ORIGINAL ARTICLE

https://doi.org/10.6063/motricidade.26680

Supine-to-stand task performance and anthropometric characteristics in children and adolescents

Martín Dario Villanueva Alonso[1], Maria Teresa Cattuzzo[2*], Guilherme dos Santos[1], Anderson Henry Pereira Feitoza[2], Paulo Cesar Wauthier[2], Alessandro Hervaldo Nicolai Ré[1]

ABSTRACT

The performance of getting up from the floor from a supine position (Supine-to-Stand task, STS) can be considered a milestone in motor development and a potential indicator of motor competence in global terms. However, the knowledge about the performance of STS task and anthropometric characteristics is limited. This study examined the relationship between STS task performance and anthropometry in youth and the differences between the sexes, range age and nationality. Participants (*n*= 397; 45% girls) from Spain and Brazil (*M*= 9.13 years; *SD*= 3.79) had the following variables measured: timed STS task, mass, height, chronological age, hip, and waist circumference; Body Mass Index (BMI), Waist/Hip Ratio (WHR), Waist/Height Ratio (WHtR) were calculated. The analysis included ANOVA, Pearson's correlation test and Stepwise multiple regression analysis in four age groups. Age was the variable that obtained statistically significant associations with timed STS task in the youngest age group; the BMI in the children group corresponded to the second childhood phase, and the WHR and the WHtR in the oldest age group. The timed STS task decreased as age groups were increasingly older, confirming that timed STS is strongly associated with growth and maturation processes; there were little differences between sexes or nationalities.

KEYWORDS: psychomotor performance; development; body mass index; childhood; adolescence.

INTRODUCTION

The term motor competence (MC) describes goal-directed movements that involve control and coordination of the human body (Robinson et al., 2015; Stodden et al., 2008; Utesch & Bardid, 2019). The role of MC in the development of health-related physical fitness (AFRS) (Cattuzzo et al., 2016; Utesch et al., 2019), obesity prevention (D'Hondt et al., 2009), and as a predictor of continuing PA practice in adulthood (Lloyd et al., 2014) has been emphasized in the last years. On the other hand, a low MC, characterized by the inability to perform motor skills at an age-appropriate level (Ré et al., 2018a; 2020), adversely affects the human life cycle. World health agencies and researchers have published alarming results regarding obesity and physical inactivity in children and adolescents, highlighting the global increase in both (Guthold et al., 2020; WHO, 2022). Thus, the development of MC can be essential in promoting an active and healthy lifestyle in children and adolescents (Lubans et al., 2010).

Several assessments are available to measure children's MC (Cools et al., 2009; Robinson et al., 2015). Such tests have been developed for young children, preventing the assessment of MC in later life stages since it affects the tests' ability to differentiate the increasing levels of MC, the well-known ceiling effect (Robinson et al., 2015; Stodden et al., 2008). Measures based on motor tasks, such as the task of getting an upright position from the supine position on the

[1]Universidade de São Paulo – São Paulo (SP), Brazil.
[2]Universidade de Pernambuco – Recife (PE), Brazil.
*Corresponding author: Escola Superior de Educação Física, Universidade de Pernambuco, Rua Arnóbio Marques, 310, Santo Amaro – CEP 50100-130 – Recife (PE), Brazil. E-mail: maria.cattuzzo@upe.br

Conflict of interests: nothing to declare. Funding: International Mentoring Foundation for the Advancement of Higher Education (IMFAHE) (AGR); São Paulo Research Foundation (FAPESP) Grant 2021/03385-7; Foundation for the Improvement of Higher Education Personnel (CAPES) – Funding Code 001; CAPES/UPE funding number 88887.633885/2021-00 and CAPES/UPE funding number 88882.435727/2019-01.
Received: 03/13/2022. Accepted: 07/18/2022.

floor (Supine-to-Stand Task, STS), getting up from a chair, and walking for three meters, among others, are based on motor tasks that explain functional capacity and have been used in populations during ageing, as well as in subjects with motor disabilities (Volpato et al., 2011). These functional measures of MC, in essence, measure gross coordination and global control over the body and can be defined as an ability to coordinate and control the centre of mass and extremities in a gravity-based environment to achieve a task goal effectively and objectively (Robinson et al., 2015). Furthermore, these assessments indicate specific developmental milestones through ageing; because they are, by nature, tasks that undergo adjustments throughout life (Nesbitt et al., 2017).

Among the assessments of functional capacity, the STS task offers both product-oriented measures, *i.e.*, quantitative (*e.g.*, the time it takes a child to get up and touch the wall) and process-oriented measures, *i.e.*, qualitative (*e.g.*, movement pattern to get up), both indicators of human MC. In particular, the timed STS task (product-oriented measure) could be used as an efficient test for functional MC examination since it is simple, fast, and affordable. In fact, a systematic literature review examined studies about the STS task performed by subjects in all life phases; it was concluded that the timed STS task would be a universal lifespan test for functional motor competence and musculoskeletal fitness for clinical or research aims (Cattuzzo et al., 2020).

