

## Research Article

# Relationship between Motor Performance and Body Composition in Brazilian School Children

Thaizi Campos Barbosa<sup>1\*</sup>, Jonathan Sousa Sarraf<sup>2</sup>, Matheus Morbeck Zica<sup>1</sup>, Bhárbara Karolline Rodrigues Silva<sup>1</sup>, Francisco Winter dos Santos Figueiredo<sup>1</sup>, Fernando Rodrigues Peixoto Quaresma<sup>1-3</sup>, Fernando Adami<sup>1-4</sup>, and Erika da Silva Maciel<sup>5</sup>

<sup>1</sup>Department of Health Sciences, Faculty of Medicine of ABC, Brazil

<sup>2</sup>Department of Genetics and Molecular Biology, Federal University of Pará, Brazil

<sup>3</sup>Lutheran University Center of Palmas, Brazil

<sup>4</sup>Laboratory of Epidemiology and Data Analysis, Faculty of Medicine of ABC, Brazil

<sup>5</sup>Physical Education course, Federal University of Tocantins (UFT), Brazil

**\*Corresponding author**

Thaizi Campos Barbosa, Department of Health Sciences, Faculty of Medicine of ABC (FMABC), Santo André (SP), Brazil, Tel: 55 -63 981060637; Email: thaizi@gmail.com

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- Body mass
- Children
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**Abstract**

**Introduction:** Modern society is faced with limitations to practice physical activity, due to the lack of infrastructure, lack of time, lack of public safety and growth of sedentary activities that favor a sedentary lifestyle.

**Objective:** Examined the relationship between motor performance and body composition of school children.

**Methods:** A cross-sectional study was carried out with schoolchildren between 9 and 10 years of age from a public school in the city of Palmas, Tocantins, Brazil. We measured the Metabolic Equivalent, body composition and motor performance. For the analysis of association between variables, the Mann-Whitney test and Spearman correlation test were used.

**Results:** The sample comprised 123 children with 65% being females, 57.72% was classified as appropriate regarding fat percentage and 62.61% as eutrophic for BMI. In relation to motor performance, 60.98% was below ideal. When the association between motor performance and gender was evaluated, it was observed that boys presented better indices than girls. Regarding the relationship between body composition and motor performance, it can be observed that the higher the body composition the lower the motor performance, mainly between cardiorespiratory endurance.

**Conclusion:** The study showed a negative relationship between body composition and motor performance of schoolchildren in both sexes, thus, students with higher body weight and body fat have lower performance.

**INTRODUCTION****Background/rationale**

Modern society has limitations regarding physical exercises, because of lack of infrastructure to practice physical activities and sports, lack of time, especially in big cities, lack of public security in places intended for exercise practice and growth of technological activities for children and young people, mostly favoring a sedentary behavior [1,2].

The prevalence of physical inactivity in children, as well as the poor quality of diets, lead to an increase in obesity, which is associated with metabolic and cardiovascular changes at an early age [3].

The pattern of motor performance in children, associated with the prevalence of physical inactivity and with the increase of variables related to body mass, has been decreasing considerably in recent years. In turn, physical conditions such as cardiorespiratory fitness, strength, muscular endurance and flexibility, have been associated with high levels of body mass and physical exercises have become a strategy for the prevention of chronic non-communicable diseases [4-6].

The low level of motor performance has been related to high levels of body composition in children and adolescents, in other words, children and adolescents with weight and body fat higher than ideal have an inferior motor performance [7].

Therefore, developing physical conditions in schools has become a challenge for physical education professionals who

need to promote activities that, in addition to playful, develop physical capabilities [8] and involve children and adolescents with specific and structured activities to the fundamental motor capacities be developed in plenitude [9], making them understand the relationship of these activities with their health conditions.

## Objectives

Considering that the high levels of body composition in children and adolescents is increasing and assuming that motor performance may be associated to the indicators of body composition, this study aimed to assess the relationship between body mass and motor performance of a group of elementary schoolchildren from a public school Northern Brazil.

