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Use of physical activity and cardiorespiratory fitness in identifying cardiovascular risk factors in male Brazilian adolescents

Uso da atividade física e da aptidão cardiorrespiratória na identificação de fatores de risco cardiovasculares em adolescentes brasileiros

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Abstract – The aim of this study was to investigate the impact of physical activity (PA) and cardiorespiratory fitness (CRF) levels on the prevalence of overweight and high blood pressure levels in adolescents. In this observational, cross-sectional study, 614 boys aged 10-14 years were assessed for height, body mass, body mass index (BMI), waist circumference (WC) and blood pressure (BP). CRF was assessed using a run test (Léger Test) and subjects were then grouped according to their CRF level. PA level was assessed through a questionnaire (The Three Day Physical Activity Recall) and classified into two groups, namely ≥ 300 minutes of PA/week and < 300 minutes of PA/week. Maturational stage was evaluated according to the development of pubic hair (self-assessment) as proposed by Tanner. We used statistical descriptive analysis, univariate and multivariate analyses in the total participants and subjects were divided by age. Fifty percent of the sample performed < 300 minutes of PA/week and 67.6% had unsatisfactory CRF levels. There was a higher prevalence of unsatisfactory CRF levels among subjects with altered BMI (overweight), WC (abdominal obesity) or BP (high blood pressure) for all age groups. PA history, however, did not show any significance. A total of 31% of participants were overweight, 24.8% had abdominal obesity and 15.4% had increased BP. Unsatisfactory CRF levels were found to be a better predictor for the diagnosis of cardiovascular diseases (CV) risk factors than PA history, regardless of age group.

Key words: Cardiovascular diseases; Health status indicators; Motor activity; Oxygen consumption; Students.

Resumo – *Objetivou-se investigar o impacto da atividade física (AF) e níveis da aptidão cardiorrespiratória (APCR) na prevalência de excesso de peso e níveis hipertensivos em adolescentes. Estudo observacional, transversal, com 614 meninos de 10 a 14 anos, que foram avaliados quanto à estatura, massa corporal, índice de massa corporal (IMC), circunferência abdominal (CA) e pressão arterial (PA). Utilizou-se teste de corrida (Léger Test) para avaliar a APCR. O nível de AF foi avaliado por questionário (The Three Day Physical Activity Recall), classificando-os conforme prática < ou ≥ 300 minutos/semana. Estágio maturacional foi autoavaliado de acordo com o desenvolvimento dos pelos pubianos, proposto por Tanner. Testes estatísticos de análises descritivas, bivariada e multivariada foram utilizados. Do total, 50% dos escolares apresentaram AF < 300 minutos/semana e 67,6% com APCR insatisfatória. Indivíduos com alterações no IMC (excesso de peso), CA (obesidade abdominal) ou PA (valores hipertensivos) apresentaram maiores frequências de APCR insatisfatória em todas as faixas etárias, enquanto que o histórico de AF não se mostrou significativo. A APCR insatisfatória apresentou-se como melhor parâmetro para o diagnóstico de fatores de risco para doenças cardiovasculares (CV) do que o histórico de AF, independentemente da faixa etária.*

Palavras-chave: *Doenças cardiovasculares; Estudantes; Indicadores básicos de saúde; Atividade motora; Consumo de oxigênio.*

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INTRODUCTION

Physical activity (PA) has always been a part of human life, from prehistory to the present day. However, with progressive lifestyle changes, everyday practical physical activities have diminished, both among children and adolescents as well as adults[1,2]. The greater availability of technology, the increased insecurity in cities and the decrease in public open spaces in urban centers have also contributed to a reduction in physical activity and favored the practice of sedentary activities such as watching TV, playing video games and using computers[3]. Moreover, there is a tendency for decline in the average daily energy expenditure with increasing age as a result of the reduction of PA due to biological, behavioral and social factors[4]. Finally, low daily PA increases the potential for a decrease in cardio-respiratory fitness (CRF) levels among children and adolescents, which may lead to health problems in this age group[1-3].

