Physical fitness diagnosis in schoolchildren of high socioeconomic status: evaluation for health criterion reference

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ABSTRACT

Regular practice of systematized physical activities in childhood and adolescence may strongly favor the development or maintenance of suitable levels of physical fitness, decreasing hence the risk of incidence of several chronic-degenerative dysfunctions in early ages. Thus, the aim of this study was to analyze the body adiposity as well as the motor performance in high socio-economical status children, according to an evaluation for health criterion reference. Therefore, 511 students (274 boys and 237 girls), age between 7-10 years were submitted to anthropometrical measurements of body weight, height and skinfolds thickness (tricipital and subscapular) as well as the following motor tests: sitting and reaching (SR); modified abdominal (ABD) and 9 minute-run/walk (9MIN). The data were analyzed according to the cutting points suggested by the *Physical Best* (1988). Concerning body adiposity; a higher number of students were verified above (33% of boys and 15% of girls, $P < 0.01$) than below the preestablished criteria. The observed behavior in the different motor tests applied was very similar in both sexes, except for the SR in which a higher proportion of girls fulfilled the adopted criteria (76% vs. 58%, $P < 0.01$). Conversely, the weakest motor development was identified in the 9MIN test where only 27% of the boys and 32% of the girls ($P > 0.05$) reached the adopted cutting points. When analyzed together, it was observed that only 15% of the boys and 21% of the girls ($P > 0.05$) presented satisfactory results in the three motor tests used. The high prevalence of children who were above the health criteria for the body fat amount, associated with the low proportion of subjects who fulfilled the established criteria in the used motor tests group, show that the physical fitness level found in the students investigated is fairly below the expectation. The results suggest the need of developing health educational programs which stimulate more effective participation of young individuals in physical exercise and sports programs of different nature, especially at school environment where a great amount of life habits is established.

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INTRODUCTION

Regular practice of systematized physical activities may contribute to the improvement of several components of health-related physical fitness such as strength, muscular and cardiorespiratory fitness, flexibility and body composition. These changes may especially favor the control of body adiposity as well as the maintenance or improvement of functional and neuromotor capacity, improving hence performance in several daily chores. Consequently, they provide better health conditions and more suitable quality of life to their practitioners[1-2].

Conversely, decrease in the usual physical activity levels seems to favor gradual development of countless degenerative-chronic dysfunctions such as obesity, dyslipidemias, diabetes, cardiovascular diseases, hypertension among others, in escalating early ages[3-7].

Thus, countless investigations have been conducted, especially in children and adolescents, in the trial to analyze the behavior of indicators of health-related physical fitness, through indicators of body adiposity as well as motor performance[8-14]. It is believed that studies of this nature may provide valuable data for the analysis of life style adopted in different societies in the past and in the present. They may also enable predictions for the future, especially concerning health-related aspects and diseases control.

Nevertheless, the majority of studies involving different components of physical fitness have been traditionally adopting analysis' procedures based on normative data[14-16] which strongly limits a more careful analysis of the produced data. Conversely, it is verified in the literature that the scarce studies which have been adopting health criteria reference analysis started to be developed in its great majority only from the last decade on[8,10-11]. Such fact seems widely justifiable due to the sudden change of paradigm that has been worldwide observed, mainly in young populations, where a growing interest for games and passive entertainment and activities, which make them spend several daily hours in front of television sets and/or personal computers, is observed[17-20].

Within this context, the social status group which seems to have been more strongly affected by this phenomenon, that is, the most economically favored, is the one which has been receiving less specific attention from the Brazilian scientific community, once great part of studies with children and adolescents in Brazil have been investigating less economically favored populations[11-12]. Such evidence undoubtedly presents great relevance, supposing that the great majority of the population in this country still fits this situation. However, research on young people behavior, not only on less economically favored populations, is essential in the perspective of health promotion, once such data may cause intervention actions in different socio-economic classes, aiming improvement of quality of life of future generations.

Based on this information, the aim of this study was to analyze the body adiposity as well as motor performance in high socio-economical status children according to health criteria reference.

METHODOLOGY

Subjects

The data presented in this study are part of an initial data collection of a broader research project of longitudinal character entitled 'Analysis of growth and health-related physical fitness in high socio-economic status students', which has been conducted in the county of Londrina (PR), Brazil.

In order to select the sample, a study was conducted for the identification of the number of students enrolled in the county's private schools during the year of 2002. According to the statistics sector of the Local Education of Paraná State District, 15.778 students were enrolled in the urban area alone, being 1.551 in preschool (9.8%); 3.874 in the first and second cycles of elementary school I (24.0%); 4.134 in the third and fourth cycles of elementary school II (26.2%); 3.976 in high school (25.2%); 46 in educational school (0.3%); 1.857 in technical school (11.8%) and 430 in intensive school (2.7%).