The present study is focused on the STS test performed by youth (children and adolescents), and, historically, the first studies on this subject were engaged in describing the STS task's sequence of movements in early and later childhood (Marsala & VanSant, 1998). Subsequently, such knowledge was extended to not typical development populations (Mewasingh et al., 2002; Mewasingh et al., 2004). After that, the STS performance started to be related to health measurements through product-oriented measurement (time) (Beenakker et al., 2005) or both measurement types (Duncan et al., 2017; Hsue et al., 2014a; Hsue et al., 2014b; Nesbitt et al., 2017; Nesbitt et al., 2018; Ng et al., 2013). However, considering the later phases of youth, only one study has investigated STS performance and health measurements in children and adolescents (Tadiotto et al., 2021).

Especially when it comes to investigating anthropometric measures and youth performance on the timed STS task, the results of Duncan et al. (2017) and Ng et al. (2013) suggested that time on the STS task follows a developmental course according to chronological age: the older the children, the better their results (less time in performing the task), regardless of other anthropometric measures. However, the study by Tadiotto et al. (2021) with adolescents added one more point to the study of this functional task: excess body adiposity was negatively related to the performance of the timed STS task.

So, considering that the STS task can be considered a milestone in motor development and a potential indicator of motor competence in global terms and that the knowledge of the relationship between the performance of STS task and anthropometric characteristics is, however, limited, this study aimed to verify the relationships between performance on timed STS task and the anthropometric characteristics of children and adolescents; and examine differences between the sexes, age groups, and nationality of these children and adolescents.

METHODS

As described in Table 1, two convenience samples of healthy children and adolescents of two nationalities (Brazilian-Spanish), between 3 and 17 years of age (*M*= 9.13, *SD*= 3.79), were recruited to participate in this study. The Brazilian participants (*n*= 130) came from a public elementary school and a community program oriented to the practice of PA for young people, both located in a community of low socio-economic status on the east side of the city of São Paulo. The Spanish sample (*n*= 289) came from a private kindergarten and three sports clubs (Club Amigos del Baloncesto, Club Tenis Mercantil, and Club Triatlón), where access to activities is paid; these institutions belong to the provincial city of Pontevedra.

Subjects included met the following criteria: a) aged between 3 and 17 years; b) be a volunteer to participate in the research; c) have the Free and Informed Consent Term (TCLE) signed by the parents or guardians d) have no diagnosis of physical or mental health problems. The Ethics Committee approved the study of the School of Sciences, Arts and Humanities of the University of São Paulo with the code CAAE: 92599518.1.0000.5390.

Table 1. Participants in the sample by nationality, sex, and age group of the Brazilian and Spanish youth (2021).

Age range (years)	Boys BRA	Girls BRA	Boys ESP	Girls ESP
3 to 4.99	18	18	15	12
5 to 6.99	29	39	10	7
7 to 8.99	0	0	31	27
9 to 10.99	0	0	34	28
11 to 17	13	16	78	52
Total	60	70	175	114

Design and procedures

The study design was cross-sectional and descriptive. The participating institutions were selected by convenience, depending on the existing possibilities to carry out the data collection, which was carried out between February 2017 and June 2018. The product of STS (time in seconds) was measured, and the anthropometric variables measured were age (years), body weight, height, and waist and hip circumference. These data were calculated: the Waist-Hip Ratio (WHR), the Waist-Height Ratio (WHtR), and the Body Mass Index. Data collection began with anthropometric measurements, and then the STS test was performed.

Anthropometric measurements

Anthropometric data were collected following a standard protocol (Norton, 2018). Height and body mass measurements were used to calculate the Body Mass Index (BMI). The child's height was measured using a tape measure (Cescorf 2m, São Paulo, Brazil) supported on the wall at 90º from the floor, with an accuracy of 0.1 cm. For measuring body mass, a precision scale with a capacity of 100 kg and a sensitivity of 0.1 kg was used (EB2000, Esselton, China). The waist circumference was taken between the last rib and the iliac crest, while the hip circumference was obtained by calculating the maximum circumference in the area of the joint formed between the iliac crest and the femur. Both circumferences were taken in a standing position, with arms crossed at chest level. Waist and hip circumferences were measured in the standing position with the same tape measure (CESCORF 2m, São Paulo, Brazil), with an accuracy of 0.1 cm. From the measurements of waist and hip circumference, the waist-hip ratio (WHR) [waist circumference (cm) / hip circumference (cm)] was calculated, and the measurements of waist circumference and height were used for the calculation of the waist-to-height ratio (WHtR) [waist circumference (cm) / height (cm)].

All anthropometric measurements were performed by the first author of the research, who is certified by the International Society for Advancement in Kinanthropometry level II.

