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Practice of Physical Activity and Its Relationship with Lipid Profile of Adolescents

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Abstract

In order to assess the prevalence of physical activity (PA) and its relationship with lipid profile among adolescents, a cross-sectional study with a quantitative approach was conducted with 102 adolescents aged 15 to 19 years from public schools of Campina Grande, Paraiba, Brazil. The following variables were analyzed: age, gender, ethnicity, maternal education, socioeconomic status, nutritional status, the practice of PA and lipid profile. The variables were obtained through validated form, anthropometry (weight and height) and blood collection by contract laboratory. Double entry and SPSS (Statistical Package for Social Sciences) 22.0 were performed. First, a descriptive analysis of all variables was conducted, as well as measures of central tendency and dispersion for continuous variables. Accordingly, distribution was tested for normality using the Kolmogorov-Smirnov test. According to results, correlation was evaluated by Pearson/Spearman tests. Significance level of 5% was adopted for all analyses. The study was approved by the Ethics Approach Committee (EAC) of the State University of Paraíba. The most prevalent sex in the sample was female and regarding maternal education, 35.4% had complete high school. Regarding serum lipoproteins, 16% showed elevated total cholesterol and HDL (High Density Lipoprotein) 66% below the desired value. With regard to physical activity, 60.8% had insufficient PA levels. The sample showed changes in lipid profile and insufficiently active life style, besides having

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overpowered the eutrophic nutritional status. No statistically significant correlations between variables of the lipid profile and the time of PA were observed. These findings highlight the importance of physical exercise for maintaining health and suggest studies with larger populations in order to check the scientific literature regarding this topic.

Keywords

Adolescents, Motor Activity, Cholesterol-HDL, Dyslipidemias

1. Introduction

Physical activity (PA) is described as any move made by the body that requires energy expenditure and physical inactivity is not performing actions that require such expenditure. The latter has presented global distribution, being one of the main reasons associated with approximately 30% of cases of ischemic heart disease in the world and the fourth cause of indirect risk of death [1].

The World Health Organization (WHO) recommends daily practice of PA for 60 minutes, including vigorous activity three times a week in healthy populations [1]. In line with these recommendations, a survey called the National Health Survey of School (NHSS) studied the practice of weekly PA in school [2].

The same survey showed that recreation actions without energy expenditure such as watching TV, using the computer and other electronic games are reasons that lead adolescents to reduce the practice of PA. Possible causes are usually linked to the restriction of active leisure options and collective spaces, which can be explained by increased violence and deficient urban mobility, in addition to cultural issues that increasingly encourage the use of technological devices [2].

According to the I Guideline for Prevention of Atherosclerosis in Childhood and Adolescence (IGPACA), regular PA improves body fitness, promotes mental health, physical and weight control, stimulates social interaction and is a preventive factor against cardiovascular disease (CVD), various cancers and mental disorders, diabetes mellitus, dyslipidemia, smoking and osteoporosis [3]-[5].

The regular practice of PA seems to be an important factor limiting the risks of CVD and dyslipidemia; it somehow influences lipids, particularly cholesterol. Phospholipids, fatty acids, triglycerides (TG) and total cholesterol (TC) are significant to the cellular structure elements, storage and transport of fats. This function, in turn, is carried out by lipoproteins rich in cholesterol: HDL (High Density Lipoprotein) and LDL (Low Density Lipoprotein) and other particles which do not have high density, referred as to non-HDL cholesterol, also involved in the atherogenic process [3] [6].

HDL is mainly responsible for the esterification process of cholesterol and its reverse transport (from peripheral tissues to the liver). It also works by removing oxidized lipids of LDL, inhibiting the attachment of adhesion molecules and monocytes to the endothelium, and stimulating the release of nitric oxide [6].

Nascimento *et al*. [7] reported that PA and body fat modulate the levels of lipids in the blood; thus, the practice of PA tends to reduce TG, TC and LDL and increase HDL. It is also noteworthy that the less atherogenic profile is statistically related, regardless of low or high intensity of this practice (since performed).

Study conducted with adolescents in Southern Brazil [8] to verify the prevalence of cardiovascular risk factors observed the prevalence of physical inactivity (61.2%) and emphasized that low HDL levels (25.9%) lead to cardiovascular risk, given that this case is a precursor factor for atherogenesis.

Aware of the benefits of PA and the existence of obstacles to its practice, policies for promoting active lifestyle for youth have been developed. The Law of Directives and Bases of Education [9] made the practice of Physical Education in schools mandatory; in addition, Decree No. 6286 [10], instituted the School Health Program (SHP), which, since then, encouraged the practice of PA in cooperation with the Family Health Strategy [11].

