Concordance between two classifications for cardiorespiratory fitness in children

Concordância entre duas classificações para a aptidão cardiorrespiratória em crianças

Concordancia entre dos clasificaciones para la aptitud cardiorrespiratoria en niños

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ABSTRACT

Objective: To verify the agreement between two different cutoff points for cardiorespiratory fitness in schoolchildren, with ages ranging from seven to 10 years of both genders.

Methods: A cross-sectional study composed of 184 schoolchildren (106 boys and 78 girls) aged from seven to 10 years-old. Cardiorespiratory fitness was measured by the run and walk test (9 minutes). Two cutoff points were used to indicate the performance in the run and walk test: Fitnessgram (1987) and Bergmann *et al* (2010). The agreement was verified by the McNemar test and the Kappa index, and $p<0.05$ was considered as significant.

Results: No differences were noticed between the percentage of fit subjects according to both cutoff criteria (Fitnessgram with 58.1% and Bergmann *et al*, 59.2%; $p=0.864$). Similarly, there was moderate concordance between the cutoff points (Kappa=0.61).

Conclusions: Both cutoff points for physical fitness similarly classified the schoolchildren, regardless of gender.

Key-words: physical fitness; motor activity; child.

RESUMO

Objetivo: Analisar a concordância entre duas diferentes tabelas de pontos de corte para a classificação da aptidão cardiorrespiratória em escolares de sete a 10 anos de idade, de ambos os sexos.

Métodos: Estudo de delineamento transversal do qual participaram 184 escolares (106 meninos e 78 meninas) de sete a 10 anos de idade. A aptidão cardiorrespiratória dos escolares foi obtida por meio do teste de campo de corrida ou caminhada de nove minutos. Para a discriminação do desempenho no teste, foram utilizados dois critérios ajustados por sexo e idade: Fitnessgram (1987) e o de Bergmann *et al* (2010). A concordância entre os pontos de corte foi verificada pelo teste de McNemar e pelo índice *Kappa*, com significância estatística de $p<0,05$.

Resultados: As análises demonstraram que não houve diferença no percentual de jovens classificados como aptos fisicamente (Fitnessgram com 58,1% e Bergmann *et al*, 59,2%; $p=0,864$). De forma similar, a concordância entre os pontos de corte apresentou-se moderada (*Kappa*=0,61).

Conclusões: Ambos os pontos de corte para aptidão cardiorrespiratória classificaram de maneira semelhante os escolares, independentemente do sexo.

Palavras-chave: aptidão física; atividade motora; criança.

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RESUMEN

Objetivo: Analizar la concordancia entre dos distintas tablas de puntos de corte para la clasificación de la aptitud cardiorrespiratoria, en escolares de siete a diez años de edad, de ambos sexos.

Métodos: Estudio de delineación transversal, en el que participaron 184 escolares (106 muchachos y 78 muchachas) de siete a 10 años de edad. La aptitud cardiorrespiratoria de los escolares se obtuvo a través de la prueba de campo de carrera o caminata de 9 minutos. Para la discriminación del desempeño en la prueba, se utilizaron dos criterios ajustados por sexo y edad: Fitnessgram (1987) y el de Bergmann *et al* (2010). La concordancia entre los puntos de corte fue verificada por la prueba de McNemar e índice Kappa, con significancia estadística de *p*<0,05.

Resultados: Los análisis demostraron que no hubo diferencia en el porcentaje de jóvenes clasificados como aptos físicamente (Fitnessgram con 58,1% y Bergmann *et al*, 59,2%; *p*=0,864). De modo similar, la concordancia entre los puntos de corte se presentó moderada (Kappa=0,61).

Conclusiones: Ambos puntos de corte para aptitud cardiorrespiratoria clasificaron de manera semejante a los escolares, independiente del sexo.

Palabras clave: aptitud física; actividad motora; niño.

Introduction

In recent decades, there was an abrupt transition in the causes of mortality and morbidity in the adult population, and an increasing incidence on the occurrence of cardiovascular diseases and its risk factors[1,2]. In the pediatric population, the diagnosis of cardiovascular disease is rare, once it has a long latency period. However, the presence of some of its risk factors (obesity, high blood pressure, insulin resistance, and dyslipidemia) has been increasingly common in young individuals[3-5].

Regarding the pediatric population, it is known that cardiorespiratory fitness (CRF) is inversely related to the occurrence of many of the risk factors mentioned[6]. This way, we have emphasized the importance of meeting the recommended values to ensure protection against the development of such factors. Thus, to evaluate and classify CRF at an early age becomes an important tool for monitoring and avoiding aggravators in the health of the adult. In addition to such needs, national information indicates that few young people follow the recommendations regarding CRF[7,8].

On the other hand, there are relevant questions on the use of cutoff points developed in other populations than the Brazilian (North-American or European) for national use, which demonstrates the importance of developing criteria, cutoff points, for the CRF of young Brazilians[9]. Thus, the aim of the present study was to analyze the agreement between the different cutoff points for the classification of CRF in schoolchildren of both sexes, from seven to ten years old.