## MATERIALS AND METHODS

### Study design

Was used a cross sectional study. Data was collected from school children in a public school in the north of Brazil, Palmas-Tocantins, using the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [10]. The present study had approval by the Research Ethics Committee with Human Beings, with the No. CAAE 07564412.0.0000.5516.

### Setting

The correlation between body mass and motor performance has been studied for years. Children with excess body weight and fat have shown compromised variables that compose the motor development [11-16].

Regardless of the geographical location of the country and its economic development, overweight can influence the conditions of motor performance and, consequently, the health of an entire generation [13,17-19], which raises concerns to the need of improving these indices through activities targeted at the promotion of health and prevention of diseases associated to physical inactivity [19,20].

### Participants

Eligibility criteria included children of both sexes, aged 9 to 10 years old, enrolled and attending elementary school, whose parents agreed to participate and signed a Free and Informed Consent Term and excluded those who did not complete the questionnaires and are not participants at all stages of the study.

The selected school has 657 students in its unit, with 280 students between 9 and 10 years of age, of whom only 123 meet the inclusion criteria, the others were excluded because they did not meet the requirements.

### Variables

The Body Composition and motor performance was the main outcome studied. This Body composition was assessed from Body Mass Index and fat percentage data, while motor performance was assessed using tests of flexibility, abdominal strength / endurance and cardiorespiratory endurance.

The level of physical activity was used as an exposure variable. In addition, characteristics such as gender, age, series and study time were used.

### Data sources/ measurement

All the data were collected by a previously trained team, with the supervision of researchers in postdoctoral, doctoral and master's degree batch.

Weight (kg) and height (cm) were measured to calculate the Body Mass Index (BMI) was classified according to the reference of the World Health Organization [21] adopted by the Food and Nutrition Surveillance [22].

Body mass was assessed by the electrical bioimpedance analysis using the Biodynamics Body Composition Analyzer System 310 and produced by Biodynamics Corporation Seattle, Washington USA. We used the Lohman Protocol [23] cited by Heyward and Stolarczyk [24] to classify body fat percentage of the schoolchildren.

- The motor performance has been analyzed according to previously validated recommendations using the tests [25]: Flexibility - The test consists of the child being barefoot, sitting facing the Wells Bank, feet flat against the box, knees fully extended, arms extended on the surface of the box, hands positioned one on top of the other, and the tip of the fingers of both matching. For the recording of results, the child one, with the palms of the hands facing downwards and in contact with the box, extends ahead along the measurement scale, trying to reach the greatest possible distance in slow movement and without jerks. Three attempts should be offered.
- Abdominal strength - The test consists of placing the child in a supine position on a mat with the knees flexed and distanced with a distance equal to the width of the hips and, the soles of the feet facing the ground, the arms should be crossed over the thorax with the palms of the hands facing the same shoulder height. In order to perform the test, the child raises the trunk until the contact of the front of the forearms with the thighs occurs and returns immediately afterwards to the initial position with the touch of at least half anterior of the scapula in the ground. The largest number of repetitions should be performed in one minute, and there may be some rest between repetitions. Only one attempts should be offered per child.
- Cardiorespiratory endurance - The test consists is to try go by walking or running, as far as possible in the space of nine minutes. At its end, a beep sounds, and the children stop moving around and wait for register the distance traveled. In this case, the test was executed in fields for practice of collective sports, without any type of obstacle, with markings every 10 meters.

To evaluate the metabolic equivalents of the schoolchildren has been chosen the instrument Physical Activities Checklist [26] and each mentioned activity has been classified according to the Compendium of Physical Activities [27].

### Bias

The sample selection process for convenience and the lack of data related to diet, which could show inadequate eating habits, require that these results be viewed with caution.

## Study size

The sample was defined through the convenience sampling method, considering the practicality of the method.

