

Relationship between the level of physical activity and indicators of cardiovascular risk in schoolchildren and adolescents in district educational institutions in the city of Bogota

Arley Camilo Linares Canti

Physical Culture, Sports and Recreation Student

Santo Tomas University. Bogotá, Colombia.

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Keywords

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Abstract

Currently, scientific evidence reflects that low levels of physical activity in childhood are the triggers of different diseases (overweight, obesity, diabetes, etc.) in adulthood. In the school population, more than 5% of children are overweight and obese. Identifying physical activity levels and establishing whether or not they are related to cardiovascular risk factors will make it possible to create strategies that work for the health of school children and adolescents and reduce the level of mortality from NCDs at later ages.

Objective. To identify the relationship between the level of physical activity and indicators of cardiovascular risk in Students of a public school in the city of Bogota.

Methodology. Cross-sectional study in 227 school children and adolescents of both sexes, between 10 and 17 years old with an average of 12.84 (± 1.58) years, from 3 District Educational Institutions (DEI) of Bogotá, who voluntarily participated in the completion of the Physical Activity (PAQ-C) questionnaire (10 to 12). 9 years, G1) and PAQ-A (13 to 17.9 years, G2), as well as from the anthropometric measurements of height, weight and waist to hip ratio (WHR), the BMI and waist to

height ratio (WHtR) were calculated. As an indicator of cardiovascular risk (CVR), blood pressure was also measured.

Results. Of the general population, 52.4% were children (12.77 ± 1.56 years); the level of PA evaluated for school children (G1) PAQ-C, had a mean of $2.13 (\pm 0.62)$ and (G2) of $1.87 (\pm 0.69)$, finding for both groups a low-moderate level of PA being a little lower in girls (1.91 ± 0.55) and adolescents (1.60 ± 0.65). 13.2% of the general population presented overweight/obesity, with a tendency to be higher after the age of 12.9 years, the WHR for the G1 (62.20 ± 6.17) and G2 (68.00 ± 6.62), the WHtR in G1 (0.42 ± 0.39) and G2 (0.44 ± 0.04) qualify as low risk; in the relationship (Pearson) of PA levels vs. RCV indicators, no statistical significance was found; however, significance was found in the SBP and DBP vs BMI and WHR.

Conclusions. Despite not finding a clear difference between levels of physical activity and indicators of cardiovascular risk in this study, it was possible to determine the relationship between blood pressure values, nutritional status and WHR, which can be used as indicators to create strategies that encourage greater PA performance in schoolchildren and adolescents that reduce the risks of CVD at early ages.

Introduction

Physical activity is understood as any body movement in which the body requires an energy expenditure in order to be performed. Currently, the World Health Organization (WHO) (2019), points out that there is a decrease in the percentages of prevalence of insufficient physical activity worldwide. This study was conducted from 2001 to 2016, 146 countries were considered and the target population was between 11 and 17 years old. According to this study, out of 146 countries involved, 3 out of 10 (43 countries) exceeded 10 percentage points the overall figure for prevalence levels of insufficient physical activity. An important finding in this research relates to the difference in values between the sexes, with about 107 countries showing an increase in this gap between 2001 and 2016. Boys showed

a slight percentage decrease (from 80% to 78%) in the prevalence of insufficient physical activity, while girls showed no change during this period (85% prevalence).

In Colombia, the picture regarding physical activity levels does not differ from the data presented by the WHO. The National Survey of the Nutritional Situation (ENSIN) (2016), indicates that in ages 6 to 12, 31.1% of the general population meets the recommended levels of physical activity, being higher in boys (35.8%) than in girls (26.0%) in this population. As for adolescents (13 to 17 years old), 13.1% of this general population meets the recommended physical activity requirements. Again, the values are higher in boys (18.7%) than in girls (7.6%).

In Colombia, physical activity levels remain low, with less than half of the population meeting the recommendations given by the WHO. These low levels of physical activity will have a direct influence on the overall health of the population, both globally and locally.

Currently there are several tools that allow us to estimate the levels of physical activity, either directly or indirectly. The physical activity questionnaires for children and adolescents (PAQ-C & PAQ-A) are one of these tools. A Canadian guide to these questionnaires was designed by Kowalski et al. (2004). This guide outlines all the components of the PAQ-C & PAQ-A questionnaires, how they work, their limitations and strengths, and how they are classified according to the two populations they assess.

