Health-Related Physical Fitness in Brasilian Schoolchildren: Data From The Brazil Sport Program

EXERCISE AND SPORTS MEDICINE CLINIC

ORIGINAL ARTICLE

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ABSTRACT

Objetive: To analyze the physical fitness of Brazilian schoolchildren, according to a health-referenced criteria assessment. Methods: This was a cross-sectional, school-based, epidemiological study of 7,507 schoolchildren (4,114 boys and 3,393 girls) aged 7 to 10 years. The following variables were measured: body weight, height, flexibility (sit-and-reach), muscle strength/resistance (1 minute modified abdominal) and cardiorespiratory fitness (9- minute walk/run). The criteria and classifications used for the motor tests were recommended by the Physical Best. Results: The motor tests demonstrated low physical fitness, representing health risk in terms of flexibility (boys: 58.3%; girls: 51.2%, p<0.001), muscle strength/resistance (boys: 75.3%; girls: 73.8%, p<0.001) and cardiorespiratory fitness (boys: 80.8%; girls: 77.6%, p<0.001). The overall classification derived from all the three motor tests showed that very high proportion of the schoolchildren (~96%) did not meet the pre-established cut-offs for a satisfactory level of physical fitness. Conclusions: Effective intervention programs promoting changes in physical fitness standards are needed in order to contribute to the development of healthier levels of motor performance, especially based on public policy initiatives that provide opportunities for physical activity and sports in neighborhoods, parks and condominiums.

Keywords: anthropometry; physical fitness; students; measurements.

INTRODUCTION

Good motor performance is considered a crucial characteristic for the building of complete motor collection during infancy, and it becomes hence essential to effective participation in daily activities[1,2]. It is in daily activities such as running, jumping and rolling that children develop basic movement skills, which reflect on their levels of physical fitness and motor performance. Besides being determined by genetics, motor performance is related to conduct behavior and motor demand of these individuals[2,3].

Studies with children and adolescents have reported a straight association between motor performance and physical activity[4,5]. Good motor performance and physical fitness level related to heath, in the initial phases of life, is associated to good health indicators such as: low cholesterol and triglycerides levels[6,7], balanced heart rate and insulin sensitivity[6-8], lower obesity risk[9], low prevalence of low back pain and posture problems[10-12], besides reflecting in good academic performance[13,14].

The mostly used battery of motor tests in the investigations with students was proposed by the American Alliance for Health, Physical Education, Recreation and Dance – AAHPERD[15], and the results interpretation suggested by the Physical Best[15]. This set (battery-criterion) presents as main advantage the large number of published articles for comparison matters[16-19], as well as high reliability and easy application. Moreover, it requires low operational cost and does not need robust physical infrastructures, being fairly appropriate for application in a large sample size. Nevertheless, other batteries are reported in the literature, for instance, the NCYFS, the Fitnessgram, the CAHPERD and the Eurofit.

International research was carried out to describe the motor performance profile as well as physical fitness related to health of schoolchildren[20-25]. Some of these investigations as subsidized public policies of health promotion for the children population[26]. Koutedakis and Bouziotas[27] revealed association between low physical fitness and educational performance. Other prospective investigations suggest that low physical fitness in infancy and adolescence negatively reflects on adulthood[12]. In Brazil, the studies are not conclusive yet concerning the low pattern of physical fitness of schoolchildren, especially for using small samples [17-19,28]; however, the found results are crucial to the understanding on the phenomenon of a given region.

Facing the importance of research which considers the different regions of a country as well as

the relevant evidence of good levels of motor performance to health, the aim of the present study was to assess physical fitness of Brazilian schoolchildren, according to a guideline using health criteria as reference.

METHODS

In order to have this transversal epidemiological study with educational grounding, the data were extracted from the Project Brazil Sport (PROESP-BR), a permanent observational ground of growth, somatomotor development and nutritional status indicators of Brazilian children and adolescents (seven to 17 years). The PROESP-BR is part of a series of projects carried out by the chain of the Sports Excellence Centers (CENESP) linked to the Department of Sports Excellence and Promotion of Events from the National Office of Performance Sports of the Sport Ministry and was approved by the Ethics in Research Committee of the Federal University of Rio Grande do Sul, in the meeting number 11, report number 91 from 09/08/2007.