## Quantitative variables

To evaluate the Body Composition of the students, the Body Mass Index method and the Bioimpedance method were used.

The Body Mass Index was evaluated according to the Nutritional Surveillance System (SISVAN), which uses the percentile method for evaluation. The cut-off point system for the Body Mass Index was according to the Percentile (World Health Organization [21] adopted by the Food and Nutrition Surveillance [22]):

- <Percentile 0.1 - Sharp Thinness
- ≥ Percentile 0.1 and < Percentile 3 - Slenderness
- > Percentile 3 and < Percentile 85 - Eutrophy
- > Percentile 85 and ≤ Percentile 97 - Overweight
- > Percentile 97 and ≤ Percentile 99.9 - Obesity
- > Percentile 99.9 - Severe Obesity

Body composition was evaluated using the Electric Tetrapolar Bioimpedance method with the portable apparatus according to the Biodynamics Body Composition Analyzer 310e System produced by Biodynamics Corporation Seattle, Washington USA.

The cut-off point of the fat percentage classification was divided between the genders (Lohman Protocol [23] cited by Heyward and Stolarczyk [24]). Male: Very Low - 5%; Below Average - 6 to 14%; Mean - 15%; Above Average - 16 to 24%; Very High - 25%. Female: Very Low - 8%; Below Average - 9 to 22%; Mean - 23%; Above Average - 24 to 31%; Very High - 32%.

The motor performance was evaluated according to the norms of the tests of flexibility, cardiorespiratory endurance and abdominal strength. The cutoff point was given according to Percentile for each age and gender.

## Statistical methods

The qualitative variables were described by absolute and relative frequency and quantitative variables that did not show normal distribution were presented by median and confidence interval 95% (CI95%). The adherence to the normal distribution of the quantitative variables was evaluated by the Shapiro-Wilk test.

Association between gender, age and motor performance (flexibility, abdominal strength and cardiorespiratory endurance) was determined with Mann-Whitney test. To assess the correlation between motor performance and metabolic equivalents, as well as to assess the correlation between body mass (BMI, fat percentage and lean weight) and motor performance (flexibility, abdominal strength and cardiorespiratory endurance), the Spearman correlation test was used. The significance level adopted was 95%. The statistical program used was the Stata 11.0.

## RESULTS AND DISCUSSION

### Participants

Of the 280 children included in the study, 123 children aged 9 to 10 years were effectively enrolled, and 157 are excluded because they do not meet the requirements of the study.

### Descriptive data

The study was composed of 123 schoolchildren of both sexes, with 65% being female, 9-10 years old, 57.72% were classified as adequate for fat percentage and 62.61% as eutrophic for BMI. Regarding motor performance, more than 60.98% of the sample was below the ideal level (Table 1).

The results obtained in this study showed that 30.99% of the sample presents excess BMI and that 33.3% with excess fat percentage. Although most children were classified with normal values for BMI (57.72%) and body fat percentage (62.61%), 30% showed values above the ideal, similar to results obtained in other studies on body mass in children within this age range [13,18,28-30]. This shows that the prevalence of overweight and obesity is great within this age range.

### Outcome data

Motor performance between sexes and ages showed that boys have a higher abdominal strength and cardiorespiratory endurance when compared to girls, without age differences between them (Table 2).

We observed that than 60.98% of the children showed a level of motor performance below the ideal, similar to results reported in other studies with the same age group. This can be explained

Characteristics	N	%
Gender		
Female	80	65
Male	43	35
BMI classification		
Slimness	8	6.51
Eutrophic	77	62.61
Overweightness	22	17.88
Obesity	15	12.19
Chronic obesity	1	0.81
Bioimpedance classification		
Excessively low	2	1.63
Low	9	7.32
Adequate	71	57.72
Moderately high	25	20.32
High	13	10.57
Excessively high	3	2.44
Motor performance		
Ideal	48	39.02
Below	75	60.98