These questionnaires allow indirect measurement of the levels of physical activity presented by a specific population. According to Bervoets et al. (2014) and Benitez et al. (2016), these questionnaires have an acceptable level of reliability and validity. Among their strengths is the moderate correlation with the peak of maximum oxygen consumption (VO₂ Peak). They recommend more validity tests that allow a more complete evaluation of the PAQs. It is also mentioned that for the PAQ-C no significant cut-off point was found.

It is clear that low levels of physical activity are related to the emergence and prevalence of

chronic non-communicable diseases (CND). These types of diseases, specifically cardiovascular diseases such as hypertension and dyslipidemia, have variables that allow us to estimate the level of cardiovascular risk such as blood pressure (BP), waist circumference (WC), waist-hip index (HHI) and body mass index (BMI). Physical activity levels may contribute to estimate the cardiovascular risk that exists in a target population, for this case in school children (9-12 years) and adolescents (13-17 years). For this reason, this research seeks to establish the relationship between levels of physical activity and indicators of cardiovascular risk in school children and adolescents in Bogotá's district educational institutions.

Methodology

This work is part of the GHAVISA study whose methodology is not yet published. It is a transversal study on 227 children and adolescents between 10 and 17 years of age with an average of 12.84 years (± 1.58) residing in Bogotá and belonging to 3 District Educational Institutions (DEI) in urban areas. The selection of the sample was determined by intention. The study was carried out following the deontological standards recognized by the Declaration of Helsinki, Resolution 008439 of 1993 of the Colombian Ministry of Health and Act 01 of 2019 of the ethics committee of the Universidad Santo Tomás. To participate in the study, parents or legal representatives of the minors filled out an informed consent form, the students made an informed assent prior to their participation in the study.

Measurements and questionnaires

The blood pressure values were obtained through the classification of the American Academy of Pediatrics (2017), the measurement was made by means of a Riester Digital Tensiometer. The PAQ-C and PAQ-A questionnaires were used to assess physical activity levels (Kowalski, Crocker & Donen, 2004), PAQ-C in the population under 12.9 years of age, and PAQ-A for children over 13 years of age. Body weight and height were measured using the SECA mobile floor scale and SECA portable height meter, and waist circumference was measured using an inextensible tape measure. The BMI

classification was taken from Colombian Resolution No. 2465 of June 14, 2016. Reference values for waist-to-size index (WSI) and waist circumference (WC) were taken from the study by Caicedo et al.

Statistical analysis

The statistical analysis of data was carried out with the Statistical Package for Social Science® software (IBM SPSS), version 25. Central tendency measurements (means and standard deviations) were made. Means were compared through the T Student test ($p < 0.05$) of the different variables. Pearson's correlation coefficient ($p < 0.01$ and $p < 0.05$) was used to examine the relationship between cardiovascular risk indicators (BMI, WSI, WC, BP) and physical activity levels (PAQ-C and PAQ-A).