The PROESP-BR has as main aim to outline the somatomotor profile, life habits as well as motor fitness factors in children and adolescents, to aggregate indicators to the design of physical education and sports policies for children and youngsters in Brazil. More detailed information on the conception and methodological aspects of the PROESP-BR have been previously published[29].

The population of the present study was composed of schoolchildren (seven to 17 years) enrolled in the public and private systems of the five Brazilian regions (North, Northeast Mid-Central, Southeast and South). However, the sample of the present study was composed only of schoolchildren from seven to 10 years of age, assessed in the years of 2004 and 2005 (n = 7.926). The schoolchildren who did not perform the flexibility (n = 114), abdominal (n = 31) and nine-minute running/walking (n = 274) motor tests were excluded from the sample, since only the schoolchildren who participated in all motor tests would enter in the general classification analysis of physical aptitude. Thus, the final sample was composed of 7,507 schoolchildren. The sample distribution according to sex and age is presented in table 1.

Table 1. Distribution of the total sample according to sex and age.

Age (years)	Male	Female	Total
7	264	244	508
8	393	345	738
9	746	787	1,533
10	2,711	2,017	4,728
Total	4,114	3,393	7,507

Data of the Project Brazil Sport, 2004-2005.-2005.

Anthropometry

The anthropometric and demographic data were obtained by the Physical education teachers of each school which engaged in the PROESP-BR. All teachers received training and had access to the application instructions of the tests and measurements in an electronic site (www.proesp.ufrgs.br), which included a video prepared by members of the Physical Education School of the Federal University of Rio Grande do Sul, for standardization and better visual presentation of the measurement techniques [29].

Body mass was determined on a digital anthropometrical scale, graded from 0 to 150kg, with resolution of 0.05kg and stature with the aid of a portable stadiometer, mounted on the wall, graded from 0 to 200cm, with precision of 0.2cm[29]. Body mass index (BMI) was calculated through the body mass quotient in kilograms, by the stature in square meters.

Motor tests

The schoolchildren were submitted to a battery of motor tests which was applied according to the following order: sit-and-reach (flexibility), abdominal one-minute modified (strength/muscular endurance) and nine-minute running/walking (cardiorespiratory fitness). health-related physical fitness (HRPF) was assessed through the battery of motor tests proposed by the AAPHERD[15] and, for results interpretation, the criteria suggested by the Physical Best were used. This set (battery-criterion) has been applied in many investigations in Brazil due to their qualities related to reliability and easy applicability. Moreover, it requires low operational cost and does not need robust physical structures, being very suitable to be applied in public and/or private schools.

Statistical procedure

Data were initially treated by descriptive procedures (mean, standard deviation). Analysis if variance (two-way ANOVA) was used for comparisons between sex and age. The Scheffé *post hoc* test was applied for identification of specific differences in the variables in which the F values found were higher than the statistical significance criterion established ($p < 0.05$). The distribution of percentage frequencies was established to verify the proportion of students who did not meet the health criteria. In the comparison between sexes, the significance test for differences between proportions was applied. In all analyses the significance level of 5% was adopted and the statistical program SPSS, version 13.0 was used.

RESULTS

Table 2 presents the mean results of body weight, stature and BMI of the schoolchildren investigated, according to sex and age. Interaction between sex and age was observed in all investigated variables ($p < 0.05$). The isolate effect of age was verified in all variables, demonstrating hence increasing values with age progression, both for male and female schoolchildren ($p < 0.05$).

Table 3 presents the values concerning the physical fitness tests of the schoolchildren, according to sex and age. Interaction between sex and age was observed only in the strength/muscular endurance test ($p < 0.05$). Isolate effect of sex and age was verified in all investigated variables ($p < 0.05$), with higher values for the male sex than for the female sex, except for flexibility ($p < 0.05$).

Table 2. Anthropometric characteristics of the schoolchildren (mean, stadanrad deviation and F statistics) according to sex and age.