The National Policy for Health Promotion (NPHP) has reported that PA is an important part of basic health actions. This, therefore, must act through counseling, outreach, mobilization of partners and encouragement, and to evaluate and monitor the effectiveness of these actions [12].

To identify the impact of these actions and focusing on adolescents and their bodily practices, NHSS found in

2009 that 40.5% of students were physically active and 59.4% were insufficiently active. In 2012, the results indicated that the proportion of physically active individuals fell to 30.1%, while insufficiently active individuals increased to 63.1% [2] [13].

In 2009, in Brazil, it was observed that 79.4% of adolescents kept sedentary recreational activity, remaining in 2012, when the prevalence was 78.6%. Under this scenario, it was recommended that the time spent on these activities, called "screen time" should be limited to the equivalent of two hours daily [2] [3] [13].

Considering the relevance of the positive effect of regular practice for PA on the serum cholesterol levels, the prevalence and the increased rates of physical inactivity is an issue to be assessed. Thus, studying this relationship increases knowledge of these factors in heterogeneous population [8] [14]. Thus, this study aimed to evaluate the prevalence of the practice of PA and its relationship with lipid profile among adolescent students.

2. Methods

2.1. Study Location and Design

Cross-sectional study with a quantitative approach developed in small public schools (up to 300 students) in the city of Campina Grande, Paraíba, Brazil, during the months of September 2012 to June 2013, except during school holidays.

2.2. Population and Sample

The sample consisted of 102 adolescents aged 15 - 19 years, 11 months and 29 days, enrolled in public high schools. The exclusion protocol excluded those who had diseases that could impair the practice of PA such as cerebral palsy, genetic syndromes and motor abnormalities; permanent or temporary situations, such as the immobilized limb, which would undermine the practice of PA or compromise the achievement of study procedures; pregnancy; other diseases such as liver failure, and nephrotic syndrome, concomitant with altered metabolism of lipids; and use of medications that interfere with lipid metabolism.

2.3. Study Variables

Factors such as age, sex and skin color were studied. Maternal education, according to categories of the Brazilian Institute of Geography and Statistics—BIGS [15], in which schooling is analyzed according to information from the series and grade or level that the individual has completed, matching the previous school systems with the current computed in years—(0 - 5 years) with no education; completed elementary (less than 8 years); completed elementary (8 years); incomplete secondary education (under 12 years); completed high school (12 years); incomplete higher (under 16 years), higher full (16 or older) and indeterminate was also included; and the socioeconomic classification was determined according to criteria of the Brazilian Association of Research Companies—ARC [16]. This in turn, analyzes, through a points system, the purchasing power of organizing the economic classes in the population, according to income (in Reais—R$), defined by the following levels: A1 = R$12926.00; A2 = R$8418.00; B1 = R$4418.00; B2 = R$2565.00; C1 = R$1541.00; C2 = R$1024.00; D = R$714.00; E = R$477.00.

Anthropometry was also performed to assess nutritional status; evaluated through the practice of PA by validated form; and lipid profile, for blood collection. To obtain the nutritional status, weight and height were measured according to procedures recommended by WHO [17]. Body mass index (BMI) was calculated from the ratio of weight (in kilograms) by the square of height (in meters). To evaluate the nutritional status, BMI and z score were used according to age: underweight ($-3 \leq$ z score < -2), normal weight ($-2 \geq$ z score $< +1$), overweight ($\geq +1$ z score $< +2$), obesity ($+2 \geq$ z score $< +3$) and severe obesity (z score $\geq +3$). For over 18 years, cutoff points for BMI (in kg/m²) were: underweight (<17.5), normal weight (≥17.5 BMI <25.0), overweight (≥ 25.0 BMI 0 < 30.0) and obesity (≥30.0) [18] [19].

The practice of PA was verified by the description of the accumulated activity, combining times and frequencies. Commuting to school (walking or cycling), Physical Education classes in school and other extracurricular physical activity were computed. The following categories were considered: inactive; insufficiently active (those who practiced PA weekly for 1 - 149 minutes and those who practiced PA weekly for 150 - 299 minutes); and active (300 minutes or more of PA weekly) [13].

The following components of lipid metabolism were assessed: total cholesterol, HDL-cholesterol, non-HDL cholesterol and triglycerides, considering the references of the V Brazilian Guidelines on Dyslipidemia [6]: desirable TC < 150.0 mg/dL; desirable HDL-C ≥ 45.0 mg/dL; desirable non-HDL-c < 130.0 mg/dL and desirable TG < 100.0 mg/dL.

2.4. Data Collection Procedures

Data collection was performed after the clarification of all procedures adopted, including the need to fast for 12 hours prior to the day of blood collection. Parental consent was required by signing the Free and Informed Consent Form (ICF). Blood for the determination of lipids was collected in schools by specialized technicians at previously scheduled day, always in the morning. Samples were processed and analyzed by outsourced laboratory (enzymatic colorimetric method), hired for this purpose, with Lab-SPC/ML quality control seal.