Results

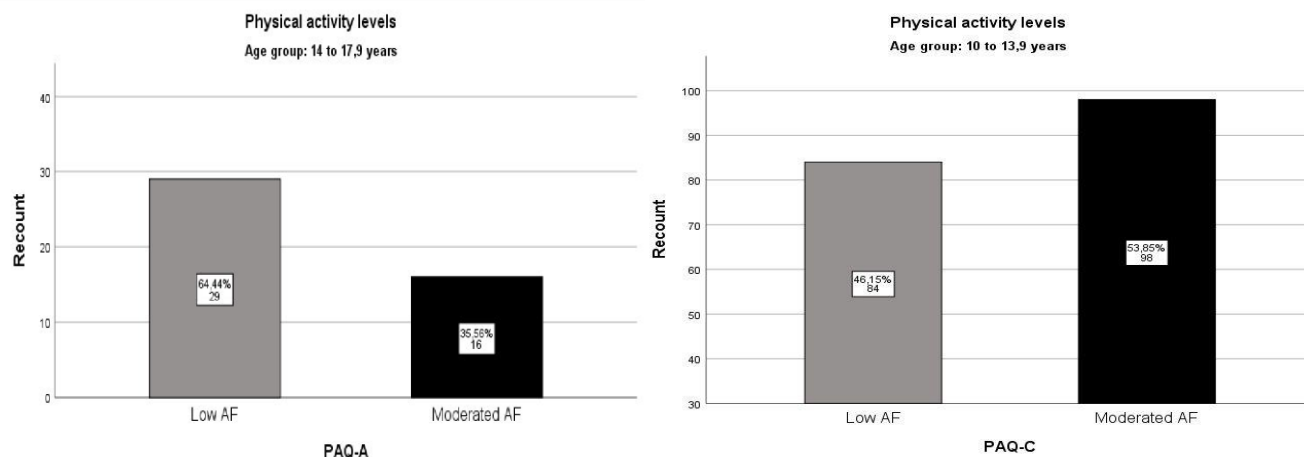


Figure I. Physical activity levels by age group

Blood pressure classification

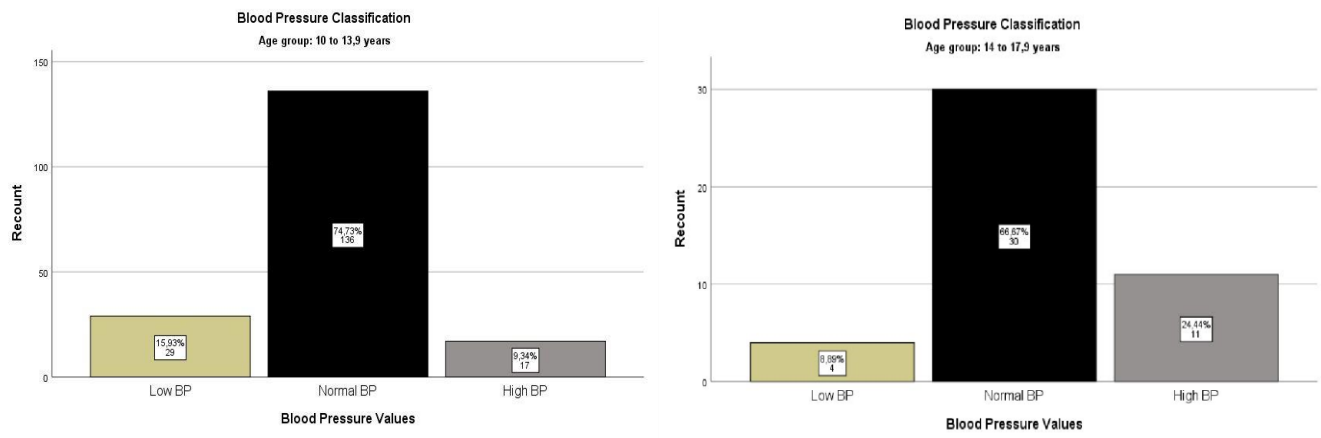


Figure II. Blood pressure levels by age group

Nutritional Status

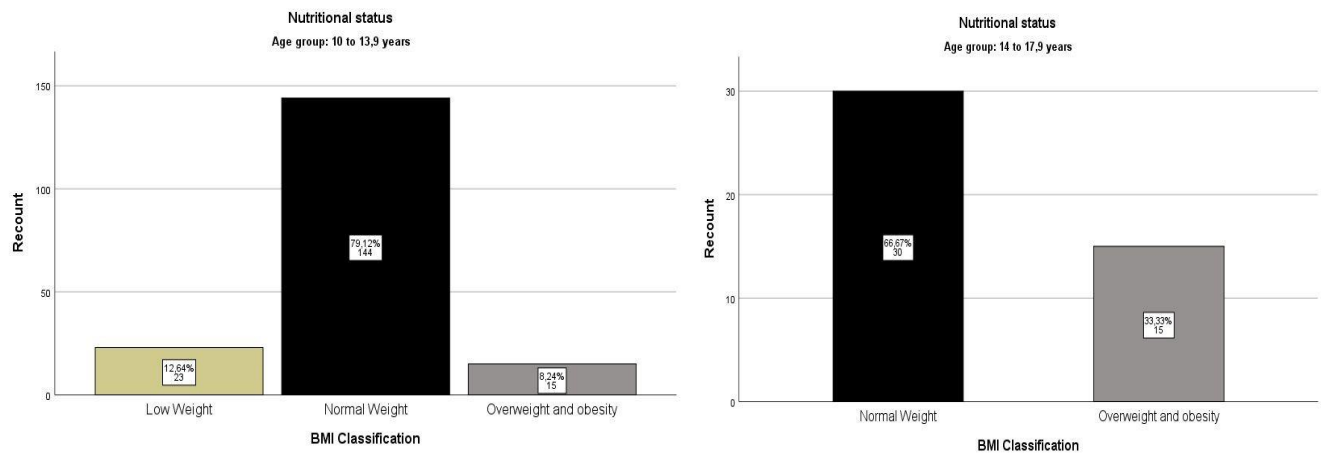


Figure III. Nutritional status by age group.