Age (years)	Sex	BM (kg)	EST (cm)	BMI (kg/m²)
7	Male	27.51 ± 5.55	127.78 ± 6.76	16.75 ± 2.43
	Female	27.10 ± 5.68	125.71 ± 6.88	17.07 ± 2.90
8	Male	30.00 ± 7.40	131.75 ± 7.48	17.15 ± 3.33
	Female	30.21 ± 7.31	131.18 ± 818	17.45 ± 3.17
9	Male	33.26 ± 7.90	137.40 ± 7.64	17.51 ± 3.34
	Female	31.96 ± 7.11	137.79 ± 6.75	16.75 ± 3.06
10	Male	34.36 ± 7.97	141.33 ± 7.20	17.15 ± 3.16
	Female	35.33 ± 8.00	142.39 ± 7.53	17.33 ± 3.09
F sex		0.299	1.534	0.011
F age		210.848*	984.156*	2.147*
F sex x age		8.783*	8.759*	9.850*

BM: body mass; EST: stature; BMI: body mass index. *p < 0.05.
Data of the Project Brazil Sport, 2004-2005.

Table 3. Performance of the schoolchidren (mean, standard deviation and F statistics) in motor tests according to sex and age.

Age (years)	Sex	FLEX (cm)	ABD (rep)	T9MIN (m/min)
7	Male	22,49 ± 7,06	22,56 ± 8,23	125,01 ± 23,92
	Female	23.55 ± 6.33	21.22 ± 9.13	112.26 ± 22.45
8	Male	22.49 ± 6.73	24.42 ± 8.20	128.24 ± 26.83
	Female	23.81 ± 6.96	22.53 ± 8.37	120.28 ± 24.49
9	Male	23.77 ± 8.29	26.67 ± 8.75	139.83 ± 34.17
	Female	25.26 ± 7.36	21.00 ± 11.37	126.78 ± 29.53
±10	Male	24.01 ± 7.47	27.26 ± 8.85	141.37 ± 34.07
	Female	25.56 ± 7.37	24.71 ± 9.27	127.62 ± 33.15
F sex		31.788*	92.742*	131.235*
F age		17.039*	52.016*	53.973*
F sex x age		0.204	13.925*	1.736

FLEX: flexibility; ABD: abdominal strength/endurance; T9MIN: cardiorespiratory fitness. *p<0.05.
Data from the Project Brazil Sport , 2004-2005.

Concerning age, increase in the values of the motor tests with age progression was observed (p < 0.05).

The proportion of students who did not meet the criteria established for each motor test investigated, as well as for the set of tests is presented in figure 1.

Regarding flexibility, the majority of the schoolchildren did not meet the established health criteria, being it more prevalent in male than female sex. Significant differences were found between sexes in all ages, as well as in the collection of ages.

In the strength/muscular endurance test, it was observed that over 50% of the students were classified below the health criteria. Significant differences were found in the comparisons between proportions in all ages (p < 0.05). These results indicated higher prevalence of female children in the seven, eight and nine years of age while male ones at 10 years of age (p < 0.05) who were below the minimum criteria recommended to health.

Concerning cardiorespiratory aptitude, approximately 80% of the students presented performance below the levels established for health. Differences between sexes in the proportions of students who did not meet the criteria proposed by the Physical Best were verified in all ages. These findings point to a higher proportion of female schoolchildren in the ages of seven and nine years and male ones in the ages of eight, 10 and in the collection of all ages, classified below the criteria recommended to health.

Regarding the general classification, it was observed high prevalence of students who did not meet simultaneously health criteria established by the adopted proposal in the three motor tests. These results indicate that, approximately 96% of the schoolchildren did not meet the expected level to health.

DISCUSSION

The present study evaluated the motor performance of Brazilian schoolchildren aged between seven and 10 years, regularly enrolled in the public and private educational systems, becoming a pioneering investigation performed with a large sampling from all Brazilian regions, which consequently decreases the cultural and socioeconomical differences which can affect motor performance.