Motor competence measure

The STS task was used as an indicator of the MC (Cattuzzo et al., 2020; Nesbitt et al., 2018). The test starts from a supine position. The feet were aligned with the rest of the body at 0.5 meters from the wall. Participants were filmed with a camera positioned under a tripod at 45º from the right side. Children were individually tested by instructing them based on an oral explanation of the task and a single demonstration of the task by the author. Five attempts were made per participant, with only the shortest time computed. (Nesbitt et al., 2017; Nesbitt et al., 2018).

After the "go" command, the children should get off the floor and touch a marked point on the wall, located approximately at the participants' shoulder height (Cattuzzo et al., 2020; Nesbitt et al., 2017). In line with Nesbitt (Nesbitt et al., 2017), individuals were encouraged to complete the task as quickly as possible. The participants themselves selected the time between trials to minimize fatigue. The total time (seconds) was calculated from the frame where the first movement took place to the frame where the individual was touching the wall (hands/fingers touching the wall), using the video analyzer software Dartfish-7 (Dartfish USA, Alpharetta, GA).

Statistical analysis

The assumptions of normal data distribution and equality of variance were confirmed using the Kolmogorov-Smirnov and Levene tests, respectively (Hair et al., 1998). Descriptive tables were constructed with the mean values of performance on the STS task with age and anthropometric characteristics, based on two-way analysis of variance (ANOVA) (age group and sex) to verify the possible differences between groups. To verify the differences between nationalities, the one-way ANOVA test was used. Correlations between measured variables were tested using Pearson's correlation test. The strength of the correlation coefficient was based on Vincent (2005): values up to 0.5 = low; between 0.5 and 0.7 = moderate, and above 0.7 = high. Stepwise multiple regression analysis to verify the set of anthropometric variables that predict the time in the STS task by sex and range age group; the time on the STS task as a dependent variable and range age, BMI, ICQ, and WHtR as independent variables. When necessary, Bonferroni's test was used to locate statistically significant differences. Statistical analyzes used SPSS v20.0 software (SPSS Inc., IBM, USA), and the significance level was set at 5%.

RESULTS

Timed STS task, age group, and sex

The mean and standard deviation of the timed STS task and the anthropometric characteristics of the sample are in Table 2. In general, there was a significant decrease in the timed STS task as age groups got older. Boys showed better performance than girls up to the age group of nine to 11 years; girls matched the STS performance of boys in the age group of the oldest participants (11 to 17 years); this group is represented only by Spanish participants. However, there were no significant differences in the performance of the timed STS task between sexes in any age group studied.

Anthropometric variables, age group, and sex

Regarding the anthropometric variables, it is noteworthy that both boys and girls exhibited a persistent increase in BMI, while the other anthropometric variables, such as WHR and WHtR, decreased significantly in the older age groups. It is worth mentioning that from seven to 11 years of age, the data obtained belonged only to Spanish participants, observing the statistically significant differences in the WHtR from nine to 11 years of age; in the older age group, with both nationalities represented again, the differences in terms of sex in the WHtR increased.

Timed STS task, anthropometric variables, and nationality

The main results of the timed STS task and the anthropometric characteristics between Brazilians and Spaniards were represented by the significant decrease in the timed STS task in both nationalities as age groups got older. Descriptively, Spanish participants performed better on the timed STS than Brazilians in all age groups, except for seven to 11-year-olds, where the Brazilian sample was not represented. Despite this, there were no significant differences in STS time performance

Table 2. Mean (M) and standard deviation (SD) for timed STS task and anthropometric characteristics according to sex and age group of the Brazilian and Spanish youth (2021).