2.5. Data Processing and Statistical Analysis

The forms were double entered and submitted for validation using the *Validate* Epi Info 5.3.2 software along with the SPSS (Statistical Package for Social Sciences) 22.0 for processing statistical analyses. Descriptive analysis of all variables was performed, with measures of absolute and relative frequencies for categorical variables and measures of central tendency and dispersion for continuous variables. For thesem, normality distribution by Kolmogorov-Smirnov test was also were tested. Significance level of 5% was adopted for all statistics.

The measures of association between variables (PA time and levels of lipids) were made by analysis of variance, considering probability less than or equal to 5% to reject the null hypothesis or no association. The association strength between variables was assessed by Pearson's correlation test and Spearman's for TC.

2.6. Ethical Aspects

The study met the criteria of ethical research with humans proposed in the letter of Helsinki and was approved by the Ethics Research Committee of the State University of Paraiba (ERC) (CAEE: 0077.0.133.000-12).

3. Results

Overall, 102 adolescents were evaluated. There were five losses by refusing to blood collection. Thus, the sample consisted of 97 adolescents. The average age was 16.4 ± 1.0 years. The prevalent gender was female (69.9%). With respect to skin color, more than half of the population (59.2%) was brown.

It was also observed that in most cases (88.3%), mothers were responsible for children and 26.2% had educational level corresponding to 12 years of study. As for the economy class, predominance of class C1 (37.9%) was found, according to criteria of BAPS (Brazilian Association of Population Studies) (**Table 1**).

The distribution of adolescents according to nutritional status was represented by 82% of normal weight, 12% overweight and 6% obese. No cases of low weight were recorded and mean BMI was 22.6 ± 5.8 kg/m^2.

Although 16.5% prevalence of change in TC was recorded, which averaged 145.7 ± 28,125 mg/dL, 65.0% of adolescents had HDL below the expected value. Similarly, there was a percentage of 12.6% of non-HDL cholesterol and 22.3% of high TG. These values are troubling and suggest possible irregular diet and sedentary lifestyle (**Table 2**).

As for the practice of PA, adolescents had on average 303.9 ± 277.3 min/week. Such variability can be explained by the percentage of 3.1% of inactive and 20.6% of insufficiently active I and 40.2% of insufficiently active II, a total of 60.8% of insufficiently active. In contrast, although only 36.1% were being physically active, the number of minutes of PA tends to increase the average.

After normality distribution test, correlation between lipid profile and weekly time of PA was verified. Unlike reported in literature, the correlations were negative, showing an inverse relationship between these variables; however, the results were not statistically significant (**Table 3**).

4. Discussion

Among adolescents observed, females were prevalent, with 64.9%—similar to other studies [20] [21]. In relation to gender, it is worth mentioning that the serum levels of lipids and lipoproteins undergo important

Table 1. Socio-demographic characteristics of the adolescents of Campina Grande, PB, 2012-2013.

VARIABLES	n	%
GENDER		
Female	**68**	69.9
Male	**29**	30.1
SKIN COLOR		
White	**39**	40.8
Not White	**58**	59.2
RESPONSABLE FOR ADOLESCENT		
Mother	**86**	88.3
Not mother	**11**	11.7
EDUCATIONAL LEVEL OF THE RESPONSIBLE		
12 years		26.2
<12 years		73.8
ECONOMY CLASS		
C1	**25**	37.9
B2	**72**	24.3

Table 2. Overall mean, standard deviation and percentage distribution of serum lipoproteins among adolescent of Campina Grande, PB, 2012-2013.

VARIABLES	n	%	MEAN	STANDARD DEVIATION
TOTAL CHOLESTEROL				
<150 mg/dL	61	59.2		
150 to 169 mg/dL	25	24.3	145.7	28.1
≥170 mg/dL	17	16.5		
HDL				
<45 mg/dL	74	65	40.7	7.8
≥45 mg/dL	29	35		
NON HDL				
<130 mg/dL	90	87.4		
130 to 159 mg/dL	10	9.7	104.9	25.9
160 to 178 mg/dL	3	2.7		
TRIGLYCERIDES				
<100 mg/dL	80	77.7		
100 to 129 mg/dL	11	10.6	86.5	49.4
≥130 mg/dL	12	11.7		

Table 3. Linear correlation for the practice of physical activity and lipid profile markers. Campina Grande, PB, 2012-2013.