Regarding flexibility, the female sex presented higher mean value than the male sex in all analyzed ages. Similar data have been reported in research from other countries[20-22,24]. Concerning the minimum criteria of flexibility established for health, more than half of the Brazilian schoolchildren did not meet the reference criteria. In developed countries the reverse phenomenon is observed, that is to say, the majority of students presents flexibility suitable to health[26,30]. The low levels of flexibility are especially of concern for the associated risks to low back pain and higher incidence of postural problems, besides a possible explanation for the low school performance[10-12]. A longitudinal study carried out in Finland revealed that, after 25 years, children with low levels of flexibility in the school period reported more back pain in adulthood[12].

Regarding abdominal strength/muscular endurance, three out of four students did not meet the recommended criteria to health. Prevalence of inadequate muscular strength was observed both in the male (75.3%) and female sexes (73.8%). These values were high when compared to the findings in other countries[22,26,30] and specific Brazilian regions[17,28]. This situation is of great concern, since inadequate levels of abdominal strength/endurance may cause postural and articular problems, as well as musculoskeletal injuries[31,32]. In the United States it was verified that the male sex presented higher mean values in abdominal muscular endurance compared to their pairs of the opposite sex in the entire school life[20,21].

Concerning the cardiorespiratory test, in both sexes with age

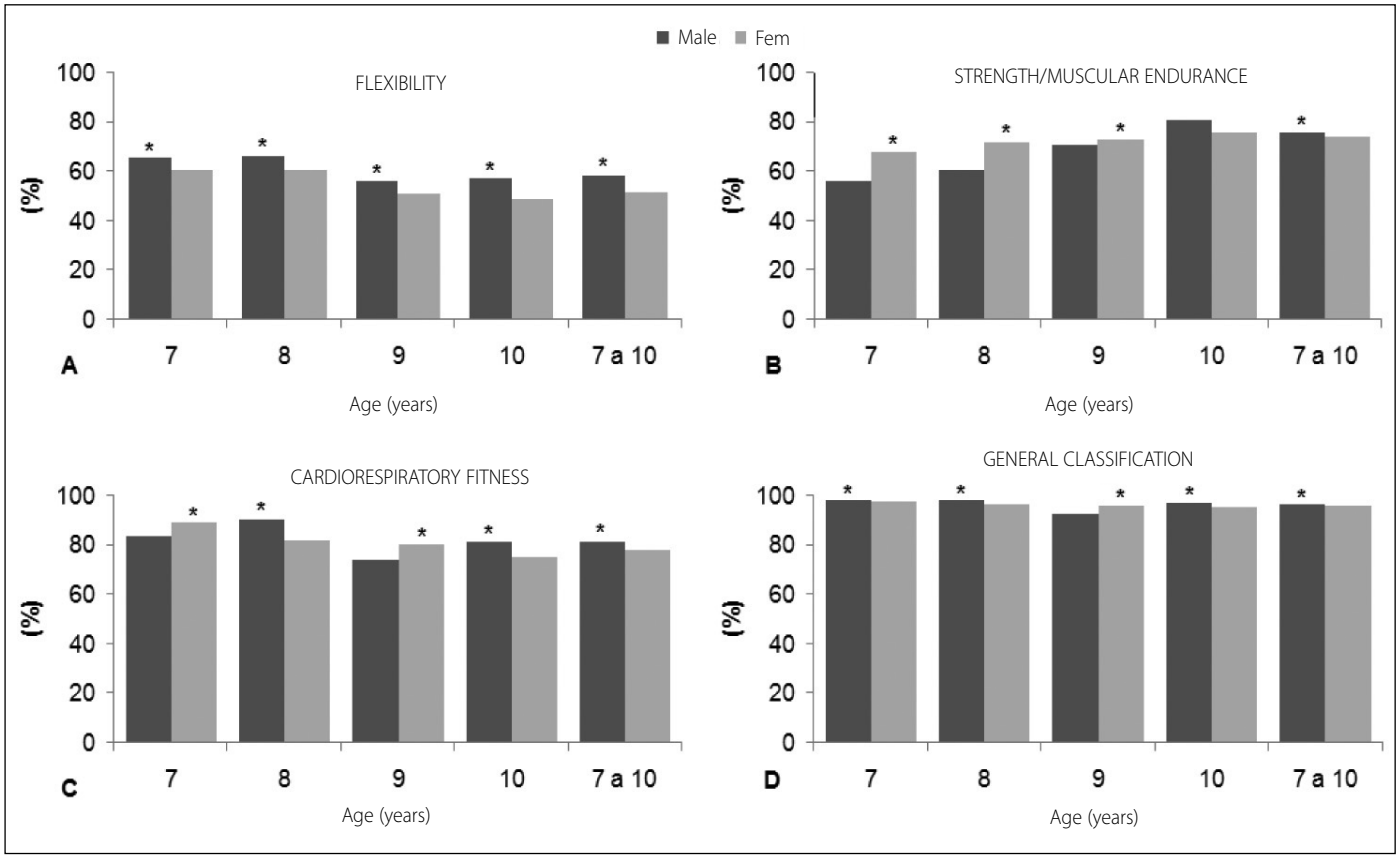

Figure 1. Proportion (%) of students who did not meet the health criteria established to each on the motor tests according to sex and age.

Data from the Project Brazil Sport, 2004-2005. *p < 0.05 for comparison between sexes.

progression decrease in the proportion of students who did not meet the minimum criteria to health has occurred. These data corroborate the ones found in the North American[20,21], German[24] and Croatian populations[25]. However, when the cohort points to health from the Physical Best were established**,** high proportion of Brazilian male students who did not meet the health criteria was evidenced. Tomkinson and Olds[33] reported that, in the last 45 years, decrease of –0.36% a year in the aerobic fitness of children and adolescents from all around the globe has occurred. This fact is alarming, since low aerobic fitness is associated with high levels of cholesterol and triglyderides[6,7], imbalanced blood pressure and insulin sensitivity[6-8] and higher obesity risk [9]. Moreover, the literature has shown that students with inadequate level of aerobic fitness presented worse academic performance[13]. Thus, the authors emphasize the need for educational policies which consider the benefits of adequate levels of motor performance to health during the entire school life, promoting hence the development of these health indicators in school.