Age range	Boys BRA	Boys ESP	Girls BRA	Gils ESP
	M± SD	*M± SD*	*M± SD*	*M± SD*
3 to 4.99 yrs				
Time STS (s)	2.42± 0.08[be]	2.29± 0.89[bcde]	2.76± 0.63[be]	2.07± 0.25[bcde#]
BMI (Kg/cm²)	16.64± 0.66[e]	15.87± 1.46[cde]	16.17± 1.31[e]	15.87± 0.72[ce]
WHR (cm)	0.89± 0.04[e]	0.89± 0.05[cde]	0.89± 0.03[be]	0.92± 0.04[de]
WHtR (cm)	0.49± 0.03[be]	0.48± 0.03[e]	0.50± 0.03[be]	0.49± 0.03
5 to 6.99 yrs				
Time STS (s)	1.89± 0.06[a]	1.73± 0.28[a]	2.01± 0.29[a]	1.87± 0.11[ad#]
BMI (Kg/cm2)	16.20± 0.52[e]	16.34± 1.18[d]	15.77± 2.10[e]	16.98± 0.89[de]
WHR (cm)	0.87± 0.05[e]	0.87± 0.04[de]	0.85± 0.05[ae]	0.87± 0.05[de]
WHtR (cm)	0.47± 0.04[ae]	0.47± 0.02[e]	0.46± 0.03[ae]	0.46± 0.04
7 to 8.99 yrs				
Time STS (s)		1.73± 0.32[a]		1.65± 0.06[a]
BMI (Kg/cm2)		16.78± 4.18[a]		18.69± 4.18[a]
WHR (cm)		0.86± 0.04[a]		0.84± 0.04[de]
WHtR (cm)		0.48± 0.05[e]		0.47± 0.04[e]
9 to 10.99 yrs				
Time STS (s)		1.75± 0.27[a]		1.76± 0.06[a]
BMI (Kg/cm2)		19.04± 2.68[a]		18.73± 2.76[e]
WHR (cm)		0.83± 0.05[ab]		0.80± 0.05[abc]
WHtR (cm)		0.44± 0.04[a]		0.44± 0.04
11 a 17 yrs				
Time STS (s)	1.72± 0.78[a]	1.62± 0.18[a]	1.78± 0.20[a]	1.62± 0.04[a#]
BMI (Kg/cm2)	19.43± 3.38[ab]	20.17± 3.06[ab]	18.29± 2.36[ab]	20.97± 3.03[abd#]
WHR (cm)	0.81± 0.02[ab]	0.82± 0.05[ab]	0.76± 0.04[ab]	0.78± 0.05[abc]
WHtR (cm)	0.43± 0.04[ab]	0.44± 0.04[abc]	0.41± 0.03[ab]	0.44± 0.04[#]

*(p< 0.05); **(p< 0.01); M: average; SD: standard deviation; Time STS: Time to get up from a supine position; BMI: Body Mass Index; WHR: Waist Ratio Hip; WHtR: Waist to Height Ratio; [a]Significant differences between the age group of 3 to 5 years; p< 0.05; [b]Significant differences between the age group of 5 to 7 years; p< 0.05; [c]Significant differences between the age group of 7 to 9 years old only for Spaniards; p< 0.05; [d]Significant differences between the age group from 9 to 11 years old only for Spaniards; p< 0.05; and Significant differences between the age group of 11 to 17 years; p< 0.05; [#]Significant differences between sex; p< 0.05.

between nationalities in the age groups studied. Regarding anthropometric characteristics, BMI increased significantly in older age groups, although there were no significant differences between male nationalities. WHR and WHtR decreased significantly in the older age groups, noting no significant differences in any studied groups.

The main results of the timed STS task and anthropometric characteristics among Brazilian and Spanish children and adolescents were represented by the significant decrease in time on the STS task in both nationalities as the age groups got older. Spanish girls significantly performed better in the timed STS task than Brazilian girls in all age groups, except for seven to 11 years of age, where there was no representation of the Brazilian sample. As with the male anthropometric characteristics, BMI increased significantly as age groups became older, and WHR and WHtR decreased with increasing age (advanced age groups) in both nationalities. There were significant differences in BMI and WHtR between both nationalities from 11 to 17 years of age in females.

Correlations between timed STS task and anthropometric characteristics

As shown in Table 3, Pearson's coefficients indicate that the timed STS task is related to anthropometric variables in this sample of children and adolescents. Age was the variable that obtained inversely significant correlations with timed STS time in boys ($r = -0.41$; $p < 0.05$) and girls ($r = -0.31$; $p < 0.05$) aged 3 to 5 years. BMI was significant in girls aged 5 to 7 ($r = 0.33$; $p < 0.05$) and aged 9 to 11 years ($r = 0.45$; $p < 0.05$), and WHR and WHtR related significantly with the timed STS task in boys ($r = 0.21$; $p < 0.05$) and girls ($r = 0.32$; $p < 0.01$) of the oldest age group in this sample.

The regressions in Table 4 presented the contribution of age, BMI, WHR, and WHtR, together and individually, with the timed STS task in children and adolescents. Taken together, having timed STS as a dependent variable and the others as independent, they contributed significantly to the explanation of the variability in the time of the STS task in the older participants of this sample of both sexes. Specifically, age and selected anthropometric characteristics accounted for 13.7% of STS task time variability in boys and 25.2% in girls aged 11 to 17.

Individually, age was the variable that had the most remarkable contribution to the timed STS task in boys aged three to 11 years. WHtR was a statistically significant variable that predicted the timed STS task from five to seven years of age. Among the older participants in this sample, age was the only independent variable that proved to be a statistically significant predictor of the timed STS task, these being found in girls. It should be noted that BMI was excluded from the analysis due to collinearity problems and because the WHtR had a higher common variance with the timed STS task.

DISCUSSION

The first purpose of this research was to verify the relationship between the performance in getting up from the floor from a supine position and the anthropometric characteristics, according to sex and age group, in children and adolescents of two different nationalities (Brazilians and Spaniards). In general, data analysis revealed significance between age group and anthropometric variables of children and adolescents, excluding the age group from seven to 11 years old, in which there were only Spanish children.