Based on these data, a school in the central area was intentionally selected, once it fulfilled the criteria established for the development of the present study concerning socio- economical status. It had an expressive number of students enrolled in the county's private schools (~15%) and presented infra-structure suitable to the data collection.

Thus, the sample consisted of 511 students (274 males and 237 females), age range of 7 to 10 years. Therefore, considering the data previously presented, 13.2% of the total students enrolled in Londrina County's private schools within this age group were investigated.

The age groups were established in decimal ages according to the procedures described by Ross and Marfell-Jones[21]. The intervals of 0.50 to 0.49 were used for the age grouping, with a convention of the ± signal according to Eveleth and Tanner[22]. The sample distribution according to sex and age is presented in table 1.

TABLE 1
Sample distribution according to sex and age

Age group	Boys	Girls	Total
± 7 years (7.18 ± 0.18)	38	36	74
± 8 years (8.01 ± 0.29)	86	61	147
± 9 years (8.99 ± 0.29)	65	64	129
± 10 years (10.01 ± 0.29)	85	76	161
Total	274	237	511

Note: The data between parentheses are express mean values (± SD)

The students' responsible ones were all informed on the investigation's purpose as well as the procedures to be adopted and signed a free and clarified consent form. This study was developed according to the instructions from the 196/96 Resolution of the National Health Committee for studies in humans, from the Health Ministry, being approved by the Ethics Committee in Research of the Londrina State University.

Although the preliminary data provided by the teaching institution itself had stated that the students belonged to medium and high classes, a questionnaire developed by the ABA/ABIPEME and adapted by Almeida and Wickerhauser[23], with classification scales subdivided in five categories (A, B, C, D, E) according to the educational status of the parents as well as the family consumption habits was applied in order to classify the socio-economical status. Based on such instrument, the study's participants were classified as of high socio-economical level (categories A and B).

Anthropometry

Weight of the subjects was obtained using a Filizola digital scale with precision of 0.05 kg and the height was determined using wooden stadiometers with precision of 0.1 cm, according to the procedures described by Gordon *et al.*[24]. From these data, body mass index (BMI) was determined.

The sum of the tricipital (TR) and sub scapular (SS) skinfolds thickness was used as indicator of body adiposity. Such measurements were performed by a single evaluator with a Lange scientific adipometer (Cambridge Scientific Industries, Inc., Cambridge, Maryland), according to the procedures described by Harrison *et al.*[25]. The test-retest coefficient exceeded 0.95 for each of the anatomic points with maximal measure error of 5%. All measurements were taken in a rotation system and reapplied three times, being the mean values registered.

Motor tests

The investigated students were submitted to a set of motor tests which was applied in the following order: sitting and reaching (SR), as an indicator of flexibility; 1-min modified abdominal (ABD), as a muscular strength/endurance indicator and 9-minute run/gait (9MIN), as a cardiorespiratory fitness indicator, following the standardizations described by the *AAPHERD*[26]. An experienced and previously trained team of evaluators applied the tests, and a single evaluator was responsible for the data registration in each test, in the trial to decrease random errors. The criteria suggested by the *Physical Best*[26] were used for the analysis concerning health-related aspects.

Statistical analysis

The data were initially treated from descriptive procedures, with data being processed in the STATISTICA computer package, version 5.1. Variance analysis (ANOVA-*two way*) was used for the comparisons between sexes in the different ages. The Scheffé *post hoc* test was applied for the identification of the specific differences in the variables in which the F values found were higher than the established statistic significance criterion ($P < 0.05$). Percentage frequency tables were established in order to verify the proportion of students who fulfilled the health criteria. The significance test for differences in the proportions was applied for the comparisons between two proportions.

