DOI: 10.1590/1809-2950/18004527012020

CC BY

ORIGINAL RESEARCH

Mean values for the 6-minute walk test in healthy children of Coari (AM), Brazil

Valores médios percorridos no teste de caminhada de seis minutos em crianças saudáveis de Coari (AM)

Valores medios recorridos por niños sanos de Coari (AM, Brasil) en la prueba de caminata de seis minutos

Wandrea Sylvia Loretta Angulo de Moraes[1], Carliane Moraes da Silva[2], Alessandro dos Santos Pin[3], Grasiely Faccin Borges[4], Thiago dos Santos Maciel[5]

ABSTRACT | The objective of this research was to establish mean values covered for the six-minute walk test in healthy children in Northern Brazil. This was an experimental, randomized, blind and cross-sectional study that evaluated 63 healthy male and female children, aged 10 to 12 years, who after having their anthropometric data recorded were trained and instructed to perform the test as recommended by the American Thoracic Society, after standard assessment. The test was carried out on a straight track of 30 meters, with markings every 3 meters and cones indicating where the return should be made for the test continuity. At the end, the pre-test evaluation was redone. Very low body mass index was observed in 11-year-old boys, and normal in other age groups. The post-test immediate heart rate was significantly elevated in all groups ($p<0.001$), while all other cardiovascular data collected did not change. The distances covered were significantly lower than those predicted by the standard equation for all groups and sexes ($p<0.0001$). The average value found in girls was 436.30±56.74m and 460.80±63.90m in boys, while the general average was 445.70±54.10m, below the expected values for the sample. The result obtained by the studied group, less than the expected average, can be credited to the regional phenotype, but the Development Index much lower than the Brazilian average should have its influence better studied. The findings are expected to contribute to the establishment of reference values for the test in children from northern Brazil.

Keywords | Exercise Test; Child; Walk Test.

RESUMO | O objetivo desta pesquisa foi estabelecer valores médios percorridos para o teste de caminhada de seis minutos em crianças saudáveis no Norte do Brasil. Este foi um estudo experimental, randomizado, cego e transversal que avaliou 63 crianças saudáveis do sexo masculino e feminino, de 10 a 12 anos, que após terem seus dados antropométricos registrados foram treinadas e instruídas para a realização do teste conforme recomendações da *American Thoracic Society*, após avaliação-padrão. O teste foi realizado numa pista reta de 30 metros, com marcações a cada 3 metros e cones indicando onde o retorno deveria ser feito para a continuidade do teste. Ao final, foi refeita a avaliação pré-teste. Foi observado índice de massa corporal muito baixo nos meninos de 11 anos, e normal nas outras faixas. A frequência cardíaca imediata pós-teste apresentou-se significativamente elevada em todos os grupos ($p<0,001$), enquanto todos os outros dados cardiovasculares colhidos não apresentaram alterações. As distâncias percorridas foram significativamente inferiores às previstas por equação-padrão para todos os grupos e sexos ($p<0,0001$). O valor médio percorrido encontrado em meninas foi de 436,30±56,74m e 460,80±63,90m em meninos, enquanto a média geral foi de 445,70±54,10m, abaixo dos valores esperados para a amostra. O resultado obtido pelo grupo estudado, menor que a média esperada, pode ser creditado ao fenótipo regional, mas o Índice de Desenvolvimento muito mais baixo que a média brasileira

Work presented at the WCPT (World Confederation for Physical Therapy) Congress held in Cape Town, South Africa, in July 2017.
[1]Universidade Federal do Amazonas (Ufam), Coari (AM), Brazil. E-mail: dedeiam@hotmail.com. Orcid: 0000-0002-0457-6686
[2]Universidade Federal do Amazonas (Ufam), Coari (AM), Brazil. E-mail: katrineprincess@hotmail.com. Orcid: 0000-0003-2391-0181
[3]Centro Universitário (UniCerrado), Goiatuba (GO), Brazil. E-mail: keysersoze@bol.com.br. Orcid: 0000-0002-6005-7696
[4]Universidade Federal do Sul da Bahia (UFSB), Teixeira de Freitas (BA), Brazil. E-mail: grasiely.borges@gmail.com. Orcid: 0000-0002-5771-6259
[5]Universidade Federal do Amazonas (Ufam), Coari (AM), Brazil. E-mail: macielts@hotmail.com. Orcid: 0000-0002-4291-7015

Corresponding address: Alessandro dos Santos Pin – Rodovia GO 320, s.n., Jardim Santa Paula – Goiatuba (GO), Brazil – CEP: 75600-000 – E-mail: keysersoze@bol.com.br –
Financing source: nothing to declare – Conflict of interests: nothing to declare – Presentation: Feb. 20th, 2018 – Accepted for publication: Oct. 20th, 2019 – Approved by Research Ethics Committee of Faculdade de Medicina, USP (FMUSP) under protocol No. 3871/12/127.

deve ter sua influência mais bem estudada. Espera-se que os achados contribuam no apontamento de valores de referência do teste em crianças do Norte brasileiro.
Descritores | Teste de Esforço; Criança; Teste de Caminhada.