**Table 2:** Association of gender, age and motor performance.

Clinic Characteristics	Motor performance		
	Flexibility	Abdominal strength/resistance	Cardiorespiratory endurance
Gender	Median (CI 95%)		
Female	29.25 (28.5-31.0)	19.00 (18-20)	122.52 (117.23 – 128.83)
Male	27.50 (25.76 – 31.5)	25.00 (21 – 26.50)	140.36 (132.90 – 146.20)
p*	0.331	<0.001	0.003
Age			
Nine years old	30.00 (28 – 31.99)	20.00 (18.00 – 22.00)	122.95 (115.64 – 132.21)
Ten years old	28.50 (26.30 – 30.50)	20.50 (19.00 – 22.84)	132.84 (123.67 – 141.23)
p*	0.28	0.516	0.076

\* Mann-Whitney test.

**Table 3:** Correlation between motor performance and metabolic equivalents.

Motor performance	Metabolic equivalents			
	Weighted METs		Total METs	
	rho	p*	rho	p*
Flexibility	-0.095	0.292	-0.098	0.280
Abdominal strength/resistance	0.109	0.229	0.104	0.248
Cardiorespiratory endurance	0.125	0.167	0.161	0.074

rho: Spearman's correlation; \*Spearman's test

**Table 4:** Correlation between body mass and motor performance for boys and girls.

Boys						
Body mass	Motor performance					
	Flexibility		Abdominal strength		Cardiorespiratory endurance	
	rho	p*	rho	p*	rho	p*
BMI	0.245	0.113	-0.104	0.504	-0.573	<0.001
% fat	0.035	0.821	-0.313	0.040	-0.533	<0.001
Lean weight	0.075	0.629	-0.014	0.925	-0.415	0.005
Girls						
Body mass	Motor performance					
	Flexibility		Abdominal strength		Cardiorespiratory endurance	
	rho	p*	rho	p*	rho	p*
BMI	-0.092	0.415	-0.193	0.086	-0.488	<0.001
% fat	-0.055	0.622	-0.268	0.016	-0.405	<0.001
Lean weight	-0.074	0.512	-0.069	0.539	-0.371	<0.001

rho= Spearman's correlation; \*Spearman's test

**Abbreviations:** BMI: Body Mass Index; MET: Metabolic Equivalent

by the excess body fat of children combined with low practice of physical activity among them [13,19,20].

There was no significant correlation between the variables of Motor Performance and Metabolic Equivalent (Table 3).

### Main results

However, in the association between body composition and motor performance, it can be observed that the higher the body composition the lower the motor performance, regardless of gender. This association occurs mainly between body composition and cardiorespiratory endurance (Table 4).

When evaluated, the association between motor performance and gender, was verified a better performance in boys when compared to girls in tests of abdominal strength and cardiorespiratory endurance. However, girls had better results in flexibility than boys. Similar to studies on children within the same age range [31-34], this result shows that flexibility is naturally more obvious in girls from an early age. Moreover, boys in this age group have higher abdominal strength and cardiorespiratory endurance than girls [35].

Excess body weight even in childhood is considered a public health problem, which can cause many emotional and social

effects, such as relationship difficulties, depression and low self-esteem [11,13]. The higher number of children with overweight and obesity problems may increase the chances of these children to become obese adults. These adults, who are obese since childhood, tend to have difficulties in the social interaction, professional life and health problems [16,17].

As a limitation of this study is highlighted that we had a lack of diet data, which could show important elements of school children consumption habits. Another limitation refers to the used sampling method, making necessary deeper studies that address these points.

## CONCLUSION

There is a relation between body composition and motor performance of the schoolchildren, higher weight and body fat are associated with low levels of motor performance, regardless the gender. Therefore, it is necessary that the school physical education teacher promote activities that allow the development and improvement of the motor skills of the students and the incentive to practice physical exercises.

Initiatives such, development and improvement of the motor skills and incentive to practice of physical exercises, could reduce the effects of a generation of adults and sedentary elderly and with conditions of chronic disease pre-installed, which will have repercussions on public health of many countries.

