical form is determined by the somatotype, *i.e.* morphological conformation, shape, size, composition and proportionality of the body [8].

As previously described, the purpose of the research was to determine the influence of an exercise program on anthropometric and lipid profile of medical students at the Quindío University.

MATERIALS AND METHODS

Type of Study

A community trial type quasi-experimental study was made, in which the exercise carried out defined the intervention. The study included 93 men and women volunteers from the medical school program willing to participate through doing exercise. All participants signed an informed consent and all concerns raised were resolved by the study investigators.

Sample

A probability sample for a finite population (93 students), where the sample size was of 79 subjects, with a sampling error of 5% and a confidence level of 95% was calculated. However, the total number of participants who completed the study was 50 people, 33 women and 17 men. This corresponds to a maximum sampling error of 8.8%.

Exclusion Criteria

Student athletes and / or students performing regular physical exercise (150 minutes per week) and those with lipid profile results above the values considered normal were excluded from the study.

Study Variables

Exercise, weight, height, body mass index (BMI), waist circumference, waist hip ratio (WHR), body fat percentage, muscle percentage, residual percentage, bone percentage, skin percentage, triglycerides, total cholesterol, HDL, LDL and VLDL cholesterol.

Intervention Program

It consisted of a 12 weeks exercise program. Research subjects provided a blood sample at the beginning and end of the program.

The exercise program was monitored and fitness (6 sessions), intensity (moderate, as recommended by WHO) [9], volume (to be developed according to the exercises, in which time and number of repetitions were considered), density (developed according to the exercises) and frequency (3 days per week, one hour per session) were taken into account. Each one of the sessions of the physical exercise program had an initial stage (joint warming up and stretching), central stage (development of the session) and final stage (cool down). Also this program was validated by experts in the field.

Anthropometric Assessment

It was performed as directed by the International Society for the Advancement of Kinanthropometry (ISAK) [10]. Before performing the evaluations, anatomical landmarks necessary to obtain measurements for the study were labeled using a demographic pencil. The marked anatomical points are in the following positions: acromial, radial, styloideum, iliocrestal, iliospinal, trochanteric, tibial, infrascapular angle and lateral abdominal. In all cases the marks were made on the right side of the subject. Measurements were made based on the anthropometric reference position. Measurements taken were: weight, height, sitting height, skin fold thickness (triceps, subscapular, supraspinal, abdominal, thigh and leg), perimeters (arm (relaxed), forearm, thigh 1, leg, chest, head and waist) and diameters (biacromial, transverse chest, anterior-posterior chest, biliocrestal, femur bicondylar andhumerus biepicondylar).

Biochemical Variables

Sample: To measure biochemical variables, a blood sample was taken (by venipuncture under aseptic and antiseptic conditions) from the ulnar or radial vein, in dry tube, with a minimum of vascular stress and with the subject seated down, after fasting for 12 hours. A sample was taken at the beginning of the protocol (physical exercise) and three months later a final sample was drawn. The blood was centrifuged at 3000 rpm for 15 minutes to separate the serum, which was stored under refrigeration until use.

Lipid profile: Total cholesterol (TC) and triglycerides (TG) tests were performed by enzymatic colorimetric methods (Human®). Cholesterol in high density lipoproteins (HDL) were assessed by initial selective separation with phosphotungstic acid/ magnesium chloride (Human®). Cholesterol in low-density lipoproteins was calculated as TC - (HDLc + TG / 5). The reference values for lipids were taken according to the ATP III [11].

Statistical Analysis

A descriptive analysis of each of the variables was made; the results are presented in mean ± standard deviation and the maximum and minimum limits. Comparison of the samples before and after exercise is calculated using ANOVA. A value of $p < 0.05$ was considered statistically significant.

RESULTS

50 subjects were studied, divided into 33 women and 17 men, average age for both sexes was 20 ± 2.7 years. Table **1** shows the anthropometric variables before and after the implementation of the physical

Table 1: Anthropometric before and after the Implementation of the Exercise Program Variables

Variables	Before	After	P-value
	n = 50		
Weight (kg)	62 ± 10.8 (45-91)	61.6 ± 10.7 (45-91)	0.8564
Abdominal perimeter (cm)	79.4 ± 8.3 (66-99.5)	77.3 ± 7.7 (64-98)	0.2011
BMI (kg / m2)	22.6 ±3.1 (16.5-29.4)	22.5±3.1(16.8-29.4)	0.8179
WHR	0.8 ± 0.06 (0.69-0.95)	0.8± 0.07 (0.69-0.97)	0.0048
Adipose %	38.8±7.1(19.5-53.4)	33.1±4.2 (18.6-39.2)	0.0000
Muscular %	37.2±8.1(18.7-50.9)	42.9±3.5 (36.6-54.5)	0.0000
Bone %	7.9 ± 2 (4.1-15.1)	8.5 ± 1.6 (4.1-10.9)	0.1817
Skin %	5.4 ± 0.9 (2.8-8.7)	5.9 ± 0.6 (4.71-7.3)	0.0043
Residual %	8.9± 1.8 (3.1-15.9)	9.5± 1.4 (7.2-13.7)	0.0835