The results provided evidence of positive relationships between timed STS task and BMI, WHR and WHtR, and

Table 3. Pearson's coefficient for timed STS and anthropometric characteristics by sex and age group of the Brazilian and Spanish youth (2021).

Age range (yrs)	Dependent variable	Age	BMI	WHR	WtHR
3 to 4.99	Timed STS Boys	–0.41*	0.00	0.17	0.12
	Timed STS Girls	–0.31*	0.00	–0.02	0.14
5 to 6.99	Timed STS Boys	0.02	0.29	–0.04	0.24
	Timed STS Girls	–0.00	0.33*	–0.11	0.09
7 to 8.99	Timed STS Boys	0.05	0.04	0.01	0.17
	Timed STS Girls	0.40	–0.28	–0.47	–0.37
9 to 10.99	Timed STS Boys	0.21	–0.05	0.06	–0.05
	Timed STS Girls	–0.17	0.45*	–0.08	0.26
11 to 17	Timed STS Boys	–0.08	0.18	0.21*	0.10
	Timed STS Girls	0.25*	0.20	0.20	0.32**

*$p < 0.05$; **$p < 0.01$; BMI: Body Mass Index; Timed STS: Time to get up from a supine position; WHR: Waist Ratio Hip; WHtR: Waist to Height Ratio.

participants' lifetime, except for the negative associations found between anthropometric characteristics and timed STS task in the 7- 9 years-old age group in females. Age had statistically significant correlations with time on the STS task (r= –0.41; p< 0.05) in the younger age group. Ng et al. (2013) found similar results in three to 8-year-old children, allowing them to create charts showing normal age-related values. So, our results support that the STS task appears to be a valuable tool for tracking MC for clinical or research purposes (Cattuzzo et al., 2020; Ng et al., 2013).

The present study results showed that BMI was not associated with the youngest children's performance in our sample of both sexes. On the other hand, the lack of interaction between time performance on the STS task and BMI, both in boys and girls, complements the results of another study, where BMI had a low correlation (r= 0.15; p< 0.05) with American, early childhood children (Nesbitt et al., 2017). Additionally, the stepwise regression coefficients showed that age proved to be the statistically predictive variable of time in the STS task, decreasing the variability of time in the STS by 0.45 seconds in boys of the younger age group.

Correlations showed that BMI proved to be a statistically significant variable and positive direction with the performance of the STS task in boys in the age group corresponding to second childhood. Such a result can be explained by the increase in body mass expected by linear growth in the middle years of childhood (from six to 11 years of age) (Rogol et al., 2002). Negative associations were found in the nine-11 age group between time on the STS task, BMI, WHR, and WHtR in girls. A recent study's results (Tadiotto et al., 2021) showed correlations moderate and direct between BMI with timed STS and inverse with STS-MC (p< 0.01) in 10- and 16-years old children; they concluded that excess fat and low physical fitness inhibit STS-test performance. In tasks where all or most of the body mass is projected, the negative relationship between BMI and MC could be partially explained by the increase in fat mass, which can be detrimental to the performance of the CM (Lopes et al., 2012). Similarly, previous study results showed that girls have a higher body fat percentage than boys during childhood (Arfai et al., 2002). Thus, we hypothesized that this body fat mass could be related to a longer time in the STS task and prevent girls from performing better in the general MC.

Continuing with the analysis of the relationship between anthropometric characteristics and time on the STS task, WHR and WHtR were confirmed to be statistically significant indicators with timed STS task in the age group of the oldest participants in our sample, which included adolescents. Such a result may be because adolescents increase both size and body composition (Ré, 2011). Previous studies have highlighted that one of the main phenomena of puberty is the height growth peak, a visible result of biological maturation that also causes improvement in metabolic and muscle functions (Thomas & French, 1985). In this way, the physical changes represented in body composition could explain the improved performance on the STS task. It is well known that boys become bigger in general, highlighting the widening of the shoulders, the legs becoming longer in relation to the chest, and the forearms becoming longer in relation to the arms and height. While in girls, the increase in body fat percentage stands out (specifically, in the breasts and hips).

Coinciding with some previous results (Cattuzzo et al., 2016; Nesbitt et al., 2018) where the connection between MC and fitness level from childhood to adolescence was demonstrated, timed STS task and the anthropometric characteristics of the sample were also shown to increase associations consistently in increasingly older age groups (Table 3).

The second purpose of this study was to examine the differences in STS task time and anthropometric characteristics between the sexes and age groups of the sample of children and adolescents. Time on the STS task was significantly shorter in older age groups, and there were no significant differences between sexes in the time of the STS task in children and adolescents. However, the stratification of the samples by nationality showed significant differences between the sexes, being found only in girls from Spain.