CRF has been considered one of the most important components of physical fitness, showing a strong relationship with performance in several athletic modalities as well as with the presence of more adequate physiological conditions that lead to the prevention and reduction of chronic degenerative diseases[4]. In addition to CRF, the amount of PA is another important variable. For the maintenance of health in children and adolescents, the performance of 300 minutes of moderate to vigorous intensity physical activity per week is recommended[5-7]. Coledam et al.[8] studied the correlation between two cut off points for physical activity and associated factors in young people and came to the conclusion that the cut off points for moderate to vigorous physical activity of 300 and 420 minutes/week showed strong concordance (90.5% of cases), and that there was no significant difference (9.5%) in the prevalence of compliance with the recommendation. That is, using different cut off points for physical activity results in similar youth prevalence values and factors. With regards to the amount of weekly physical activity of young people, despite the recommendations that moderate to vigorous physical activity is 60 minutes a day, studies have used a cut off as much as 300 minutes to 420 minutes weekly[8].

Regular PA may improve CRF. In addition, it helps to reduce weight gain and maintains health among the young, which can be diagnosed by monitoring anthropometric and metabolic indicators[6]. The decline seen in CRF is influenced by multiple factors, including the level of PA and genetic components[6].

Several studies have demonstrated the association between physical inactivity and excess body adiposity as factors that negatively affect health status, predisposing a person to a higher frequency of illness[1-3]. Being overweight interferes with an adolescent's daily physical performance, consequently resulting in the reduction of physical fitness and cardiorespiratory capacity, and leading to a vicious cycle of decline that predisposes obese adolescents to lower cardiorespiratory fitness levels than their normal-weight peers[6]. Moreover, studies performed in different Brazilian regions have shown a high prevalence of high blood pressure among children and adolescents, ranging from 2.5% to 44.7%[7], depending on the amount of body adiposity[9,10].

Therefore, obesity and changes in systemic arterial blood pressure are highlighted as the diseases most frequently associated with PA decline and unsatisfactory CRF levels. Nevertheless, there are controversies regarding the most reliable parameter for the diagnosis of cardiovascular (CV) risk factors. For some authors, it is low PA[3], while for others, it is unsatisfactory CRF[1,9]. This study investigated the impact of physical activity history and CRF levels on the prevalence of overweight and high blood pressure in male Brazilian adolescents.

METHODOLOGICAL PROCEDURES

This observational, cross-sectional study was conducted with a sample of 10-14-year-old boys from state schools in Curitiba, Brazil. Two-stage cluster sampling was employed. In the first stage, one state school was randomly drawn from the schools in the city of Curitiba and all sixth to ninth graders (aged 10-14 years) in that school were invited to participate and explained the objectives and procedures of the study.

The sample size was calculated using EpiInfo (Version 3.5.1). We considered the number of students enrolled in each school of the municipal school network, with a 95% confidence level and 5% sampling error. The sample size was calculated for 50% prevalence due to the fact that this study was part of a larger research project that aimed to assess the frequency of several CV risk factors in children and adolescents.

The study population of 8, 140 students came from five public schools, with one school representing each educational district in the city. This population provided a calculated sample of 1, 523 students with the collected sample being 1, 497 students. The final sample came out as 1, 441 students, of which 770 were adolescent males (53.4% of the sample).

Physical activity history was assessed using a 3-day physical activity recall, 3DPAR[11], which was translated, adapted and validated by Pires (2001). The questionnaire was administered on Fridays only. Participants were asked to report their PA for two week days (Wednesday and Thursday) and one weekend day (Sunday). Moderate-to-vigorous PA cut off points were defined as 300 minutes or more of PA per week (min/week)[7,8] The questionnaire has a reproducibility of r =0.92 and 0.99 for all levels of effort[11].

Using the Léger Test, the maximum VO2 was calculated according to the equation for the age range 6 to 18 years: y=31,025 + 3,238(1) – 3,248(2) + 0,1536(1)(2) where y=ml/kg/min; 1=km/h (maximum speed reached during the test) and 2=age (in years). As proposed by Rodrigues et al.[14], subjects were categorized in 3 groups according to their VO2 max: low/very low, average and good/excellent CRF.