BMI: body mass index. WHR: waist hip ratio

Table 2: Anthropometric Variables by Sex of Participants

Variables	Women n= 33			Men n= 17		
	Before	After	P- value	Before	After	P- value
Weight (kg)	59.1	58.6	0.8196	67.5	67.3	0.9653
Waist circumference (cm)	78.8	76.1	0.1548	80.5	79.6	0.7760
BMI (kg / m2)	22.9	22.7	0.7948	22.1	22.1	0.9668
WHR	0.8	0.82	0.8190	0.8	0.87	0.0012
Adipose%	39.9	33.7	0.0000	38.0	31.3	0.0015
Muscular%	36.6	42.93	0.0000	38.3	43.7	0.0063
Bone%	8.1	8.1	0.8968	7.52	8.9	0.0176
Skin%	5.5	5.9	0.0519	5.2	5.8	0.0034
Residual %	9.2	9.2	0.8409	8.7	10.2	0.0051

BMI: body mass index. WHR: waist hip ratio.

exercise program; we can see that the variables of weight, waist circumference, bone percentage, residual percentage and body mass index (BMI) did not differ significantly according to statistics. Although BMI values show that an average of the subjects are in a normal range (18.5-24.9), according to the WHO classification chart, two overweight (25-29.9) and three underweight (<18.5) participants were found. While waist-hip ratio (WHR) variables, muscle percentage, skin percentage and fat percentage showed statistically significant differences.

Table **2** describes the anthropometric variables by sex of participants. Women showed statistically significant differences with respect to adipose and muscular percentage after exercise, while in men, with the exception of weight, waist circumference and BMI, the other variables showed statistically significant differences.

Table **3** shows the lipid profile before and after exercise, it shows a statistically significant increase in the level of total cholesterol, triglycerides, LDL and VLDL, and a statistically significant decrease in HDL.

Table **4** shows the lipid profile by sex of participants before and after exercise, it shows a statistically significant decrease in HDL and increase of other profile variables in both sexes.

DISCUSSION

Abundant scientific literature shows that sedentary lifestyles with increased cardiovascular risk factors are a constant in the student population, especially medical students [12-14]. In addition to data confirming the unhealthy lifestyles of medical students, our research shows further results on anthropometric variables not taken into account in other papers; Thus, the information analyzed show that regardless of sex, adipose percentage in the study population decreased 5.48% in women and 17.41% in men after exercise, similar results to those obtained by Ruiz *et al* [15], who found a decrease in fat percentage in people who are more consistent with exercise and diet. However, although a decrease in adipose percentage was observed in our study population, these values remain high in both men and women according to WHO, which establishes that men fat percentage should be between 11-14%, and between 16-19% [16] in women; according to these guidelines our study group had more than twice that percentage, indicating that the intervened subjects are more likely to develop NCDs.

With respect to muscle percentage with exercise, there was an increase of 17.3% in women and 14.07% in men (statistically significant in both cases); As is known, exercise can increase the size and length of the

Table 3: Biochemical Variables before and after Exercise

n = 50			
Variables	**Before**	**After**	**P-value**
TC (mg/dL)	125.32 ± 28.5 (59-200)	146.8 ± 37.7 (63-200)	0.0017
TG (mg/dL)	96.9 ± 33.7 (39.1-150)	126.4±25.4 (74.6-150)	0.0000
HDL (mg/dL)	56.5 ± 13.9 (26-109	44.4 ± 10.4 (24-82)	0.0000
LDL (mg/dL)	50.7±22.4 (4.32-102.1)	71 ± 39.5 (3.7-176.1).	0.0018

TC: total cholesterol. TG: Triglycerides. HDL: High-density lipoprotein. LDL: low density lipoprotein.

Table 4: Biochemical Variables by Sex before and after Exercise

Variables	Women n= 33			Men n= 17		
	Before	After	P- value	Before	After	P-value
TC (mg/dL)	129.4	147.8	0.0356	117.3	144.8	0.0134
TG (mg/dL)	94.52	124.1	0.0000	101.5	131.0	0.0130
HDL (mg/dL)	60.3	43.1	0.0000	49.2	41.0	0.0233
LDL (mg/dL)	51.7	69.0	0.0302	47.8	74.7	0.0268

TC: total cholesterol. TG: Triglycerides. HDL: High-density lipoprotein. LDL: low density lipoprotein.

muscle fibers, through metabolic, hormonal and physiological stimulus that triggers an insulin-like growth factor 1 (IGF-1) which is involved in stimulating muscle protein synthesis [17], among others. This suggests that the exercise program influenced the development of muscle mass during the (3 months) intervention by varying the intensity, volume and frequency of the proposed activities, allowing the study population to experience physiological, physical, metabolic, cardiovascular processes as well as strength and endurance work, helping to reduce fat levels and increasing muscles, as this is inversely proportional, *i.e.* when the muscular percentage increases the fat percentage decreases.