Variables	Mean	Standard deviation	R	p
TC	114.7	±23.5	−0.066*	0.519
HDL	43.0	±14.7	−0.027	0.789
Non-HDL	116.9	±115.2	−0.027	0.790
TG	77.6	±32.0	−0.038	0.709

*Spearman.

variations attributed to sexual maturation—girls had higher mean TC, HDL and LDL levels and boys showed HDL inversely associated with testosterone levels [3] [8] [21]-[23]. In relation to skin color, most participants were brown (63.3%); however, no relationship between color and PA and HDL level was observed.

In the current study, mothers showed prevalence in the responsibility of family head (88.5%), with mean schooling corresponding to completed elementary education. With regard to social class, there was considerable domain, observing only increased presence of C1 (34%) and corresponding monthly family income [16]. This finding should be interpreted with caution, since female adolescents of this social class are more likely to be physically active compared to those of class E [24].

A study with adolescents in Northeastern Brazil [24], observed a positive relationship between physical activity level and parental educational level and the perception of its health benefits.

Studies show that psychological and social support from parents and friends is an important factor for the adoption of positive attitudes about practice of PA. An example of the reciprocity between youth and relatives is the time and the intensity of exercise [21] [22] [25].

Regarding nutritional status, it has been well established that overweight and obesity are associated with dyslipidemia, arterial hypertension, type II diabetes and cardiovascular diseases—diseases of multifactorial origin that are affected both by the influence of disturbances in eating behavior and by the presence of physical inactivity. This is also stressed as an important predisposing factor to obesity [2] [7] [8] [14].

In agreement with the influence of the nutritional status on dyslipidemia, research conducted to evaluate the lipid profile of children and adolescents found that obese individuals have higher lipid abnormality when compared to those of normal weight [26]. Statistically significant values indicating changes in HDL and TG associated with obesity [27] were also found.

In this study, unlike research characterized by considerable obesity and/or overweight rates, the prevalence of individuals with normal weight was 82% [20] [28] [29].

Regarding the lipid profile, concerning changes were observed, since 71% of students showed TC values above the desired levels (55% borderline and 16% high) and HDL below 66% of the expected value, consistent with the low practice of PA and wrong eating habits. This table refers to the susceptibility to dyslipidemia and atherosclerosis, which, according to Bertolami *et al*. [30], predispose to the development of cardiovascular diseases and their complications. These findings are similar to other cross-sectional studies [14] [26].

The sample exhibited a predominance of 63.9% of individuals who do not show adequate levels of PA and 3.1% are physically inactive, in contrast to only 36.1% of physically active. These results demonstrate the existence of obstacles to this practice, confirming what was found in the Brazilian capitals [2].

According to NHSS, 2012, 63.1% of adolescents were considered insufficiently active, 6.8% inactive and 30.1%, active, and the northeastern region showed the lowest national rate of active students (25.2%), region on which this study was conducted [2]. This condition was verifiedin several studies, which showed dichotomous outcomes [8] [20] [24] [26] [28].

Some authors found higher rates of active individuals when questionnaires included all areas of classification (work-related activities, leisure and sports) and different PA environments (within or outside the school), in contrast with other studies that restricted certain areas or activities in school [31].

Despite the low rate of inactive individuals (3.1%) in this study, recent meta-analysis that examined the national prevalence of physical inactivity found that female adolescents are more inactive, which can be physiologically explained by factors inherent to development and hormones [31].

The hegemony of inactivity in females was also reported in several studies [8] [21] [24] [29]. However, Campos *et al.* [29] found that boys are 4.1 times more likely to present hypercholesterolemia and high LDL levels when compared to their active peers. These findings are consistent with studies of similar methodology, in which PA level appears to be inversely associated with risk of CVD.

According to some authors, the prevalence of PA in men has biological, socio-cultural explanations of body perception and sociocultural gender attributes such as like strength, virility and skill [24] [28].

The absence of a statistically significant association between PA practice and changes in serum lipoproteins is in line with other studies that have found different relationships or their lack between the above factors [32].

5. Conclusions

Unlike research characterized by considerable obesity and/or overweight rates, this study showed predominantly eutrophic population, which does not rule out the existence of overweight-related health risks due to the lipid changes observed, the condition is equally troubling. This finding shows the importance of the early investigation of serum lipoproteins and the encouragement for the regular practice of PA.

Comparing these findings with those found in studies with similar methodological design, it could be inferred that sex, maternal education and social class influence the lifestyle of adolescents and their lipid profile.

This study found insufficient PA levels and lack of statistical association between the other variables, which can be explained by the sample size and the limitation of the instrument used, absence of blood pressure monitoring, which is susceptible to recall bias, reliability and validity of those being investigated.

The relevance of PA practice for the prevention of health problems has been well established, which is of great importance to public health policymaking for its encouragement and incentive in the adolescent age group.

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