Anthropometric assessment was performed as follows: Height was measured in centimeters (cm) to the nearest 0.1 cm, using a wall stadiometer

(Wiso®,Brazil). The individual remained in an orthostatic position, barefoot and feet together with the posterior surface of the heel, limb-girdle, and occipital region in contact with the wall, and the head in the horizontal plane of Frankfort. Body mass was measured in kilograms (kg) on platform scales (Plenna®, São Paulo, Brazil) with 150 kg capacity and accurate to 100g. The individual remained barefoot, in a standing position in the center of the platform, with arms against the body and wearing only the school uniform without a jacket or objects in his pockets. The uniform weight was not deducted from the value of the body mass. Body Mass Index (BMI) was calculated according to the following formula: body mass (kg) divided by height squared (m^2).

Waist circumference (WC) was measured in centimeters to the nearest 0.1 cm using a flexible non-elastic tape. Measurement was performed at the smallest circumference between the ribs and iliac crest with the subject standing with abdomen relaxed, arms at sides and feet close together. The anatomic location considered for the measurement of waist circumference was chosen to be the same used by Fernández et al.[15] WC values at or above the 75th percentile were classified as borderline or high for age and gender[11].

Body Mass Index was calculated according to the usual formula, and the z-score was obtained according to age and gender using the World Health Organization Anthroplus software. Students were classified as follows: underweight (z-score < -2), normal weight (-2 < z-score < 1), and overweight/obese (z-score $\geq$ 1)[16].

Resting heart rate and Systolic (SBP) and Diastolic Blood Pressure (DBP) were assessed with the subject sitting after ten minutes' rest. Three measurements at 2-minute intervals were performed and the average was calculated. A previously calibrated mercury column sphygmomanometer from Wan Med was used with an appropriate cuff width to the circumference of the individual's arm. The obtained values were classified in percentiles according to age and gender. Values at or above the 90th percentile were classified as high for age and gender[17].

Maturational stage was assessed according to the pubic hair development self-assessment staging (P1-P5) as proposed by Tanner (1962).[18] According to Tanner's staging, stage 1 is prepubertal (no hair), stages 2-4 are pubertal, and stage 5 is postpubertal.

The collection took place in 2010. Data were collected by specialists and post graduate students of the Federal University of Parana. The entire staff received training and a pilot study was conducted before initiation. Each team was responsible for the same variable in all schools.

Values were analyzed using the statistical package Statistica 10.0 (Statsoft). The results were presented using descriptive statistics, charts and graphs. Weight, height, WC and PA data were analyzed for normality using the Kolmogorov-Smirnov goodness of fit test. For quantitative variables, we performed a means test using statistical test analysis of variance (ANOVA) factorial design, followed by the Duncan post hoc test to compare statistically different pairs of means. For categorical variables, we built frequency tables resulting from the counting statistics and performed the chi-square test, followed by the Haberman residuals to identify statistically significant proportions. Statistical significance was set at p ≤ .05.

This study was approved by the Ethics Committee of the Federal University of Paraná (UFPR), Opinion number 0047.0.091.000-0 and protocol number CEP/SD: 403.083.07.07, according to Resolution CNS 466/12. Participation was voluntary and written consent was obtained from parents or legal guardians.

RESULTS

A total of 770 male students were assessed for eligibility. Students eligible for participation in the study were those who submitted the Informed Consent Agreement (ICA) signed by parents or guardians. Of these, 166 were excluded for not being between 10 to14 years of age (n = 69), not completing all assessments (n = 87) and ten subjects were at that time using medication and / or suffering from a disease that could alter blood pressure levels. Thus, the end sample consisted of 614 adolescents.

Maturation was used to verify whether there were differences between age groups as the variables of physical activity and CRF. Taking into account chronological and biological age, 90.5% of boys were pubescent, 5.2% pre-pubertal and 4.3% post-pubertal.