It is important to note that although the intervention was only three months it should be take account that when sedentary people start an exercise process, their body tends to quickly assimilate physical stimuli. Related literature estates that "the body has the ability to adapt to the needs through total or partial adaptation [18-19]. The main purpose of every training program is to achieve changes through the overcompensation and adaptation syndrome" [18-19]. This is one of the most important biological phenomena, as it is the product of combining the proper load of training and adequate recovery. But there comes a point where the body gets used to the same level and presents no change, so it is important to have diversity in terms of training loads, applying different methodologies and exercises making the process more bearable, while maintaining its efficiency.

The results show that bone percentage increased significantly only in men when compared to women; perhaps, the difference is that the amount of bone mass (amount of bone: protein and minerals, primarily calcium) in a skeleton depends on many factors such as sex, age, race and especially genetic factors; Thus, the male hormones increase the concentration of substances needed for bone synthesis [20].

As to the percentage of residual mass, a statistically significant increase was found only in men; residual mass are vital organs and viscus comprising connective tissue, nerves, blood vessels with clotted blood and adipose tissue that could not be physically dissected from gastrointestinal tract organs (excluding the tongue which is considered part of the head muscle mass), sexual organs, remaining mesenteric, bronchial tract, lungs, heart and major vessels and all other tissues and fluids not included in the other four fractions. The basic assumption is that the mass of residual tissue fills the thoracic cavity and pelvis, in volume. Since this is independent from the length of limbs, Phantom Z values were related to sitting height and not height [21].

Although skin percentage increased in both sexes, it was only statistically significant in men. The skin percentage corresponds to the anatomically dissectable mass of connective tissue, smooth muscle, some surface striated muscle, hair, glands, associated adipose tissue, nerves and blood vessels with clotted blood. Accordingly, the body surface, thickness and density of skin are measured. Data obtained from corpses showed that dissected skin surface is larger in men than in women [22].

With respect to the WHR, there was an increase in both sexes but only statistically significant in men; according to the WHO reference values [16], such results are within the range considered normal, that is, from 0.71 to 0. 85 for women and from 0.78 to 1 for men.

The traditional risk factors (lipid profile), TC, triglycerides and LDL increased while HDL decreased in both men and women with significant differences in all variables after exercise. However, concentrations were within the normal range according to the ATP III [11].

Related literature expresses that exercise have a beneficial effect on cardiovascular risk by reducing the TC and LDL and increasing HDL [23-25], contrary to what happened in this work. This has been a both national and international trend in medical students; Mendoza and Del Castillo [26] conducted a study on risk factors associated with cardiovascular disease in a group of medical students, where they found that 24% of the students presented a higher lipid profile than considered desirable and 18% of the studied population had HDL below 35mg / dl. Also, these alterations have been linked to nutritional factors, sleep behaviors, and overweight status as described for several author [27-31], where it is suggested that those who eat well, are more likely to have better overall sleep quality and fewer sleep-related issues; in addition to this, Moreno Gómez *et al.* [29] studied the habits and lifestyles of students in second- and ninth semester of a medical school, and found that 17% of students are malnourished and that 14% suffers overweight; on the other hand Alba [30] determined the risk profile in medical students, where founded that prevalence of inadequate diet was 74.8%, risky alcohol consumption was 55.6% and 55.8% in the first and fifth years respectively. With regard to diet, the study by Páez and Brown [31] on students from the School of Medicine shows that 84.6% of students have an inadequate diet.

The increase in TC, LDL and triglycerides and decrease in HDL in this population despite exercise suggests in an apparent contradiction, that other factors, different than exercise, have a more significant influence over the lipid metabolism; in that aspect, it has been demonstrated that factors such as diet, and stress, among other things, affect metabolism and healthy conditions of medical students [32-34], who are subjected to specially stressful conditions due to the demanding curriculum and training; in this sense several studies show a positive association between stress and lipid metabolism [33], for example, Djindjic *et al* demonstrated an association between stress and low HDL levels, high levels of total cholesterol and triglycerides in middle-aged workers [34]; a biochemical approximation of the effect of stress on the metabolism of patients with a metabolic disorder, found several studies [35-37], *i.e.* in the work of Rocha and collaborators, who shows that a single bout of exercise was unable to prevent the reduction of endothelial progenitors cells, (EPCs) in subjects with metabolic syndrome (MetS) [35]; Under physiological conditions, EPCs play an important role in vascular damage repair, and it has been suggested that a decreased number of EPCs is associated with an increased prevalence of sub clinical atherosclerosis [35]. Other studies show that the combination of diet and exercise (but neither one alone) partially restored hedonic behavior and exerted multiple trophic effects on the hippocampus underscores the potential for potent synergistic effects between the dietary supplement designed to ameliorate inflammation, oxidative stress, and aerobic exercise in the treatment of stress-related disorders in humans [37]. Our study students continued their food routines during the exercise period.

In summary, studies with humans and experimental animals show statistically different effects of exercise in stressed and non-stressed groups [35-37]; there fore, there is a need to deepen the studies linking stress with metabolic processes in medical students.

In conclusion, this study showed that the exercise program positively influences physical structure, given that it increased muscle percentage and decreased fat percentage, but not enough to positively change the lipid profile of the studied population. Further it suggests the need for intervention programs on healthy habits (healthy foods, appropriate rest and sleep intervals) for medical students.

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