Method

This study was a comparative, cross-sectional descriptive study, which was conducted in the first semester of 2011. Although the present sample was not selected randomly, we used an equation to estimate the sample size, using the McNemar test. Through this test, there was an agreement ratio expected for the two tests (68%), having to meet the criterion in both (arbitrary due to the absence of similar studies), and a mismatch of 25% (arbitrary due to the absence of similar studies), two-tailed test, with an alpha error of 0.05 and 80% power, identifying the need to assess at least 180 participants.

Hence, a school unit was selected for convenience (school located inside the University responsible for the research), in the municipality of Londrina, Paraná. During the study period, this school had 193 students enrolled in the selected grades (2nd to 4th grades, morning and evening shifts), which were invited to participate in the study. Inclusion criteria were: belonging to the pre-established grades, to be enrolled in the selected School, agreeing to participate in the study and obtaining permission from parents or guardians. Exclusion criteria were: presenting any physical problem that would prevent the performance of the motor test. After exclusions, the sample was comprised by 184 schoolchildren (106 boys and 78 girls, 95.3% of participation) from seven to ten years old.

Students involved in the research and their parents/guardians were previously informed about the purposes of the study and received instructions about the procedures adopted. Parents signed an informed consent form. The study was approved by the local Research Ethics Committee (280/11), according to the guidelines and standards of the resolution 196/96 from the National Health Council on research involving humans.

Anthropometric variables measured were: body mass, obtained in a digital Urano scale (model PS 180; accuracy of 0.1kg and maximum capacity of 180kg), and height, determined by a wooden stadiometer with accuracy of 0.1cm and maximum length of 2m. Anthropometric measures followed the procedures described by Gordon *et al*[10]. The

measurements were performed within the school by physical education teachers previously trained. In addition, young people wore light clothing and were barefoot.

The 9-minute run-walk field tests were performed on an official athletic track, located in the very institution of higher education, following the recommendations of Cooper[11]. In this test, the subjects walked or ran during the set time of 9 minutes, and the distance was controlled by the number of complete laps on the track (400m), plus the additional meters of the incomplete lap.

For analysis of the classification criteria of CRF for the age group seven-ten years old, the values were adapted to the ones suggested by the Fitnessgram[12] battery of motors tests, which was designed by the Cooper Institute for Aerobics Research. The Fitnessgram recommends the 1-mile run and/or walk test to assess CRF or run and/or walk tests for a period longer than 6 minutes.

Therefore, the recommended values for the 1-mile run and/ or walk test were divided by the time of the running test used, establishing cutoff speed (m/minutes) for the 9-minute testing. The second cutoff point used was recently suggested by Bergmann *et al*[9], in which CRF was measured by the 9-minute test, designed from the data on Brazilian schoolchildren.

Based on recommended values for health, according to age and sex, the students were classified as "met" or "did not meet" the cutoff points analyzed (Chart 1).

In relation to the numerical variables of the study, as normality of the data set was not confirmed by the Shapiro-Wilk test, the descriptive characteristics of the sample were expressed as median values (central tendency) and interquartile range (dispersion). Thus, the U Mann-Whitney test was used to compare the sexes. For the representation of categorical variables, values were expressed by frequencies. The chi-square test was applied to assess the association between CRF and sex, and the McNemar test was used for checking differences between the proportions of students who met the criteria for CRF, in both cutoff points. *Kappa* index was used to verify the agreement between the two ways to diagnose CRF. The statistical significance adopted was $p<0.05$ and data were processed at the Statistical Package for the Social Sciences (SPSS), version 17.0.

Results

Table 1 presents the descriptive variables of the total sample and is classified according to sex. There were no differences between sexes for the following variables: age ($p=0.758$), body mass ($p=0.242$), height ($p=0.359$) and body mass index – BMI ($p=0.322$). However, the boys covered a greatest distance in the running test compared to the girls, and this difference was significant ($p=0.004$).

When the percentage of students classified as fit by both reference tables was analyzed, we observe much closer values for the national (59.2%; n=109) and international (58.1%; n=107) tables, a fact that reflected on the significant difference appointed by the McNemar test ($p=0.864$). On the other hand, when agreement between both tables was analyzed, *Kappa* scores

Chart 1 - Values of cutoff points (in meters) for the Fitnessgram and the Bergman *et al* (2010) 9-minute run/walk tests

Age (years)	Fitnessgram (1987)		Bergman *et al* (2010)	
	Male	Female	Male	Female
7	1,034.3	965.4	157.0	1,090.5
8	1,113.9	998.7	157.0	1,101.5
9	1,206.7	1,113.9	174.5	1,103.5
10	1,316.4	1,206.7	208.0	1,157.0

Table 1 - Characteristic of the sample expressed as median (interquartile range)

Variable	Boys (n=106)	Girls (n=78)	Total (n=184)
Age (years)	9.0 (2.0)	9.0 (2.0)	9.0 (2.0)
Body mass (kg)	30.9 (9.8)	29.4 (12.0)	30.3 (11.0)
Height (m)	1.3 (0.1)	1.3 (0.1)	1.3 (0.1)
BMI (kg/m^2)	17.0 (3.5)	16.9 (4.8)	16.9 (3.8)
Test distance (m)	1,229 (301) *	1,169 (248)	1,207 (266)