From Table 1, mean values of anthropometric and SBP measurements increased with age (p<.01), while DBP measurements were lower for 12-year-olds than for 11- and 14-year-olds (p<.01). The lowest mean max VO2 values were found among 10-year-olds. However, this group of students also showed the lowest median of physical activity (p<.01).

Table 1. General characteristics of male Brazilian adolescents by age group, Curitiba, PR, 2010

Variables	10 years (n=72)	11 years (n=136)	12 years (n=137)	13 years (n=163)	14 years (n=106)
Decimal age (y)	10.69(0.21) [b,c,d,e]	11.49(0.30)[a,c,d,e]	12.57(0.35)[a,b,d,e]	13.48(0.29)[a,b,c,e]	14.40(0.29)[a,b,c,d]
Weight (kg)	39.22(9.61)[c,d,e]	41.52(9.90)[c,d,e]	44.95(9.93)[a,b,d,e]	50.31(11.26)[a,b,c,e]	57.30(12.42)[a,b,c,d]
Height (m)	1.43(0.05)[b,c,d,e]	1.46(0.07)[a,c,d,e]	1.52(0.08)[a,b,d,e]	1.57(0.09)[a,b,c,e]	1.65(0.09)[a,b,c,d]
Height(z escore)	0.22(-1.70-2.24)[b,c,d,e]	-0.12(-3.60-3.32)[a]	-0.08(-2.34-2.65)[a]	-0.13(-2.91-3.35)[a]	0.11(-4.75-2.77)[a]
BMI (kg/m^2)	18.91(3.74)[d,e]	19.13(3.36)[e]	19.25(3.52)[e]	19.99(3.23)[a,e]	20.91(3.63)[a,b,c,d]
BMI (z escore)	0.63(-2.85-3.22)[b,d,e]	0.47(-2.76-3.57)[a]	0.21(-2.95-3.02)[d]	0.28(-2.62-2.90)[c]	0.42(-2.14-3.07)[a]
SBP (mmHg)	102.98(11.50)[d,e]	104.81(11.91)[e]	104.47(10.57)[d,e]	109.17(10.83)[a,c,e]	111.70(10.57)[a,b,c,d]
DBP (mmHg)	59.53(10.49)	61.14(10.95)[c]	57.92(8.49)[b,e]	60.99(9.90)	63.02(11.77)[c]
WC (cm)	66.52(10.14)[d,e]	67.55(9.23)[d,e]	68.74(8.90)[e]	70.78(8.92)[a, b,e]	73.55(8.77)[a,b,c,d]
$VO_{2máx}$.abs(l/min)	1.63(0.36)[c,d,e]	1.67(0.39)[d,e]	1.76(0.35)[a,d,e]	1.97(0.43)[a,b,c,e]	2.31(0.49)[a,b,c,d]
PA level (min/w)	210(0-1440)[b,c,e]	285(0-1830)[a]	315(0-2980)[a,d]	300(0-1980)[c]	320.5(0-2220)[a]

*Anova one way independent groups, post hoc Duncan's, with p<0.01; ** Kruskall Wallis test (no parametrics),T test for independent sample by groups. a 10 years different (p<0.01); b 11 years different (p<0.01); c 12 years different (p<0.01); d 13 years different (p<0.01); e 14 years different (p<0.01). Average (SD), Median (Min-Max). Note: BMI =Body Mass Index; SBP:=Systolic Blood Pressure;

The participants were classified according to the adequacy or inadequacy (Figure 1) of values assumed for BMI, WC, blood pressure (BP), CRF and PA. Of these 5 variables, unsatisfactory CRF (67.6%) and history of less than 300 minutes of PA per week (50%) showed the greatest alterations.