Table 1.
Differences between boys and girls of the different variables

	Girls (n= 76)	Boys (n=80)		Girls (n= 32)	Boys (n=39)	
Variables	10 to 13.9 years		p	14 to 17,9 years		p
Age (años)	12,24 (0,72)	12,12 (0,82)	0,289	15,78 (1,6)	15,38 (0,99)	0,198
Weight (kg)	41,22 (8,63)	41,45 (10,26)	0,870	52,79 (7,48)	58,96 (13,93)	0,068
Height (cm)	148,56 (6,92)	148,85 (8,43)	0,809	152,67 (8,72)	167,00 (8,66)	0,000*
BMI (kg/m2)	18,54 (2,94)	18,52 (3,38)	0,970	22,78 (3,83)	21,10 (4,66)	0,196
WHR (cm)	62,97 (6,40)	65,65 (8,76)	0,019*	69,41 (6,32)	72,88 (10,33)	0,177
WHtR	0,42 (0,04)	0,44 (0,50)	0,014*	0,46 (0,05)	0,44 (0,06)	0,276
SBP (mmHg)	107 (11,39)	105 (10,53)	0,249	105 (9,98)	114 (10,57)	0,005*
DBP (mmHg)	67 (6,67)	66 (6,68)	0,311	67 (6,10)	73(8,78)	0,014*
PAQ-C	1,94 (0,58)	2,39 (0,64)	0,000*	0,0	0,0	-
PAQ-A	0,0	0,0	-	1,61 (0,65)	2,12 (0,64)	0,011*

Note: BMI: Body Mass Index; WHR: Waist-to-hip ratio; WHtR: Waist-to-height ratio; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; PAQ-C: Physical Activity Questionnaire for Older Children; PAQ-A: Physical Activity Questionnaire for Adolescents; Mean Difference, * significant value ($p < 0.05$)

227 school children made up the sample. Table I presents the differences between boys and girls of the different variables evaluated. For the first age group (10 to 13.9 years) there were significant differences ($p < 0.05$) in waist to hip ratio (WHR), waist to height ratio (WHtR) and PAQ-C. In the second age group there were significant differences ($p < 0.05$) for the variables height, systolic blood pressure (SBP), diastolic blood pressure (DBP), and PAQ-A.

Table 2.
Correlation of CVR indicators and the level of physical activity

Indicators	PAQ-C		PAQ-A	
	Girls	Boys	Girls	Boys
	10 to 13,9 years		14 to 17,9 years	
BMI (kg/m2)	-0,094	-0,200	-0,045	-0,085
WHR (cm)	-0,136	-0,153	-0,077	-0,085
WHtR	-0,036	-0,174	-0,036	-0,142
SBP (mmHg)	,224*	-0,034	-0,315	0,070
DBP (mmHg)	0,143	0,007	-0,286	0,239

Note BMI: Body Mass Index; WHR: Waist-to-hip ratio; WHtR: Waist-to-height ratio; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; PAQ-C: Physical Activity Questionnaire for Older Children; PAQ-A: Physical Activity Questionnaire for Adolescents; Pearson Correlation, * significant value ($p < 0.05$)

Table II shows the results obtained by Pearson's correlation for both boys and girls, and for each age groups. Of the five indicators of cardiovascular risk (CVR), only systolic blood pressure (SBP) had a significant correlation with physical activity levels ($p < 0,05$). This case was presented only for girls aged 10-13.9 years (physical activity levels obtained by PAQ-C).

As a complementary analysis, 12.33% of the general population presents high blood pressure values, being higher in boys than in girls. As for the levels of physical activity, 53.85% of school children present moderate levels of physical activity; for both sexes there were not high levels of physical activity. Boys show higher levels of moderate physical activity ($n=64$) than girls ($n=34$). Moderate physical activity levels are lower in adolescents; boys maintain higher levels than girls. For the latter group there were also no high levels of physical activity.

In the case of body mass index (BMI), 79% of school children present normal levels of body weight. However, there were both underweight (13%) and overweight (8%) levels, the former being a factor to be taken into account in this type of population. The values change for adolescents, where 67% of the general population presents normal weight values, while 33% is overweight and obese. These values of overweight and obesity are higher in the case of girls (20%). It is evident that school children present healthier values in terms of BMI and physical activity levels compared to adolescents.

As for the other variables, Pearson's significant correlations were found between the different indicators of cardiovascular risk. The body mass index presented a correlation with 3 of the 4 indicators, having a stronger correlation ($p < 0.01$) with the waist-hip ratio and the waist-height ratio.