In addition, the results presented in this study may direct to the development of increment programs about to encourage the practice of physical exercises in schoolchildren, as a strategy for the prevention of non-transmissible chronic diseases. The potential innovation of this study is in relation to the benefits of improving motor performance levels and controlling body composition for a more active and healthy life.

## REFERENCES

1. Dias PJ, Domingos IP, Ferreira MG, Muraro AP, Sichieri R, Gonçalves-Silva RM. Prevalence and factors associated with sedentary behavior in adolescents. *Rev Saude Publica*. 2014; 48: 266-274.
2. Ferrari GL, Araújo TL, Oliveira LC, Matsudo V, Fisberg M. Association between electronic equipment in the bedroom and sedentary lifestyle, physical activity, and body mass index of children. *J Pediatr (Rio J)*. 2015; 574-582.
3. Gama SR, Carvalho MS, Chaves CR. Childhood prevalence of cardiovascular risk factors. *Cad Saude Publica*. 2007; 23: 2239-2245.
4. Aparecido JM, Marquezi M, Sayuri DO, Uzunian MA, Tozato C, Kochi C. Evaluation of physical fitness in obese children and adolescents. *Science*. 2015; 6: 80.
5. Mello JB, Hernandez MD, Farias VM, Pinheiro ED, Bergmann GG. Physical fitness related to adolescent motor performance in Uruguaiãna, Rio Grande do Sul. *Rev Bras Ciênc e Movimento*. 2015; 23: 72-79.
6. Nascimento MA, Brito CD, Lucena KT, Barbosa FP. Body Composition and Physical Fitness of Schools of Patos Municipality – PARAÍBA. *Rev Bras Ciênc e Movimento*. 2015; 23: 65-75.
7. Zequinão M, Medeiros P, Santos JO, Silva IP, Pereira BO, Cardoso FL. Relationship between motor performance and anthropometric variables in children and adolescents from Florianópolis, SC / Brazil. *Studies in Child Motor Development VIII*. 2015: 18-23.
8. Krebs RJ, Ferreira Neto CA. Topics in motor development in childhood and adolescence. Rio de Janeiro: New letter. 2007.
9. Rodrigues D, Avigo EL, Leite MM, Bussolin RA, Barela JA. Motor development and growth of children with different contexts in childhood education. *Driving*. 2013; 19: 49-56.
10. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies. *Ann Intern Med*. 2014; 12: 1495-1499.
11. Leone C, Bertoli CJ, Schoeps DD. New growth curves of the World Health Organization: comparison with growth values of pre-school children in the cities of Taubaté and Santo André, São Paulo. *Rev paul pediatr*. 2009; 27: 40-47.
12. Logan SW, Scrabis-Fletcher K, Modlesky C, Getchell N. The relationship between motor skill proficiency and body mass index in preschool children. *Res Q Exerc Sport*. 2011; 82: 442-448.
13. Marramarco CA, Krebs RJ, Valentini NC, Ramalho MH, Santos JO, Nobre GC. Previous, overweight and obese malnourished children present poor motor performance. *Rev Educação Física/UEM*. 2012; 23: 175-182.
14. Ronque ER, Cyrino ES, Mortatti AL, Moreira A, Avelar A, Carvalho FO, et al. Relationship between cardiorespiratory fitness and indicators of body adiposity in adolescents. *Revista Paulista de Pediatria*. 2010; 28: 296-302.
15. Sales-Nobre FS, Jornada-Krebs R, Valentini NC. [Brazilian girls' and boys' leisure practices, physical activity level and physical fitness]. *Rev Salud Publica (Bogota)*. 2009; 713-723.
16. Southall JE, Okely AD, Steele JR. Actual and perceived physical competence in overweight and non-overweight children. *Pediatric Exercise Science*. 2004; 16: 15-24.
17. Azambuja AP, Netto-Oliveira ER, de Oliveira AA, Azambuja MD, Rinaldi W. Prevalence of overweight / obesity and economic level of school children. *Rev Paulis Pediatr*. 2013;1: 166-171.
18. Leal VS, Lira PI, Oliveira JS, de Menezes RC, Sequeira LA, Arruda Neto MA, et al. Excess weight in children and adolescents in the State of Pernambuco, Brazil: prevalence and determinants. *Cad Saúde Pública*. 2012; 28: 1175-1182.
19. Pereira ES, Moreira OC. Importance of physical and physical fitness in children and adolescents. *RBPPEX-Rev Bras. Prescription and Exercise Physiology*. 2013; 7: 309-316.
20. Arruda GA, Oliveira AR, Harami GH, Greguol M, Fernandes RA. Evaluation of Body Composition and Performance Engine Referred by Standards and Criteria for Girls and Boys. *Rev Bras. Ciência e Movimento*. 2011; 18: 50-57.
21. World health organization. Growth reference data for 5-19 years. 2007.
22. Brazil, Ministry of Health, Secretariat of Health Care, Department of Basic Attention. Guidelines for the collection and analysis of anthropometric data in health services: Technical Standard of the Food and Nutrition Surveillance System-SISVAN. 2011.
23. Lohman TG. The use of skinfold to estimate body fatness on children and youth. *J Phys Educ Recreation & Dance*. 1987; 58: 98-103.
24. Heyward VH, Stolarczyk LM. Evaluation of applied body composition. São Paulo. 2001; 91-105.
25. Guedes DP. Practical handbook for physical evaluation. Editora Manole Ltda. 2006.
26. Adami F, Bergamaschi DP, Hinnig Pde F, Oliveira NS. [Validity study of