RESUMEN | El presente estudio tuvo como objetivo establecer los valores medios recorridos por niños sanos en el Norte de Brasil en la prueba de caminata de seis minutos. Este estudio es experimental, aleatorizado, ciego y transversal, que evaluó a 63 niños y niñas sanos/as, de edades entre 10 y 12 años, y tras registrados sus datos antropométricos recibieron capacitación e instrucción para realizar la prueba según lo recomendado por *American Thoracic Society,* después de la evaluación estándar. La prueba se realizó en una pista recta de 30 metros, con marcas cada 3 metros y conos que indicaban dónde debe realizarse el retorno para la continuidad de la prueba. Al final, se rehízo la evaluación previa a la prueba. Se observó un índice de masa corporal muy bajo en niños de 11 años, pero normal en otros grupos de edad. La frecuencia cardíaca inmediata posprueba fue significativamente elevada en todos los grupos (p<0,001), mientras que no cambiaron los demás datos cardiovasculares recopilados. Las distancias recorridas fueron significativamente más bajas que las predichas por la ecuación estándar para los grupos y géneros (p<0,0001). Los valores medios encontrados fueron de 436,30±56,74m en las niñas y 460,80±63,90m en los niños, mientras que el promedio general fue de 445,70±54,10m, por debajo de los valores esperados para la muestra. El resultado obtenido en el grupo estudiado, inferior al promedio esperado, puede acreditar al fenotipo regional, pero el Índice de Desarrollo mucho más bajo que el promedio brasileño debe tener su influencia mejor estudiada. Se espera que los hallazgos contribuyan al establecimiento de valores de referencia para la prueba en niños del Norte de Brasil.
Palabras clave | Prueba de Esfuerzo; Niño; Prueba de Paso.

INTRODUCTION

The six-minute walk test (6MWT) is a clinical evaluation performed by a submaximal effort[1] that estimates the functional capacity of patients by measuring the distance covered (6MWD) in a flat corridor for a period of six minutes[2,3]. The test is considered an important complementary tool in monitoring the solution of cardiorespiratory diseases[4], and can be used in primary health care services as long as there are reference values for the different biotypes.

The 6MWT is used to measure the physical capacity of adults and young people with some type of cardiorespiratory pathology, as its application is simple, low cost, and has a significant correlation with gold standard tests (more complex and with higher application costs) and high reproducibility[2-4]. Evaluation is also a reliable tool when pointing out the relationship between physical fitness, oxygen consumption and functional status of the cardiovascular and respiratory system of healthy individuals[5] and patients with diseases, including assessing the ability to perform activities of daily living[3,4,6-9].

The constant use of the 6MWT as an instrument for assessing the physical condition of patients has encouraged researches to obtain reference values for the test[10-13], which is essential in the child population, considering the physiological and structural changes in short spaces of time[3,14-16]. The 6MWT is used in children with different pathologies[7-8,17-21],and many countries have already established reference values for the test in healthy children[22,23].

In Brazil, a single study was performed to obtain mean values for the 6MWT in children from the South[24]. The authors pointed a correlation between the distance covered in the test and anthropometric data (weight and height) and between the pre and post-test heart rate, as well as drawing an equation to obtain reference values. It is important to note that factors such as phenotypic, climatic, geographic and cultural diversity can influence the values[15,22]. Therefore, the mentioned study should not represent Brazilian children as a whole.

There are few reports on the use of the 6MWT in healthy children under 12[25-27], which makes it difficult to interpret values and observe the evolution of pathological individuals.

The objective of this study was to establish average values for the six-minute walk test in healthy children between 10 and 12 years old in Northern Brazil, with a view to collaborating in the development of future reference values for the region.

METHODOLOGY

This article presents the results of a cross-sectional study carried out between February and December 2014,

with healthy children between 10 and 12 years old, both sexes, inserted in the city and state education network of Coari (AM), in schools that agreed to participate in the survey. The investigation is part of a multicenter study carried out throughout Brazil, with the national coordination of the Instituto do Coração of Faculdade de Medicina of Universidade de São Paulo.