Regarding the significant decrease in time in the STS task, previous studies have described how the different age groups investigated in the present study are strongly associated with the growth and maturation processes; and it is possible to affirm that childhood is a period represented by rapid neurological development and greater neural plasticity (Ré, 2011). Nesbitt et al. (2017) were the first to validate STS task timing and developmental sequences, suggesting that the effective control of the centre of mass is essential for getting up faster. In this sense, the present study expanded the findings of this previous study (Nesbitt et al., 2017) according to sex. Our results offered performance (time) on the STS task (cf., Table 1) in Spanish and Brazilian children aged three to 17. In general, the mean times obtained in the STS task of this study coincide with the mean times found in other studies (Nesbitt et al., 2017; Ng et al., 2013) in populations represented by different nationalities — e.g., American and English children - and Brazilian (Cattuzzo et al., 2019), such as those in the present study.

Understanding the assessment of the STS task as a test that combines flexibility, locomotion, and balance (Duncan et al., 2017) and that many previous studies have observed superior performance in males compared to females in tests of strength (Bäckman & Henriksson, 1988), speed (Thomas & French, 1985) and coordination (Levy & Hobbes, 1979), it would be expected in the present investigation, boys to perform better on the STS task; this fact did not occur in any age group. In this sense, our results are compatible in not having found statistically significant differences in psychomotor performance between boys and girls during childhood and adolescence (Thomas & French, 1985). Another way of interpreting the results could be that the differences in mass gain and maturation of muscle functions during puberty between boys and girls might not be sufficient to provide these significant differences between the sexes in this task.

Considering that socio-economic factors particular to a region/country can impact the level of physical activity and MC (Fu & Burns, 2018) and that in economically developed places, this impact is likely to be lower than in places of greater social vulnerability, especially in large urban centres such as the city of São Paulo (Ré et al., 2018b), may explain the statistically significant difference between the times in the STS task of Spanish girls compared to Brazilian girls. Understanding the different contexts of the samples compared in this study and the need to develop valid assessments in samples from different countries (Robinson et al., 2015), the timed STS task could be a valid instrument to fulfil this need.

To our knowledge, this is the first research that studies the relationships between STS task performance and the anthropometric characteristics of children and adolescents aged three to 17 and how these anthropometric characteristics affect STS task time in increasing age groups. As limitations of this study, we can note that it did not include the measurement of skinfolds to observe the interaction of the time of the STS task with these body composition variables, anthropometric characteristics strongly associated with growth and development (Thomas & French, 1985). Also, we did not research the socio-economic context of the participants in this study. However, if any of these factors had induced advantages, it is worth thinking that a global effect on the assessed motor performance could be found. Some caution must be taken with our results since the design is cross-sectional, preventing any conclusion relative to lifespan change. Further studies could examine the relationship between biological age and physical activity practice with STS task performance.

CONCLUSIONS

In the investigated sample, we conclude that there were consistently associations between the STS task and the anthropometric variables from three to 17 years of age. Specifically, our results verified that age was the variable that obtained statistically significant associations with timed STS task in the children of the youngest age group in the sample, which corresponds to the preschool phase, as well as the BMI in children corresponding to the second childhood phase and, the WHR and the WHtR variables, in the oldest age group of the sample, corresponding to the adolescence phase.

The first interactions between timed STS task and anthropometric variables occur from 3 to 5 years of age. Thus, the present investigation extends previous findings (Nesbitt et al., 2017), where no association was found between BMI and STS task time, in both sexes, in early childhood children.

Regarding the decrease in time on the STS task as age groups are increasingly older, they confirm that time on the STS task is strongly associated with growth and maturation processes; there were little differences between sexes.

Finally, comparing the times of the STS task between nationalities and considering the specific socio-cultural and socio-economic factors, we observed similar times for males but statistically significant differences for females.

REFERENCES

Arfai, K., Pitukcheewanont, P. D., Goran, M. I., Tavare, C. J., Heller, L., & Gilsanz, V. (2002). Bone, muscle, and fat: sex-related differences in prepubertal children. *Radiology, 224*(2), 338-344. https://doi.org/10.1148/radiol.2242011369

Bäckman, E., & Henriksson, K. G. (1988). Skeletal muscle characteristics in children 9-15 years old: force, relaxation rate and contraction time. *Clinical Physiology, 8*(5), 521-527. https://doi.org/10.1111/j.1475-097x.1988.tb00217.x

Beenakker, E. A. C., Maurits, N. M., Fock, J. M., Brouwer, O. F., & van der Hoeven, J. H. (2005). Functional ability and muscle force in healthy children and ambulant Duchenne muscular dystrophy patients. *European Journal of Paediatric Neurology, 9*(6), 387-393. https://doi.org/10.1016/j.ejpn.2005.06.004