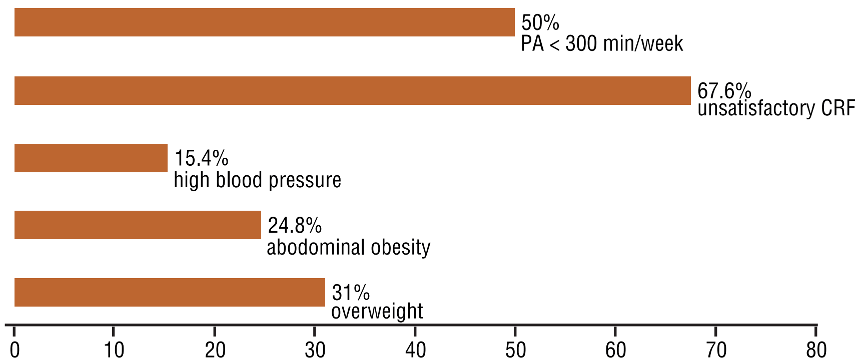

Figure 1. Percentile distribution and sample classification according PA < 300 min/week, unsatisfactory cardio-respiratory fitness and cardiovascular diseases risk factors. PA: physical activity.

Students who were overweight, had abdominal obesity and hypertensive values were analyzed according to the cut off points for PA (≥ or < 300 minutes/week) and CRF (satisfactory or unsatisfactory) (table II). As shown in Table II, adolescents who were overweight and had abdominal obesity had the highest frequency of unsatisfactory CRF (p<.05), whereas 10-year-old students with visceral obesity had the highest frequency of history of PA ≥300 minutes/week (p<.05).

Table 2 provides evidence that those students with poor cardiorespiratory fitness are most prevalent in all age groups for being overweight and having abdominal obesity.

Table 2. Frequency of risk factors, satisfactory/unsatisfactory cardio-respiratory fitness and > or < than 300 minutes of PA per week by age group in school boys, Curitiba, PR, 2010 - Univariate analysis.

Age and Risk Factors	≥ 300 min/week	<300 min/week	p	CRF+	CRF-	p
	n	n (%)		n	n (%)	
10 years old						
Overweight	10	13 (56.5)	0.10	8	23 (74.2)	0.001*
Abdominal obesity	12	7 (36.8)	0.03*	6	19 (76)	0.002*
High blood pressure values	7	4 (36.3)	0.13	4	8 (66.7)	0.240
11 years old						
Overweight	16	17 (51.5)	0.82	7	39 (84.8)	0.100
Abdominal obesity	14	10 (41.7)	0.34	4	31 (88.6)	0.020*
High blood pressure values	12	12 (50)	0.95	4	21 (84)	0.390
12 years						
Overweight	16	16 (50)	0.69	5	33 (86.8)	0.090
Abdominal obesity	11	12 (52.2)	0.78	2	25 (92.6)	0.030*
High blood pressure values	9	4 (30.8)	0.07	1	13 (92.8)	0.140
13 years						
Overweight	15	12 (44.4)	0.54	5	30 (85.7)	0.001*
Abdominal obesity	16	11 (40.7)	0.40	4	28 (87.5)	0.001*
High blood pressure values	10	10 (50)	0.83	8	14 (63.6)	0.820
14 years						
Overweight	9	10 (52.7)	0.84	5	24 (82.7)	0.003*
Abdominal obesity	7	9 (56.2)	0.61	2	22 (91.7)	0.002*
High blood pressure values	4	9 (69.2)	0.10	6	9 (60)	0.580

Note: * p value <0.05; CRF: cardio-respiratory fitness.

DISCUSSION

This study investigated the impact of PA history and CRF levels on anthropometric indicators and BP in male adolescents. The CRF was the best parameter assessed to diagnose risk factors because the direct method is considered the "gold standard" for this type of evaluation. PA, however, was self-reported which implies method limitations, but because of its low cost and practicality in its application in large populations it was the method chosen by the researchers.

When comparing physical inactivity and poor CRF to overweight, abdominal obesity and high blood pressure, CRF was significantly correlated with these factors among different age groups. These results show that most risk factors are present in these groups (less than 300 minutes/week and unsatisfactory CRF). On the other hand, boys who perform moderate to vigorous physical activity regularly, and who meet the recommended levels of physical activity that includes aerobic exercise, muscle strengthening and muscle stretching, experienced the most benefit, especially in terms of physical growth, increased muscle mass, and increased levels of hemoglobin which consequently leads to better oxygen transportation, thus improving their CRF[19-21].