The sample calculation was performed by the team based on the precepts of Jennen-Steinmetz and Wellek[28], with the objective of constructing a 95% reference curve of distance covered by children aged 10 to 12 of both sexes, with normal distribution and parametric method. An absolute error of 1.5% was tolerated in relation to the percentiles of order 2.5% and 97.5%, considering a calculation of six subpopulations, formed by the three classes in which children from 10 to 12 are inserted. The sample size was calculated according to the distribution and population density of the North region in 2010 – 15,865,678 people and 8.3%, respectively, according to data from the Brazilian Institute of Geography and Statistics (IBGE)[29] – , resulting in a sample of 63 subjects.

The research subjects were invited through individual invitations to their legal guardians, who, after agreeing with the study objectives, signed the Informed Consent Form (ICF), duly approved by the Research Ethics Committee of Faculdade de Medicina of Universidade de São Paulo.

Healthy children were included in the selection according to previous screening (data such as date of birth, presence of chronic pathologies, recent health history, history of physical exercise and parental perception of the child's physical behavior, family income and housing), who had not fallen ill in the two weeks prior to the test, who practiced some regular physical exercise and who returned the informed consent form. Those who had cardiorespiratory or musculoskeletal diseases, made use of medication that prevented physical exercise, did not understand the procedure to be performed, or did not have the ICF were excluded from the selection.

After screening, the approved subjects were randomly selected, up to the 63rd, and invited to perform the 6MWT on a specific date, at the school where they studied in a place previously prepared by the researchers. Before the test, an anthropometric assessment was performed, with weight, height and body mass index (BMI) measurements according to the World Health Organization (WHO) classification[25].

The walk test was performed as established by the American Thoracic Society[4]. The materials used for the test were: portable weather station instrument (Oregon BAR388HG) to check air humidity and temperature, stopwatch (Cronobio SW2018) to mark the test time, measuring tape (Lufkin 50m V1750CM), arterial pressure monitor – PA (Omron HEM-742INT), pulse oximeter (Geratherm Oxy Control GT300C203) to check the heart rate and peripheral oxygen saturation, stadiometer (Avanutri) to check the child's height, digital scale (Acqua Sim 09190) to check the weight, adhesive tapes to demarcate the route, two cones made of cardboard and modified Borg[30] perceived exertion scale; which consists of a rating from 0 to 10, where 0 represents no effort and 10 represents maximum effort.

The test was performed in a 30-meter-long corridor with a flat, hard and straight surface, in an environment with temperature and air humidity control, where markings were placed on the ground with adhesive tapes every 3 meters. The cones were positioned before the final and initial line of the course, so that the child would make the turn passing over the line of the test start mark[4].

Before performing the test, the child was instructed to walk with the objective of reaching the greatest possible distance, without running, for six minutes, being able to slow down the walk and stop if they felt the need. In the event of an interruption, the timer continued to record the time of the walk and, if possible, the test could continue; otherwise it should be ended. The evaluator also presented Borg's perceived exertion scale and how it worked and would be used[30].

The child was positioned on the start line of the course and instructed to walk alone during the test. The examiner observed the child from the starting point, beginning the time count as soon as they started walking. During the test, standardized incentive phrases were used every minute, and every 30 meters traveled, a square was filled in the extraction form. At the end of the test, after six minutes, the evaluator asked the child to stop, offering them a chair to sit on, checking their heart rate (HR), peripheral oxygen saturation ($SatO_2$) and perceived exertion (dyspnea and fatigue) and asking them about the test difficulty.

After the first and second minutes after the 6MWT, HR and $SatO_2$ were again checked, following the multicenter research protocol. The additional distance covered (the number of meters in the last partial lap, if it was incomplete) was checked and calculated at the end of the test. A calculation[16] of reference equations for the distance provided for in the six-minute walk test (6MWT) was also

performed, which is used to establish the minimum and maximum 6MWT using variables such as sex, weight, height and age of each individual. The calculation performed for boys is 6MWT=554.16+(absolute difference in HR×1.76)+(1.23×height [cm]). For girls, 6MWT=526.79+(absolute difference in HR×1.66)+(0.66×height [cm]) is calculated.

Means and standard deviations of the variables were calculated: height, body weight and pre/post-test HR. The D'Agostino test for sample normality was performed, Student's t test for parametric data and Wilcoxon test for nonparametric data; One-tailed Anova test with Dunnett's post-test (multiple comparisons), considering the significance level of 5% ($p<0.05$). The data were analyzed with the aid of the Graphpad Prism 5.0 program.