Cattuzzo, M. T., Henrique, R. D. S., Ré, A. H. N., Oliveira, I. S., Melo, B. M., Moura, M. S., de Araújo, R. C., & Stodden, D. F. (2016). Motor competence and health related physical fitness in youth: A systematic review. *Journal of Science and Medicine in Sport, 19*(2), 123-129. https://doi.org/10.1016/j.jsams.2014.12.004

Cattuzzo, M. T., Santana, F. S., Safons, M. P., Ré, A. H. N., Nesbitt, D. R., Santos, A. B. D., Feitoza, A. H. P., & Stodden, D. F. (2020). Assessment in the supine-to-stand task and functional health from youth to old age: a systematic review. *International Journal of Environmental Research and Public Health, 17*(16), 5794. https://doi.org/10.3390/ijerph17165794

Cattuzzo, M. T., Santos, C. F., Silva, J. P., Jr., Silva, L. G. B. C., & Cavalcante, W. A. (2019). A habilidade de alinhamento postural "levantar-se do solo". In T. Cattuzzo, A. H. P. Feitoza, R. S. Henrique, & C. J. F. Souza (Eds.), *Desenvolvimento Motor Infantil: Estudo em Escolares do Colégio da Polícia Militar de Pernambuco* (p. 47-54). Appris.

Cools, W., Martelaer, K. D., Samaey, C., & Andries, C. (2009). Movement skill assessment of typically developing preschool children: a review of seven movement skill assessment tools. *Journal of Sports Science & Medicine, 8*(2), 154-168.

D'Hondt, E., Deforche, B., De Bourdeaudhuij, I., & Lenoir, M. (2009). Relationship between motor skill and body mass index in 5- to 10-year-old children. *Adapted Physical Activity Quarterly, 26*(1), 21-37. https://doi.org/10.1123/apaq.26.1.21

Duncan, M. J., Lawson, C., Walker, L. J., Stodden, D., & Eyre, E. L. J. (2017). The utility of the supine-to-stand test as a measure of functional motor competence in children aged 5–9 years. *Sportscience, 5*(3), 67. https://doi.org/10.3390/sports5030067

Fu, Y., & Burns, R. D. (2018). Demographic characteristics related to motor skills in children aged 5-7 years old. *International Journal of Kinesiology and Sports Science, 6*(2), 15-21. https://doi.org/10.7575/aiac.ijkss.v.6n.2p.15

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2020). Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. *The Lancet. Child & Adolescent Health, 4*(1), 23-35. https://doi.org/10.1016/S2352-4642(19)30323-2

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis*. Englewood Cliff.

Hsue, B. J., Chen, Y. J., Wang, Y. E. (2014). The intra- and inter-rater reliability of component analysis of rise from supine in the children with typical development and developmental delay. *Research in Developmental Disabilities, 35*(1), 162-170. https://doi.org/10.1016/j.ridd.2013.10.011

Hsue, B. J., Wang, Y. E., Chen, Y. J. The movement patterns used to rise from a supine position by children with developmental delay and age-related differences in these. *Research in Developmental Disabilities, 35*(9), 2205-2214. https://doi.org/10.1016/j.ridd.2014.05.008

Levy, F., & Hobbes, G. (1979). The influences of social class and sex on sustained attention (vigilance) and motor inhibition in children. *The Australian and New Zealand Journal of Psychiatry, 13*(3), 231-234. https://doi.org/10.3109/00048677909159141

Lloyd, M., Saunders, T. J., Bremer, E., & Tremblay, M. S. (2014). Long-term importance of fundamental motor skills: a 20-year follow-up study. *Adapted Physical Activity Quarterly, 31*(1), 67-78. https://doi.org/10.1123/apaq:2013-0048

Lopes, V. P., Maia, J. A. R., Rodrigues, L. P., & Malina, R. (2012). Motor coordination, physical activity, and fitness as predictors of longitudinal change in adiposity during childhood. *European Journal of Sport Science, 12*(4), 384-391. https://doi.org/10.1080/17461391.2011.566368

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: review of associated health benefits. *Sports Medicine, 40*(12), 1019-1035. https://doi.org/10.2165/11536850-000000000-00000

Marsala, G., & VanSant, A. F. (1998). Age-related differences in movement patterns used by toddlers to rise from a supine position to erect stance. *Physical Therapy, 78*(2), 149-159. https://doi.org/10.1093/ptj/78.2.149

Mewasingh, L. D., Demil, A., Christiaens, F. J. C., Missa, A. M., Cheron, G., & Dan, B. (2002). Motor strategies in standing up in leukomalacic spastic diplegia. *Brain and Development, 24*(5), 291-295. https://doi.org/10.1016/S0387-7604(02)00059-1

Mewasingh, L. D., Sékhara, T., Pelc, K., Missa, A. M., Cheron, G., & Dan, B. (2004). Motor strategies in standing up in children with hemiplegia. *Pediatric Neurology, 30*(4), 257-261. https://doi.org/10.1016/j.pediatrneurol.2003.09.014