In the general physical fitness classification, more than 95% of the children of both sexes did not meet the recommended threshold to health. When these data are compared with an investigation carried out in a Brazilian city[17] and with data from the United States[34], it is possible to verify that the students of the present study presented higher physical fitness deficit. The low levels of physical fitness are directly related to the increase of sedentarism in the contemporary society, especially due to the interest in passive activities such as portable games, television and computers[35]. Minimum indices of motor performance are necessary to maintain functional, motor and morphological levels to an expected physical fitness concerning health. In order to better infer on the level of physical fitness of students, longitudinal studies which follow-up the entire childhood and adolescence become necessary, investigating also the life style of these subjects.

Therefore, it seems that the Brazilian children have had few opportunities to practice physical activities. However, it is known that schools do not present objective resources and conditions to meet the students' demands due to several reasons which go from lack of work material to mistaken educational legislation which increasingly remove body practices from classes.

In Greece, Koutedakis and Bouziotas[27], when investigating the association of the Physical Education curriculum with levels of motor performance in children, evidenced that the curriculum applied in the schools is responsible for the low levels of physical fitness and motor performance, since their demands are not sufficient to bring benefits to health. The present study carried out with Brazilian students did not correlate the Brazilian Physical Education curriculum with the level of motor performance; therefore, the situation reported in Greece cannot be inferred. Nevertheless, investigations on this interrelation which aim to search for the causes for the high levels of schoolchildren who did not meet adequate levels of health in the physical fitness tests are widely recommended. Research on the life style of these students and of the physical activities in leisure time is also recommended.

The main limitations of the present study are: outlining of the transversal cohort, which does not permit identification of the causality relations; the use of classification criteria based on

samples form other countries; teachers training by video system and lack of pilot study. Among the advantages of the study, we can highlight the sample representativeness, including students from all the Brazilian geographic regions and outlining the national situation of motor performance, since no studies which presented this characteristic have been found in the literature.

According to the findings of the present study it is possible to conclude that the Brazilian students presented inadequate levels of physical fitness. Therefore, we suggest that mechanisms which contribute to the promotion of physical fitness in children are implemented, especially with public policies in neighborhoods, parks and condominiums which enable physical activities and sports practice.

All authors have declared there is not any potential conflict of interests concerning this article.

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