RESULTS

Sixty-three children were evaluated – 24 male (M) and 39 female (F) – randomly selected from the assembled list, according to the inclusion and exclusion criteria, until reaching the predicted number. All of them appeared adequately prepared at the research site, on the scheduled day, and met the requirements of the pre-test screening, completing the 6MWT uneventfully. The average temperature and air humidity during the 6MWT application corresponded to: 30.47±2.29°C and 54.14±7.49%. All children completed the 6MWT.

Table 1. Anthropometric measurements (M±SD) of schoolchildren in the city of Coari (AM), 2014

Age	Sex	Weight (kg)	Height (m)	BMI
10 (n=20)	F (n=15)	35.66±6.16	1.41±0.06	17.89±2.52
	M (n=5)	26.52±2.45	1.31±0.05	15.49±0.89
11 (n=23)	F (n=11)	37.60±7.86	1.44±0.08	18.10±2.93
	M (n=12)	34.54±7.08	1.41±0.06	17.33±2.67
12 (n=20)	F (n=13)	39.14±9.03	1.46±0.09	18.19±3.05
	M (n=7)	44.64±9.49	1.50±0.09	19.63±2.36

F: female; M: male; BMI: body mass index.

Table 1 describes the subjects' anthropometric measurements, separated by age and sex. We observed in subpopulations 10 and 11 years old that male individuals presented lower values of weight and height in relation to female, inverting the proportion in the 12 years old' group. The average total BMI was 18.46±2.80. Male children aged 10 had a very low BMI: 15.49±0.89.

All research participants practiced physical exercise, among which 38.1% (n=24) performed only physical education at school, 49.2% (n=31) practiced soccer, 4.8% (n=3) performed walking/running and 7.9% (n=5) did other activities. The time of physical exercise practiced in the range of 10 years was 29.92±19.38 months, 11 years 31.18±31.56 months, and 12 years 39.71±27.20 months. The average weekly frequency was 2.48±2.02 days.

In Table 2, which shows the cardiorespiratory parameters when performing the 6MWT, a significant change in the final HR is noted. The initial HR, at the first and second minutes of rest, the pre-test systolic and diastolic blood pressure (BP), the $SatO_2$ and the perception of exertion did not present any significant difference between sexes.

Table 2. Cardiorespiratory parameters obtained in the six-minute walk test according to the traced protocol

	Sex	Initial (M±SD)	Final (M±SD)	1st minute post (M±SD)	2nd minute post (M±SD)
HR	M	73.75±8.99	86.58±16.81*	74±13.84	77.79±9.33
	F	80.79±15.73	94.56±16.08*	86.59±13.23	85.67±15.32
SBP	M	97.88±10.31	-	-	-
	F	100.54±9.53	-	-	-
DBP	M	57.25±6.53	-	-	-
	F	58.31±6.21	-	-	-
$SatO_2$	M	97.96±1	97.21±2	-	-
	F	97.92±1.08	97.69±1.28	-	-
Borg	M	-	0.98±1.31	-	-
	F	-	1.15±1.46	-	-

M: mean; SD: standard deviation; HR: heart rate; SBP: systolic blood pressure; DBP: diastolic blood pressure; $SatO_2$: oxygen saturation; Borg: perceived exertion through a modified Borg scale. *$p<0.001$, test power>95%.

The distance covered was 445.70±54.10m. In Figure 1, it can be seen that the difference between the distance covered in the 6MWT (DCWT) and the distance predicted in the 6MWT (DPWT) was significantly low for boys (DPWT 460.80±62.97m vs. DCWT 750.60±35.68m) and girls (DPWT 436.30±56.74m vs. DCWT 647.00±36.42m).