- the "Physical Activity Checklist" in children]. *Rev Saude Publica*. 2013; 47: 488-496.
27. Ainsworth BE, Haskell WL, Leon AS, Jacobs DR Jr, Montoye HJ, Sallis JF, et al. Compendium of physical activities: classification of energy costs of human physical activities. *Med Sci Sports Exerc*. 1993; 25: 71-80.
28. Flores LS, Gaya AR, Petersen RD, Gaya A. Trends of underweight, overweight, and obesity in Brazilian children and adolescents. *J Pediatr (Rio J)*. 2013; 456-461.
29. Rivera IR, Silva MA, Silva RD, Oliveira BA, Carvalho AC. Physical inactivity, TV-watching hours and body composition in children and adolescents. *Arq Bras Cardiol*. 2010; 95: 159-165.
30. Rivera IR, Silva MA, Silva RD, Oliveira BA, Carvalho AC. Physical activity, hours of TV assistance and body composition in children and adolescents. *Arq Bras Cardiol*. 2010; 95: 159-165.
31. Burgos MS, Reuter CP, Tornquist L, Piccin AS, Reckziegel MB, Pohl HH, et al. Profile of related physical fitness to the health of children and adolescents from 7 to 17 years. *J Health Sciences Institute*. 2012; 30: 171-175.
32. Minatto G, Ribeiro RR, Junior AA, Santos KD. Age, sexual maturation, anthropometric variables and body composition: influences. *Brazilian Journal of Cineanthropometry and Human Performance*. 2010; 12: 151-158.
33. Santana CCS, de Andrade LP, da Gama VD, Mota J, do Prado WL. Association between nutritional status and health-related physical fitness in children. *Rev Educação Física/UEM*. 2013; 24: 433-441.
34. Silva LV, Packe C, Tkac C, Braga RK, Urbinati KS. Association between Variables of Body Composition and Physical Fitness In Adolescents. *Revista de Atenção à Saúde*. 2014; 12: 51-56.
35. Pereira ES, Moreira OC, Brito ISS, de Matos DG, Mazini Filho ML, Oliveira CE. Health-related physical fitness in schoolchildren from the interior of Brazil. *J Phys Educ/UEM*. 2014; 25: 469-479.

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