Of particular note in this study, we found that the proportion of students who had a PA history of less than 300 min per week (50%) was lower than that of students who had an unsatisfactory CRF (67.6%), probably because some of the students perform therapeutic PA. These proportions of unsatisfactory CRF found in this study are possibly linked to the lifestyle adopted by young males, especially during leisure hours and free time.

The performance of less than 300 minutes of PA per week showed a correlation with abdominal obesity ($p<.001$) only in 10-year-olds. This may be due to several reasons, such as an instrument limitation (being a self-report measure), students' interpretation of vigorous-intensity PA, this PA cut off not being sufficient to achieve benefits to health or the fact that these boys perform therapeutic PA, since they had abdominal obesity.

Studies conducted in different countries reveal that 13.7% to 56.0% of adolescents perform PA according to the current recommendations/ guidelines[7,8]. In Brazil, despite the increasing number of studies on the topic, information on the proportion of physically active adolescents (≥ 300 minutes of PA per week) in nationally representative samples is limited. Data from the National School Children's Health Survey, conducted with 9th graders from state and private schools, show that 43.1% of adolescents are sufficiently active. In general, much of the available data are from the Brazilian studies that mostly do not have representative samples and show that 13-63.5% of adolescents perform 300 minutes or more of moderate-to-vigorous physical activity per week[9,11].

It is important to highlight the fact that there are also other risk behaviors among adolescents, such as time spent watching TV, sitting in front of a computer or playing videogames - also called "screen time". These are sedentary habits that contribute to a decrease in daily caloric expenditure[3]. Studies show that a decrease in children's resting metabolic rate while watching certain TV shows, and this decrease was even greater in obese children[3, 9]. Sedentary behavior is associated with decreased physical fitness [9], and the assessment of CRF levels is considered to be one component of health-related fitness. This study did not assess screen time. However, we found that 67.6% of participants had unsatisfactory CRF. These results are in accordance with other studies performed with Brazilian students that showed that approximately 60% of students of both sexes had CRF levels below the recommended level for age and gender[6, 9]. Kolle et al.[6] found decreased CRF in Norwegian children and adolescents of both sexes. The authors concluded that maintenance of CRF is associated with regular physical activity.

Regular moderate-to-vigorous PA in all ages leads to an increase in CRF levels[20], and the recommendation for children and adolescents is ≥300 minutes of PA per week. Moreover, according to Pereira et al.[9], maximum aerobic power (VO2 max) highlights the importance of developing CRF during adolescence. Maintenance of CRF can therefore be considered a health-protecting factor. The results of this study confirm the importance of this physical fitness component for all age groups, as evidenced by a lower prevalence of overweight and abdominal obesity among boys with satisfactory CRF. Thus, lifestyle changes resulting from reduced physical effort and, consequently, reduced CRF are another cardiovascular risk factor for adolescents[6].

We found that all anthropometric measurements increased with age. This was expected due to the growth and pubertal development of our study population. In boys, peak height gain occurs at approximately 14 years of age, although with great individual variations, and is normal between ages 12 and 16 years[19]. The absolute mean values of max VO2 increased with age (probably due to age-associated maturation) as well as the median minutes per week of moderate-to-vigorous PA. These factors have also been cited by other studies[20, 21].

Studies have shown an association between cardiorespiratory fitness and physical activity level. Souza et al.[22], while studying 282 adolescents, examined the relationship between CRF and regular participation in exercise and found results which suggested that regular participation in sports was positively associated with CRF. These same authors also evaluated direct methods and indirect CRF to evaluate the PA. During this research the authors acknowledged that they were unable to measure the use of technologies for large populations of young people and this was also a limitation of our research[22].