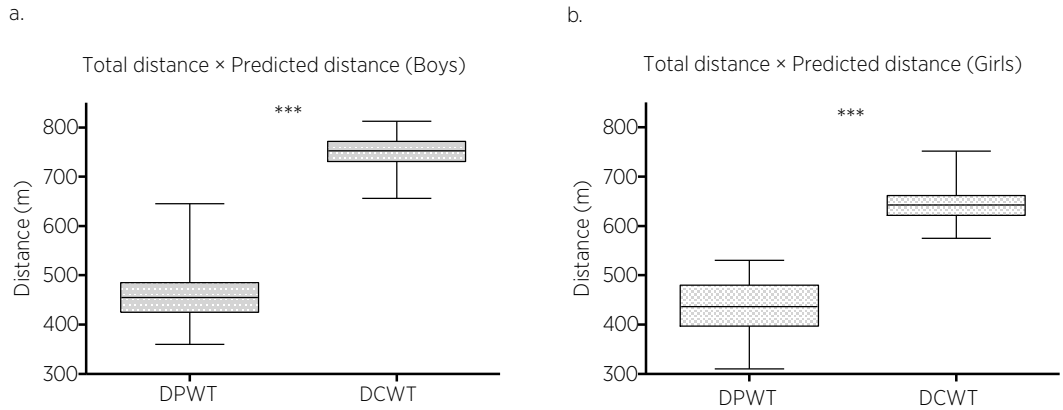

Figure 1. Comparison of distance covered and distance predicted in the six-minute walk test
(a) boys; (b) girls. DCWT: distance covered in the six-minute walk test; DPWT': distance predicted in the six-minute walk test. ***p<0.001, test power>95%.

As seen in Figure 2, the distances covered were 434.70±47.28m in the 10-year group, 460.70±46.23m in the 11-year group and 449.1±56.46m in the 12-year group. The 11-year-old group covered the longest distance of the test, which may seem strange, given that due to growth, a greater distance should be expected for the 12-year-old group, although the difference was not significant. Differences in distance covered by sex and age group were also not significant (10 years: M 445.40±18.62m, F 421.30±61.41m; 11 years: M 472.80±82.67m, F 443.40±43.07m; 12 years: M 452.50±46.48m, F 446.9±64.17m).

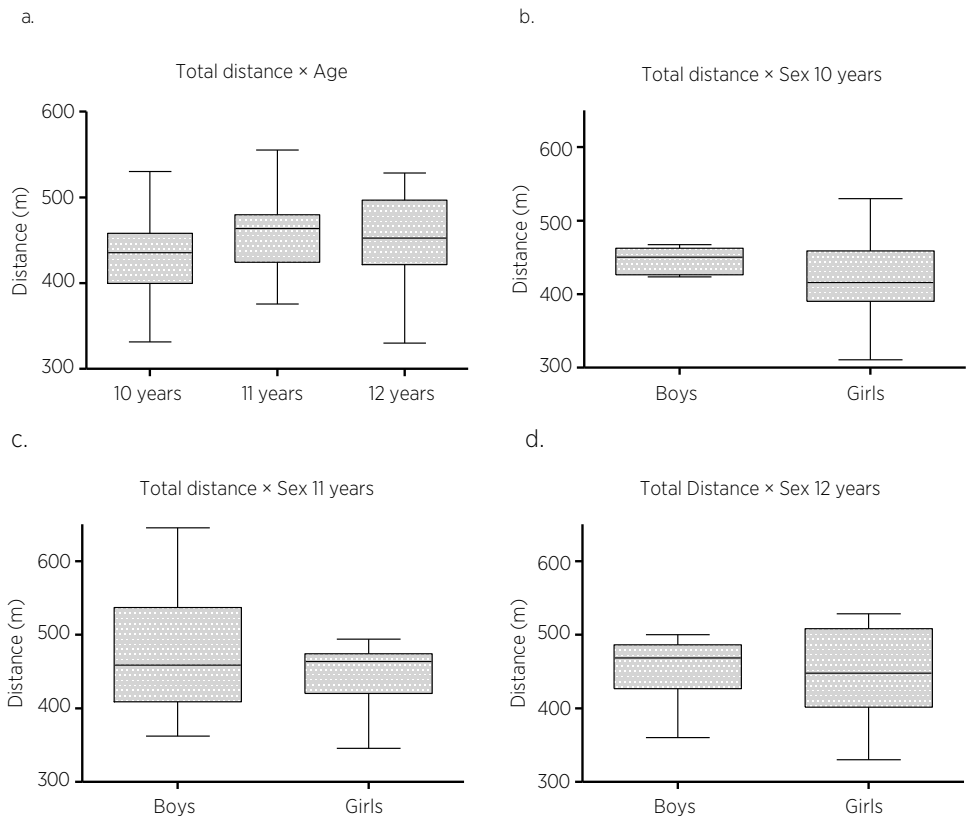

Figure 2. Comparison of distance covered and distance predicted in the six-minute walk test
(a) between age groups; (b) between sexes in the 10-year age group; (c) between sexes in the 11-year group; (d) between the sexes in the age 12-year group. Test power>95%.

DISCUSSION

This study determined average values for schoolchildren aged 10 to 12 in the North of Brazil, contributing to more consistent test results in Brazil, providing normal values for clinical application, enabling the comparison with atypicals and, thus, being able to establish early treatments safely, in order to avoid health problems and reduce hospital expenses and the mortality rate due to cardiorespiratory disorders[26].