Discussion

This study evaluated the physical activity levels in Students of a public school in the city of Bogota in an attempt to determine whether they could be used as indicators of cardiovascular risk. Despite not finding significant correlations beyond the one mentioned previously in the results, important data were found regarding the different indicators of cardiovascular risk.

In terms of physical activity levels, the data provided by the ENSIN (2016) and the results of

the study agrees that both school children and adolescents have higher levels of moderate (recommended) physical activity than girls in both groups. Currently, the Colombian school population presents more favorable levels in terms of compliance with the physical activity recommendations given by the WHO, as opposed to the adolescent population. It is noted that of the total child population, 35.8% of boys and 26% of girls comply with the recommendations; these levels decrease for the second population group, within which only 18.7% of boys and 7.6% of girls present favorable levels of physical activity. The presence of a problem that affects our country is evident, and that is that age and physical activity levels are inversely proportional. Programs and strategies that promote an increase in physical activity should be implemented, since the lack of it is a risk factor for presenting chronic noncommunicable diseases from early ages. (Figure I).

As for the values obtained for blood pressure, 75% of the school population and 66% of adolescents are in normal blood pressure values. The percentage of high blood pressure is higher in adolescents 24.4% than in school children 9.3% (Figure II). There is a tendency for blood pressure values to be higher in boys than in girls in the adolescent group, which is in line with what De la Cerda and Herrero (2014) state, where they point out that this may be due to later pubertal development and a greater body mass developed by boys. Although it is clear that blood pressure is directly proportional to age, it should be borne in mind that this indicator of cardiovascular risk can be modified by various variables specific to an individual or modified by his or her environment.

According to Rosas et al. (2015), weight loss is a starting point in the primary treatment of obesity-related hypertension. It is necessary to reduce and control excess and abnormal weight gain in order to lower elevated blood pressure values. Maintaining optimal levels of physical activity and decreasing sedentary time will make it possible to maintain a stable weight and decrease the presence of high blood pressure. In the case of children and adolescents, it is important to modify the diet in such a way that a healthy habit can be built, especially in children who have a certain degree of prehypertension.

Finally, with regard to the nutritional status obtained through the BMI classification, the

results show that in school children the prevalence of overweight and obesity occupies 8% of the general population, 13% is equivalent to underweight levels and 79% of the population presents normal weight values (Figure III). A different case occurs in adolescents, where the prevalence of overweight and obesity corresponds to 33% of the population, being higher in girls than in boys. According to Navarro and others (2016), in a study carried out in Colombia, these levels of overweight and obesity are mainly due to a low nutritional level, related to a low-quality diet, which causes weight and an increase in the prevalence and risk of chronic noncommunicable diseases. Gomes et al. (2015), mention that reducing sedentary time in children and adolescents should be an aspect that is worked on from the school environment. This should be done through policies that promote healthy lifestyle habits, nutritional awareness that facilitate body weight control and therefore guarantee an optimal nutritional level for each age group.

One aspect that must also be taken into account to reduce the prevalence of overweight and obesity is the lifestyle and nutritional diet present in parents, as pointed out by Deniz & Oguzoncul (2019), mentioning that the lifestyle and habits they present can have a direct influence on the behavior of children and adolescents, increasing or not the prevalence not only of overweight and obesity but also of other aspects involved with health.

This study corroborates evidence supported at the local level, which indicates that nutritional status, associated with cardiovascular risk indicators, is currently low in the school and adolescent population of Bogotá, Colombia. The ENSIN (2015), mentions that excess weight within the last 5 years (2010/15), has presented a percentage increase, being higher in school population (18.8% to 24.4%) than in adolescents (15.5 to 17.9). This is where the central problem comes into focus once again, namely, that levels of physical activity are increasingly lower while excess weight increases over the years. It is clear that being overweight is associated with higher mortality from cardiometabolic diseases; therefore, it is urgent that policies that promote sport, physical activity and recreation reach more people every day, thus allowing for an improvement in the quality of life of each and every one of

the Colombian population. Wu et al. (2017), point out that maintaining an optimal level of physical activity and less sedentary time is directly associated with an increase in health-related quality of life in both the school and adolescent populations.

Conclusions

No significant correlation was found between physical activity levels and indicators of cardiovascular risk, beyond the correlation between PAQ-C and SBP in school girls. Despite the above, significant correlations were found between BMI and WC vs. blood pressure values, which can be taken into account as an indicator that allows the creation and structuring of strategies that encourage the practice of physical exercise and sport not only at the school level but also extra-curricular, and thus reduce the prevalence of chronic non-communicable diseases in later ages and future generations.

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