IR: interquartile range; BMI: body mass index; *$p<0.05$

Table 2 - Agreement between the two cutoff points for cardiorespiratory fitness in Brazilian students

Classification by Fitnessgram	Classification by Bergmann *et al*[9]			
	Meets	Does not meet	*p*-value	Kappa index
Meets	91 (49.4)	16 (8.7)	0.864	0.6
Does not meet	18 (9.8)	59 (32.1)		

Values expressed in n (%)

Table 3 - Association between the level of cardiorespiratory fitness and sex according to the Fitnessgram (1987) and the Bergmann *et al* (2010) classification tables

Sex	Fitnessgram Classification			*p*-value
	Meets	Does not meet	Total	
Male	65 (61.3)	41 (38.7)	106 (57.6)	
Female	42 (53.8)	36 (46.2)	78 (42.4)	0.311
Total	107 (58.2)	77 (41.9)	184 (100.0)	
Sex	Classification by Bergmann *et al*[9]			*p*-value
	Meets	Does not meet	Total	
Male	66 (62.2)	40 (37.8)	106 (57.6)	
Female	43 (55.1)	35 (44.9)	78 (42.4)	0.332
Total	109 (59.3)	75 (40.8)	184 (100.0)	

indicated a moderate agreement: 0.61 (Table 2). Approximately 81% (n=150) of students assessed presented the same classification in both reference tables.

Table 3 presents the association between CRF and sex, according to both classification tables. Values obtained by the chi-square test pointed that there was independence between both variables, in both cutoff points. The Fitnessgram[12] table identified that 61.3% of boys and 53.8% girls met the fitness criterion (without significant difference, *p*=0.311), while, on the Bergmann *et al*[9] table, 62.2% of boys and 55.1% of girls met the criterion established (without significant difference, *p*=0.332). Such results indicate, again, similarity between the classification of the tables, regardless of sex.

Discussion

The aim of the present study was to assess the agreement between two tables with cutoff points for CRF adjusted according to sex and age (one national, recently released, and another international, widely used), by means of a cross-sectionals study involving young Brazilians. The results identified little divergence between both regarding the classification of the performance on the referred motor test.

Specialized literature has shown significant relationship between CRF and reduced cardiovascular and metabolic risk among young people[3-5]. Accordingly, for the measurement of CRF in the pediatric population, a widely used alternative

is the 9-minute run/walk test[13-15]. The evidence that supports the employment of such motor test for the discrimination of CRF in pediatric populations is the recognized linear relationship between test performance and measures of maximal oxygen consumption[16].

It is known that, for the same construct, different cutoff point tables may sensitively modify the prevalence of the outcome analyzed, as well as its diagnostic capability. Fernandes *et al*[17] analyzed three different cutoff point tables for BMI, in the same sample of adolescents, and showed that the presence of overweight/obesity varied from 29.8 to 40.6%, in males, and from 14.7 to 20.9%, for females. The high variation observed for the BMI was not verified for the CRF analyzed in the present study, once the two cutoff point tables did not differ significantly.

A possible explanation for the similarity of the CRF classification is based on the form of construction of both tables. The Fitnessgram[12] proposal was developed according to the values of maximum oxygen consumption by adults (associated with cardiovascular problems), extrapolating these values for children and adolescents and respecting the development of running economy. Similarly, the cutoff points established by Bergmann *et al*[9] were based in a sample of Brazilian children and adolescents from seven to 12 years old, considering the risk factors for cardiovascular diseases. Thus, it seems acceptable to say that the construction of both

tables, based on the detection of cardiovascular risk factors, may have influenced the consistent agreement observed.

Still, the two proposals ranked similarly CRF in 81% of students, reaching moderate *Kappa* values (0.61). The values of agreement observed were lower to those observed at different cutoff points for the component body fat estimated by bone densitometry (*Kappa* index ranging from 0.87 to 0.93)[18] and, also, below the different cutoff points for BMI (*Kappa* index ranging from 0.81 to 0.91). These data show that in larger samples and with greater age range, discrepancies between the cutoff points analyzed may manifest more markedly. Moreover, the significant impact that the biological maturation exerts on the CRF component, which can hardly be observed in a group as young as the analyzed. Thus, to confirm these findings or to demonstrate other aspects of

them, we suggest future studies with larger samples and adolescents from other age groups.

The limitations of the study need to be pointed out. The reduced sample size is emphasized and deserves special attention in future studies, due to its possible implications in the findings of the present study. The importance of CRF to identify adolescents in higher cardiovascular or metabolic risk lies as a backdrop for the performance of this study. Thus, the absence of such cardiovascular risk factors deserves to be highlighted, as it is determining in the use of one or another cutoff point.

In summary, regardless of sex, the two criteria for the classification of cardiorespiratory fitness in young populations are discriminated similarly to those of children with low CRF.

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