Nesbitt, D., Molina, S. L., Cattuzzo, M. T., Robinson, L. E., Phillips, D., & Stodden, D. (2017). Assessment of a supine-to-stand (STS) task in early childhood: A measure of functional motor competence. *Journal of Motor Learning and Development, 5*(2), 252-266. https://doi.org/10.1123/jmld.2016-0049

Nesbitt, D., Molina, S. L., Sacko, R., Robinson, L. E., Brian, A., & Stodden, D. (2018). Examining the feasibility of supine-to-stand as a measure of functional motor competence. *Journal of Motor Learning and Development, 6*(2), 267-286. https://doi.org/10.1123/jmld.2017-0016

Ng, J., Conaway, M. R., Rigby, A. S., Priestman, A., & Baxter, P. S. (2013). Methods of standing from supine and percentiles for time to stand and to run 10 meters in young children. *Journal of Pediatrics, 162*(3), 552-556. https://doi.org/10.1016/j.jpeds.2012.08.030

Norton, K. I. (2018). Standards for anthropometry assessment. In K. I. Norton & R. Eston (Eds.), *Kinanthropometry and exercise physiology* (p. 68-137). Routledge. https://doi.org/10.4324/9781315385662-4

Ré, A. H. N. (2011). Crescimento, maturação e desenvolvimento na infância e adolescência: Implicações para o esporte. *Motricidade, 7*(3), 55-67. https://doi.org/10.6063/motricidade.7(3).103

Ré, A. H. N., Logan, S. W., Cattuzzo, M. T., Henrique, R. S., Tudela, M. C., & Stodden, D. F. (2018a). Comparison of motor competence levels on two assessments across childhood. *Journal of Sports Sciences, 36*(1), 1-6. https://doi.org/10.1080/02640414.2016.1276294

Ré, A. H. N., Okely, A. D., Logan, S. W., Silva, M. M. L. M., Cattuzzo, M. T., & Stodden, D. F. (2020). Relationship between meeting physical activity guidelines and motor competence among low-income school youth. *Journal of Science and Medicine in Sport, 23*(6), 591-595. https://doi.org/10.1016/j.jsams.2019.12.014

Ré, A. H. N., Tudela, M. C., Monteiro, C. B. de M., Antonio, B. de A., Silva, M. M. do L. M., Campos, C. M. C., Santos, G. dos, & Cattuzzo, M. T. (2018b). Competência motora em crianças do ensino público da cidade de São Paulo. *Journal of Physical Education, 29*(1), e2955. https://doi.org/10.4025/jphyseduc.v29i1.2955

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine, 45*(9), 1273-1284. https://doi.org/10.1007/s40279-015-0351-6

Rogol, A. D., Roemmich, J. N., & Clark, P. A. (2002). Growth at puberty. *Journal of Adolescent Health, 31*(6 Suppl.), 192-200. https://doi.org/10.1016/s1054-139x(02)00485-8

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. *Quest, 60*(2), 290-306. https://doi.org/10.1080/00336297.2008.10483582

Tadiotto, M. C., Duncan, M., Mota, J., Moraes-Junior, F. B., Corazza, P. R. P., Czoczuk, M., Menezjes-Junior, F. J. de, Tozo, T. A. A., Coelho-e-Silva, M. J., Rodacki, A. L. F., & Leite, N. (2021). Excess adiposity and low physical fitness hamper Supine-to-Stand test performance among sedentary adolescents. *Jornal de Pediatria, 97*(6), 658-664. https://doi.org/10.1016/j.jped.2021.01.007

Thomas, J. R., & French, K. E. (1985). Gender differences across age in motor performance a meta-analysis. *Psychological Bulletin, 98*(2), 260-282.

Utesch, T., & Bardid, F. (2019). Motor competence. In D. Hackfort, R. Schinke, & B. Strauss (Eds.), *Dictionary of sport psychology: Sport, exercise, and performing arts* (p. 186). https://pureportal.strath.ac.uk/en/publications/motor-competence

Utesch, T., Bardid, F., Büsch, D., & Strauss, B. (2019). The relationship between motor competence and physical fitness from early childhood to early adulthood: a meta-analysis. *Sports Medicine, 49*(4), 541-551. https://doi.org/10.1007/s40279-019-01068-y

Vincent, W. J. (2005). *Statistics in Kinesiology (3rd ed)*. Human Kinetics.

Volpato, S., Cavalieri, M., Sioulis, F., Guerra, G., Maraldi, C., Zuliani, G., Fellin, R., & Guralnik, J. M. (2011). Predictive value of the Short Physical Performance Battery following hospitalization in older patients. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences, 66A*(1), 89-96. https://doi.org/10.1093/gerona/glq167

World Health Organization (WHO) (2022). *Physical activity*. World Health Organization. https://www.who.int/health-topics/physical-activity