In addition, it is important to note that this is the first study of its kind carried out in the region, allowing to describe the current profile of the subjects, which may indicate cardiovascular and pulmonary dysfunctions. The 6MWT was carefully applied, but without any complications or high expenses, proving to be an accessible method, which can be performed by practically everyone, except those with severe disease[27].

The decreased BMI may be related to the human development index (HDI) in the city of Coari (AM). The HDI is information used by the United Nations (UN) to analyze the quality of life of a given population through the assessment of education, monthly income and health status. According to IBGE[29], Coari's HDI was 0.586, a value considerably below the national average, which suggests a relationship with the nutritional factor.

According to the American Thoracic Society[4], factors such as height, sex, overweight and motivation, among others, can influence the DPWT. The BMI observed here, according to the classification proposed by the WHO[25], was below normal for some ages[31]. Perhaps, with the establishment of reference values for each Brazilian region, which until now did not exist, it would be possible to point out with greater accuracy the existence of this relationship.

The variations observed in HR, peripheral BP and $SatO_2$ are in accordance with the expected physiological behavior. An example of this was the increase in HR, probably caused by the degree of exertion expended during the test[32]. However, in the first post-test minute, there was a reduction in HR, suggesting that the first post-exercise minute is enough to recover a level close to that of the pre-test. In the second minute there was no further drop, which suggests that the verification of the cardiac response in the recovery phase should be done in a longer time after the completion of the activity, for example at 5 minutes, as it has been happening in protocols of other studies with the 6MWT[14-16,22,23,33].

Systolic BP (99.52±9.82mmHg) and diastolic BP (57.90±5.56mmHg) at rest were lower than the BP values at rest found in the literature[21].

The average variation of $SatO_2$, in a British study, was 97-98% for baseline and 95-96% during the test run[14]. The findings of this study revealed physiological values of $SatO_2$ between 97-98% pre- and post-test in all children. The modified Borg scale, applied in a survey by Priesnitz et al.[24] had an average perceived exertion of 3 (moderate), while here the average of scale was 1 (low), with no differences between sexes and age.

Regarding the DPWT and DCWT, although the DPWT in boys is higher than that of girls, the difference was not significant. Although research has determined reference values in a population of 456 healthy, Caucasian children, with a difference between sexes[15] (boys walked greater distances than girls), here this difference was not significant. One factor to consider is that, observing the children's height, considered as a determining factor for the distance covered[4], one sees the anticipation of girls' body development in about two years in relation to boys, perceived in the height difference in favor of them at 10 and 11, reversed by boys at 12, which would mitigate the difference in distance traveled. Another factor to consider is that the studies presented here are made with children from other regions and other countries, with a different socio-cultural and phenotypic situation than the one studied here.

Using data from Brazil as a comparison parameter, if the prediction equation drawn by the southern researchers in a 6MWT determination research in children[24] were used, we would find the predicted distance for the male sample studied here of 608.72m and for the female of 600.36m. The distances found, of 460.80m for boys and 436.30m for girls, are equivalent to 75.7% and 72.67%, respectively, of what a southern child of the same age group should travel. This reinforces the thesis that children from different regions of the country should not be leveled (with their biotypic and socioeconomic differences).

Extremely significant was the inferiority of the DPWT of boys and girls compared to the DCWT according to the predictor equation[16]. A study carried out in Hong Kong with healthy children aged 7 to 16 showed a strong correlation between height and DPWT[19], possibly because taller children have a longer stride[4]. Considering the results of this research, only among the age groups the result would agree with the research cited. However, analyzing the distances traveled between the sexes by age, curiously the opposite of what is expected in the age

group of 10 to 11 years is observed, in which the average traveled by boys is higher than that of girls, contrary to the average height of the sexes, observing the expected agreement is only in the 12-year age group. There is no explanation to justify this difference in relation to other studies[17,19], but in the establishment of reference values for Swiss children, an atypical difference between genders in the age group of 11 years was also found[33]. One hypothesis: the influence of the onset of puberty[19].

The 6MWD for the group, regardless of age and sex, was 445.70±54.10m, lower than that found in other studies[15,24]. However, as previously discussed, several factors can intervene in the results of the 6MWD, including sociodemographic and cultural differences and singularities in the protocols that establish the reference values for each survey[15,22,24,33]. In addition, Chilean researchers[22] also correlated their results with reference values published in other countries, including Brazil, with significant changes in the findings. This confirms the premise that cultural, economic and geographical differences in Brazil require a regional mapping of the ideal values of the 6MWT.