RESULTS

Table 2 presents the anthropometrical characteristics of the investigated students, according to their sex and chronological age. An interaction between age and sex was found only for height ($P < 0.05$). Conversely, an isolated effect of sex ($P < 0.01$) was identified in weight as well as BMI, with boys presenting higher values than girls. On the other hand, the age effect ($P < 0.05$) was ob-

TABLE 2
Anthropometrical x characteristics of the studied subjects, mean values, Standard-deviation and F statistics according to sex and age

Age (years)	Weight (kg)		Height (cm)		BMI (kg/m²)	
	Boys	Girls	Boys	Girls	Boys	Girls
± 7	25.6 ± 4.0	26.6 ± 5.3	123.3 ± 3.7	125.6 ± 4.7	16.7 ± 2.0	16.7 ± 2.5
± 8	29.7 ± 7.1	28.2 ± 6.5	130.1 ± 6.2	127.4 ± 5.9	17.3 ± 2.9	17.2 ± 2.8
± 9	34.9 ± 9.5	31.5 ± 7.1	135.3 ± 7.0	133.6 ± 6.5	18.8 ± 4.0	17.5 ± 2.9
± 10	37.5 ± 8.4	35.8 ± 7.5	140.0 ± 6.4	140.2 ± 7.0	18.9 ± 3.1	18.1 ± 2.9
F sex	4.10**		0.72		4.28**	
F age	46.16*		139.46*		8.17*	
F sex x age	1.39		3.18**		1.29	

** $P \leq 0.01$ and * $0,01 < P < 0.05$

served in all variables, being the mean values increasing with age progression. The differences observed between 7 and 10 years were of 46.5% and 34.6% in weight, 3.5% and 11.6% in height and 7.8% and 8.4% in BMI in boys and girls, respectively.

Figure 1 presents the proportion (%) of students who were below (A) and above (B) the established criteria by the adopted reference for measurements of skinfolds thickness, according to sex and age. A higher proportion of students above than below the adopted criteria for health was verified both for boys and girls, except for the values found in girls aged 7 and 8 years. Although the results show that about 60% of boys and 70% of girls fulfilled the established criteria, a reduction in the number of girls below, concomitantly with an increase of the ones who were above the established criterion, was observed starting at 9 years. It is worth mentioning that about 45% of boys and 24% of girls presented surplus fat to 10 years of age.

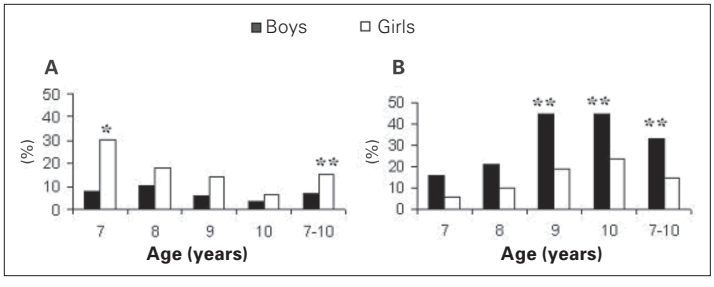

Figure 1 *– Proportion (%) of students who were below* ***(A)*** *and above* ***(B)*** *the health-criteria established for the sum of the skinfolds thickness*
** P ≤ 0.01 and * 0,01 < P < 0.05

Figure 2 presents the proportion of students who reached the established criteria for each motor test investigated as well as the collection of the motor tests performed.

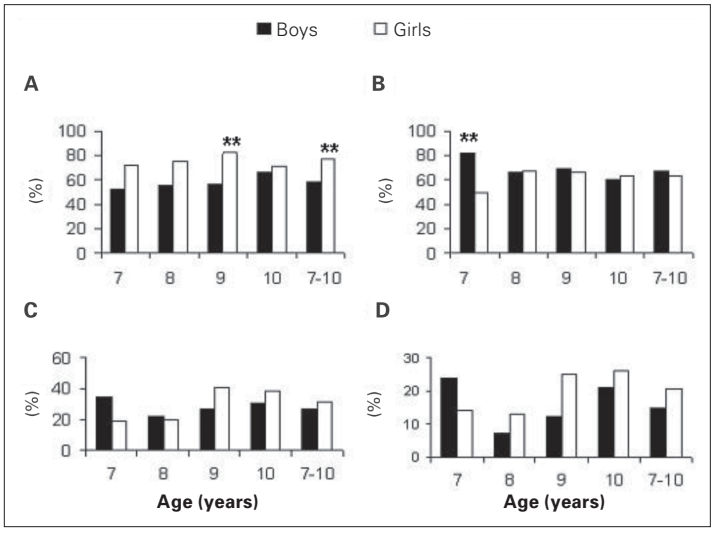

Figure 2 *– Proportion (%) of students who fulfilled the health-criteria established for each of the motor tests.* Note: **A** *= flexibility (SR);* **B** *= muscular strength/endurance (ABD);* **C** *= cardiorespiratory fitness (9MIN);* **D** *= set of motor tests.*
**P ≤ 0.01 and * 0,01 < P < 0.05

The results found in the SR test showed that a greater number of girls than boys ($P < 0.001$) reached the established criteria (76% vs. 58%, respectively), despite the fact that among the age groups, only differences in the 9 years were verified. ($P < 0.01$). Concerning age, both in boys and girls the number of students who reached the pre-set cutting points was stable, except for boys at 10 years (67%) as well as girls at 9 years (82%), who presented higher values (figure 2A).