With regard to being overweight, the results found in this study were similar to those found in segments of the Brazilian population in general[23] and, more specifically, in Curitiba[24]. According to data from the Brazilian Institute of Geography and Statistics[23], in the previous 30 years there was a six-fold increase in the prevalence of overweight and obesity among male

Brazilian adolescents aged 10-19 years (from 4.1% to 27.6%). Moreover, higher rates of overweight prevalence have also been found in other Brazilian cities, which demonstrates the tendency towards obesity[24-28]. These results reveal lifestyle changes in the Brazilian population, and particularly in boys, due to eating and sedentary behaviors that lead to obesity[29].

These data are worrying because excess body weight in childhood and adolescence tends to track into adulthood[29,30]. It is estimated that only one in every five overweight adolescents loses weight and maintains his body weight within normal range as an adult[30]. At the same time, body weight reduction and control programs for adolescents seem to have a rather limited efficacy because many of the adolescents who are overweight will probably continue to be overweight in adulthood[29]. The results of this study show that intervention programs for this age group are important to prevent overweight and its comorbidities[30].

Like obesity, the prevalence of systenic arterial hipertension (SAH) has increased among children and adolescents[3,10]. In Brazil, its prevalence has risen from 2% to 13% in recent decades[17]. In this study, 15.4% of the sample had hypertensive values. This is in line with other studies conducted in Brazil[9,10,23], which have shown that the frequency of high blood pressure in the population may vary according to the region of the country where studies are conducted, due to methodological differences such as sampling methods, sample size, sample characteristics, the quality of assessment tools, measurement techniques, the number of measurements and cut off points for the classification of blood pressure. In addition, it is important to note that the frequency of SAH is also influenced by intervening variables due to its multifactorial character, which involves both genetic and environmental aspects[10].

Among the environmental factors, physical inactivity leads to changes in several body systems, such as excess adiposity and SAH. Therefore, children and adolescents need to be encouraged to do 300 minutes or more of moderate-to-vigorous physical activity per week[30] as it promotes cardiorespiratory fitness, improves performance and optimizes growth[3]. In this study, 50% of the students performed less than 300 minutes of moderate-to-vigorous PA per week, less than the global trend, since, according to the WHO (2010), 80% of the world's youth is insufficiently physically active due to a decrease in physical activity levels[26]. Regardless of the methods used, physical activity participation tends to decrease with age for all types of exercises, and the same holds true for participation in sports and physical education programs[30].

It is important to highlight the fact that comparisons between epidemiological studies should be made with caution because results are influenced by the methodological procedures employed, as well as by intervening variables. In addition to the methodological differences stressed above, the lack of description of certain anthropometric characteristics limited the discussion about differences between the studies cited. Some of these limitations should be taken into consideration for the interpretation of results, because recommendations that include diet and PA programs are part of weight-loss therapies and seem to help in the maintenance of healthy blood pressure levels[8-10]. Thus, a history of more than 300 min of PA per week may have included individuals who participate in therapeutic physical exercise training, a limitation of cross-sectional studies. Furthermore, the PA history assessment tool allowed us to assess only general participation in different types of PA. Thus, shorter periods and variations in intensity could not be included in the analyses. Nevertheless, even though it is a self-report instrument, the tool allowed us to identify different types of PA, a relevant aspect when analyzing the relationship between PA and self-efficacy. The strong point of this study is the utilization of the Léger-test, an objective measure that identifies an individual´s current fitness state through a test of progressive difficulty. By assessing VO2 max, it allows us to diagnose students as having satisfactory or unsatisfactory CRF[13], regardless of their PA history. CRF assessment is of paramount importance, because the prevalence of satisfactory CRF levels are declining worldwide for both sexes, presenting itself as a health risk[17,20,21]. PA should be encouraged in all environments frequented by children and adolescents. In addition, in order to develop and maintain CRF, they should participate in at least 50 minutes of moderate-to-vigorous PA daily or most days of the week.

CONCLUSION

CRF was found to be a more reliable parameter for the diagnosis of cardiovascular risk factors than PA history, regardless of age group, especially because it is an objective, non-self-report measure. Thus, we suggest the development of adequate CRF levels in children and adolescents through enhanced opportunities for participation in regular physical activity, both during physical education and extra-curricular sport and PA, creating more opportunities for participation in guided physical exercise, and physical and leisure activities.

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