CONCLUSION

This study, the first of its kind carried out in the North, showed average values covered by children aged between 10 and 12 years on the 6MWT. The differences in the average covered by the subjects (significantly lower than in other regions) can be explained by the phenotypic differences characteristic of the region, which influence the average height of the group, for example. Another hypothesis to be considered and studied further is the HDI considerably low compared to the national average, so that socio-environmental and nutritional factors may have influenced the results. Finally, it is expected that the values presented here will contribute to future reference equations for the 6MWT in Brazil.

REFERENCES

1. Aquino ES, Mourão FAG, Souza RKV, Glicério BM, Coelho CC. Análise comparativa do teste de caminhada de seis minutos em crianças e adolescentes saudáveis. Rev Bras Fisioter. 2010;14(1):75-80.
2. Du H, Newton PJ, Salamonson Y, Carrieri-Kohlman VL, Davdison PM. A review of the six-minute walk test: its implication as a self-administered assessment tool. Eur J Cardiov Nursing. 2009;8(1):2-8. doi: 10.1016/j.ejcnurse.2008.07.001
3. Okuro RT, Schivinski CIS. Teste de caminhada de seis minutos em pediatria: relação entre desempenho e parâmetros antropométricos. Fisioter Mov. 2013;26(1):219-28. doi: 10.1590/S0103-51502013000100024
4. American Thoracic Society. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166(1):111-7. doi: 10.1164/ajrccm.166.1.at1102
5. Gibbons WJ, Fruchter N, Sloan S, Levy RD. Reference values for a multiple repetition 6-minute walk test in healthy adults older than 20 years. J Cardiopulm Rehabil. 2001;21(2):87-93. doi: 10.1097/00008483-200103000-00005
6. Marino DM, Marrara KT, Di Lorenzo VAP, Jamami M. Teste de caminhada de seis minutos na doença pulmonar obstrutiva crônica com diferentes graus de obstrução. Rev Bras Med Esporte. 2007;13(2):103-6.
7. Noonan V, Dean E. Submaximal exercise testing: clinical application and interpretation. Phys Ther. 2000;80(8):782-807. doi: 10.1093/ptj/80.8.782
8. Rodrigues SL, Assis Viegas CA. Estudo de correlação entre provas funcionais respiratórias e o teste de caminhada de seis minutos em pacientes portadores de doença pulmonar obstrutiva crônica. J Pneumologia. 2002;28(6):324-8.
9. Lima CA, Andrade AD, Campos SL, Brandão DC, Mourato IP, Brito MCA. Six-minute walk test as a determinant of the functional capacity of children and adolescents with cystic fibrosis: a systematic review. Respiratory Medicine. 2018;137:83-8. doi: 10.1016/j.rmed.2018.02.016
10. Casanova C, López MV, Marin JM, De Torres JP, Casas A, Montes de Oca M. Six minute walk distance in a multicenter study of healthy subjects aged 40-80 years in Spain and South America. Am J Respir Crit Care Med. 2007;175:A955.
11. Osses AR, Yáñez JV, Barría PP, Palacios MS, Dreyse DJ, Díaz PO, Lisboa BC. Reference values for the 6-minutes walking test in healthy subjects 20-80 years old. Rev Med Chile. 2010;138(9):1124-30.
12. Mylius CF, Paap D, Takken T. Reference value for the 6-minute walk test in children and adolescents: a systematic review. 2016;10(12):1335-52. doi: 10.1080/17476348.2016.1258305
13. Dourado VZ. Equações de referência para o teste de caminhada de seis minutos em indivíduos saudáveis. Arq Bras Cardiol. 2011;96(6):e128-38.
14. Cacau LDAP, Santana-Filho VJD, Maynard LG, Gomes Neto M, Fernandes M, Carvalho VO. Reference values for the six-minute walk test in healthy children and adolescents: a systematic review. Braz J Cardiovasc Surg. 2016;31(5):381-8.
15. Vandoni M, Correale L, Puci MV, Galvani C, Codella C, Togni F, et al. Six minute walk distance and reference values in healthy Italian children: a cross-sectional study. PloS one. 2018;13(11):e0205792. doi: 10.1371/journal.pone.0205792
16. Li AM, Yin J, Au JT, So HK, Tsang T, Wong E, et al. Standard reference for the six-minute-walk test in healthy children aged 7 to 16 years. Am J Respir Crit Care Med. 2007;176(2):174-8. doi: 10.1164/rccm.200607-883OC
17. Holland AE, Spruit MA, Troosters T, Puhan MA, Pepin V, Saey D, et al. An official European Respiratory Society/American