Likewise, in the ABD test (figure 2B) there was also stability in the proportion of students who fulfilled the proposed criteria, according to age groups in both sexes, except for boys at 7 years, when a higher proportion of subjects (81%) fulfilled the criteria. About 67% of boys and 64% of girls reached the number of minimal repetitions proposed by the adopted reference.

Conversely, in the 9MIN test a remarkable decrease in the prevalence of students of both sexes in the age groups that fulfilled the proposed criteria was observed[22] (27% and 32%, of the total of boys and girls, respectively). However, no statistically significant difference was verified between sexes ($P > 0.05$). It is worth mentioning that this was the test in which more varied behavior among boys was verified (figure 2C).

Figure 2D presents the prevalence of students who simultaneously fulfilled the health-criteria established by the adopted proposal[22] in the three investigated tests. It was verified that only 15% of boys and 21% of girls reached the expected limit. Moreover, no statistically significant difference ($P > 0.05$) between sexes according to age group was identified.

DISCUSSION

Several researchers have investigated the impact of regular practice of systematized physical activities in the perspective of promoting health as well as controlling many metabolic dysfunctions. Many of these researchers claim that the adoption of a physically active life style may produce important modifications in several components of health-related physical fitness (muscular strength and fitness, flexibility, cardiorespiratory fitness, body composition) which may promote a reduction of many diseases which tend to remarkably compromise human life quality[8,27-28]. Therefore, similarly to other risk behavior such as smoking and inadequate eating habits, typically sedentary life style has been considered an important health risk factor in adults, as well as in children and adolescents of both sexes in different age groups[29].

Starting from this premise, youngsters who carry out unhealthy life habits during childhood and adolescence, which go from low levels of routine physical activity to a diet of low nutritional value and high energetic value, seem to have a higher predisposition for the development of several metabolic dysfunctions in early ages[30]. Moreover, there is strong evidence that habits built in this life period usually remain throughout one's lifetime, which may develop a future generation of physically inactive, overweight and obese adults[31-32].

Therefore, the investigation of the behavior of the components of physical fitness in young individuals may provide important data for the adoption of public politics, which may favor the improvement of current and future life quality as well as the population's general health status.

Nevertheless, one of the great difficulties for the interpretation of data produced in studies which involve different components of physical fitness in the health-related perspective has been to define cutting points which truly reflect satisfactory conditions or not.

Some trials to establish criteria, which point to satisfactory patterns of physical fitness concerning motor performance as well as body fat amount, are found in the literature, especially in young subjects, from 1980. Within these trials one which still has been widely accepted by the international scientific community is the one proposed by the *AAHPERD*[26] called *Physical Best*[8-11,33], once it presents standardized reference criteria which enable the evaluation of health-related physical fitness according to age and sex.

It is worth mentioning that in the present study, although the applied tests have followed the recommendations by the *AAHPERD*[26], the set of tests and measurements used, due to operational issues, considered only part of the complete set suggested for evaluation in children.

In a recent study Ronque *et al.*[34], with data obtained in this same research project, verified a prevalence of 19% of surplus fat and 14% of obesity among students of high socio-economical status with data being obtained from the analysis of BMI values based on the reference curves of the NCHS. However, the World Health Organization[35] has been suggesting the use of the tricipital and subscapular skinfolds thickness associated with the BMI for the diagnosis of surplus fat, once the BMI isolated presents low sensibility for the evaluation of children and adolescents. Thus, the use of the sum of the thickness of these two skinfolds as indicator of adiposity suggested by the *AAHPERD*[26] relies mainly in this recommendation.

Based on this reference, the results of the present study indicate that ~7% of the boys and ~15% of the girls had body fat percentage below the adopted health criteria, while ~33% and ~15% of the boys and girls, respectively demonstrated values above these criteria. Considering that the surplus fat is related to the increase in the incidence of cardiovascular diseases, hypertension, diabetes, dyslipidemias and mainly obesity[36-37], it is believed that at least 25% of the studied sample may be exposed to a higher risk to develop many of these metabolic dysfunctions. On the other hand, low amounts of body fat also observed in part of the sample, may favor the development of important metabolic disturbances such as energetic-protein malnutrition, compromising the evolution process of these children[38-39].