Thoracic Society technical standard: field walking tests in chronic respiratory disease. Eur Respir J. 2014;44(6):1428-46. doi: 10.1183/09031936.00150314

18. Vanhelst J, Fardy PS, Salleron J, Bérghin F. The six-minute walk test in obese youth: reproducibility, validity, and prediction equation to assess aerobic power. Disabil Rehabil. 2013;35(6):479-82. doi: 10.3109/09638288.2012.699581
19. Donadio MV, Heinzmann-Filho JP, Vendrusculo FM, Frasson PX, Marostica PJ. Six-minute walk test results predict risk of hospitalization for youths with cystic fibrosis: a 5-year follow-up study. J Pediatr. 2017;182:204-9. doi: 10.1016/j.jpeds.2016.11.071
20. Moalla W, Gauthier R, Maingourd Y, Ahmaidi S. Six-minute walking test to assess exercise tolerance and cardiorespiratory responses during training program in children with congenital heart disease. Int J Sports Med. 2005;26:756-62. doi: 10.1055/s-2004-830558
21. Kanburoglu MK, Ozdemir FM, Ozkan S, Tunaoglu FS. Reference values of the 6-minute walk test in healthy Turkish children and adolescents between 11 and 18 years of age. Respiratory Care. 2014;59(9):1369-75. doi: 10.4187/respcare.02891
22. Gatica D, Puppo H, Vilarroel G, San Martín I, Lagos R, Montecino JJ, et al. Reference values for the 6-minutes walking test in healthy Chilean children. Rev Med Chile. 2012;140:1014-21. doi: 10.4067/s0034-98872012000800007
23. D'Silva C, Vaishali K, Venkatesan P. Six-minute walk test-normal values of school children aged 7-12 Y in India: a cross-sectional study. Indian J Pediatr. 2011;79:597-601. doi: 10.1007/s12098-011-0559-x
24. Priesnitz CV, Rodrigues GH, Stumpf CS, Viapiana G, Cabral CP, Stein RT, et al. Reference values for the 6-min walk test in healthy children aged 6-12 years. Pediatr Pulmonol. 2009;44:1174-9. doi: 10.1002/ppul.21062
25. World Health Organization. Growth reference 5-19 years [Internet]. Geneva: World Health Organization; 2007 [cited 2020 Mar 6]. Available from: http://www.who.int/growthref/who2007_bmi_for_age/en/index.html
26. Shoemaker MJ, Curtis AB, Vangsnes E, Dickinson MG. Clinically meaningful change estimates for the six-minute walk test and daily activity in individuals with chronic heart failure. Cardiopulm Phys Ther J. 2013;24(3):21-9.
27. Polkey MI, Spruit MA, Edwards LD, Watkins ML, Pinto-Plata V, Vestbo J, et al. Six-minute-walk test in chronic obstructive pulmonary disease: minimal clinically important difference for death or hospitalization. Am J Resp Critical Care Med. 2013;187(4):382-6. doi: 10.1164/rccm.201209-1596OC
28. Jennen-Steinmetz C, Wellek S. A new approach to sample size calculation for reference interval studies. Stat Med. 2005;24(20):3199-212. doi: 10.1002/sim.2177
29. Instituto Brasileiro de Geografia e Estatística. Cidades [Internet]. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; c2017 [cited 2020 Mar 6]. Available from: http://www.cidades.ibge.gov.br
30. Borg GV. Psychophysical bases of perceived exertion. Med Sci Sports Exercise. 1982;14(5):377-81. doi: 10.1249/00005768-198205000-00012
31. Géa-Horta T, Felisbino-Mendes MS, Ortiz RJF, Velasquez-Melendez G. Association between maternal socioeconomic factors and nutritional outcomes in children under 5 years of age. J Pediatr. 2016;92(6):574-80. doi: 10.1016/j.jpedp.2016.05.012
32. Lobato JCP, Kale PL, Velarde LGC, Szklo M, Costa AJL. Correlation between mean body mass index in the population and prevalence of obesity in Brazilian capitals: empirical evidence for a population-based approach of obesity. BMC Public Health. 2015;15(1):322. doi: 10.1186/s12889-015-1637-1
33. Ulrich S, Hildenbrand FF, Treder U, Fischler M, Keusch S, Speich R, Fasnacht M. Reference values for the 6-minute walk test in healthy children and adolescents in Switzerland. BMC Pulm Med. 2013 Aug 5;13:49. doi: 10.1186/1471-2466-13-49