The higher proportion of high socio-economical status children found more above than below than the health-criteria adopted by this study concerning body adiposity, suggests that, probably, the main cause of this phenomenon is the adoption of inadequate life habits that especially may include low levels of daily physical activity and/or inadequate food ingestion (quantity and/or quality). Unfortunately, the lack of control of these variables in the present investigation did not enable us to confirm these hypotheses or not.

Both conditions (surplus fat/obesity and malnutrition), found in the studied children, have been frequently observed in Brazilian families, once in 11% of the families living in the country low weight and overweight conditions coexist, where 45% of the families which have at least one member with low weight have a member with overweight as well[40].

Concerning motor performance in the three used tests (SR, ABD and 9MIN), distinct behavior between the neuromuscular fitness indicators both for boys and girls was observed.

In the SR and ABD, it was verified that in average, more than 60% of the investigated children were able to fulfill the established criteria. Therefore, considering that these tests may provide valuable information related with the levels of flexibility (SR) and torso muscular strength/endurance (ABD), it is believed that the behavior observed in this part of subjects analyzed may offer some kind of protection, especially against low back pain as well as postural deviations. It may also be associated with the improvement of performance in many daily chores[41]. Nonetheless, these results should be cautiously analyzed, once the cutting points recommended by the *Physical Best*[26] for these tests only and exclusively reflect the experiences and the judgments of some specialists[8], which has been an issue for serious academic discussions.

Within this context, Cardon *et al.*[42], after having investigated possible associations between indicators of physical fitness and presence of back and neck pain in 749 students (367 boys and 382 girls), mean age of 10 years, did not find any difference which could be attributed to the physical fitness levels. On the other hand, Payne *et al.*[43], in a sample consisted of 233 men and 287 women, of different age groups (15 to 69 years of age), verified that the best results in the torso flexion movement were obtained by the individuals who did not report history of back pain comparing with the ones who reported such symptoms ($P < 0.05$).

Confronting the results observed in the present study with others conducted in Brazil, we could verify that the proportion of subjects who fulfilled the established criteria for the SR test was similar to other studies developed in Brazil[8,11]. Conversely, concerning the ABD test the proportion of individuals who reached the criteria was similar[8] or higher[11] than the values reported by these studies.

On the other hand, concerning the 9MIN test a low proportion of students who were able to fulfill the adopted criteria in the present investigation was observed. We should mention that several epidemiological studies have demonstrated the importance of maintenance of suitable levels of cardiorespiratory fitness as protection factor to many health risk factors related with the appearance and development of degenerative-chronic dysfunctions[44-45].

Although the routine physical activity levels have not been controlled in the present study, the results found in the 9MIN test show that probably the level of routine physical activity of the majority of the investigated children is really relatively low, once there is evidence that the cardiorespiratory fitness presents a straight relationship with the levels of physical activity in children[46].

Considering that the evaluated subjects could reach or not the established criteria in each of the used tests, it was reached in this study as well to evaluate the proportion of children who simultaneously fulfilled the established criteria for the set of three motor tests studied. Based on such reference, the results showed a remarkable decrease in the proportion of students of both sexes who presented satisfactory levels of health-related physical fitness (15% of boys and 21% of girls).

Although the present study presents some important limitations such as lack of control of the routine physical activity levels, as well as the lack of information about nutritional habits of the investigated subjects, the found results are very worrisome, once they suggest that a large number of the analyzed children seem to be adopting at early ages behavior typically sedentary. Moreover, there is strong evidence that such behavior when incorporated in childhood and adolescence tends to be kept in adulthood, severely compromising hence the health and life quality levels in a near future[1,16].

CONCLUSIONS

The results of the present study showed a greater prevalence of high socio-economical status children above (~25%) than below (~11%) the health criteria established for the variable body adiposity. Therefore, the results suggest a greater predisposition of these youngsters for the development of surplus fat and obesity than for malnutrition and consequently higher health risks associated with this behavior.

Conversely, the data produced by this study, based on the motor performance verified in the three analyzed tests (SR, ABD and 9MIN), showed that only a low number of investigated children (~17%) was able to reach the pre-set cutting points for a satisfactory level of health-related physical fitness.

Finally, the results found show that despite the favorable socio-economical condition, the studied children seem to be incorporating health risk behaviors at early ages, which suggests the need for adoption of public politics towards health education from the initial phases of school life (basic education), once great part of life habits start to be built in such phase.

According to the findings as well as limitations of the present study, further investigation is needed incorporating data concerning nutritional habits as well as the level of routine physical activity. It should also provide a long-term follow-up of these indicators, that is, from childhood to adulthood.

All the authors declared there is not any potential conflict of interests regarding this article.

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