DOI: 10.1590/1809-2950/20016529022022EN

ORIGINAL RESEARCH

Do simple and quick functional tests reflect a more comprehensive test or physical activity in daily life in healthy young subjects?

Testes funcionais simples e rápidos refletem um teste mais abrangente ou atividade física na vida diária em jovens saudáveis?

¿Los tests funcionales simples y rápidos reflejan un test más completo o actividad física en la vida diaria en jóvenes sanos?

Joice Mara de Oliveira[1, 2], Jéssica Amanda de Oliveira Quirino[3], Natielly Soares Correia[2, 4], André Vinícius Santana[2, 5], Diery Fernandes Rugila[2, 6], Karina Couto Furlanetto[2, 7]

ABSTRACT | Considering the wide use of functional tests and that faster and simpler evaluations are preferable, this study aimed to verify the association between five protocols of simple functional tests (timed up and go [TUG], four-meter gait speed [4MGS] and sit-to-stand [STS] in five-repetitions [STS5rep], 30-seconds [STS30sec] and one-minute [STS1min] protocols) and the six-minute walk test (6MWT), as well as physical activity in daily life (PADL) in healthy young subjects. In this cross-sectional study, PADL was quantified by a pedometer validated for step counting and we considered the mean of seven consecutive days during the time awake. We assessed functional capacity by the TUG, 4MGS, STS5rep, STS30sec, and STS1min tests and the 6MWT. A total of 79 subjects without lung functional impairments were included (49% male, aged 28 [23–36] years). Performance of simple functional tests correlated with the 6MWT ($0.23<r<0.56$; $P<0.05$ for all) and the TUG test showed the best association ($R^2= 0.34$). However, simple functional tests did not correlate with PADL ($0.03< r <0.13$; $P>0.05$ for all). The less time-consuming functional tests were weakly-moderately related to the 6MWT in healthy young subjects. The TUG showed the best association and explained up to 34% of the 6MWT. However, the 6MWT cannot be replaced by none of these simple functional tests. Finally, functional capacity showed no association with physical activity in daily life assessed by the pedometers in this population.

Keywords | Motor Activity; Exercise; Sedentary Behavior.

RESUMO | Considerando o amplo uso de testes funcionais e que avaliações mais rápidas e simples são preferíveis, o objetivo deste estudo foi verificar a associação entre cinco protocolos de testes funcionais, a saber, *timed up and go* [TUG], 4-*meter gait speed* [4MGS] and *sit to stand* [STS] in 5-*repetitions* [STS5rep], 30-*seconds* [STS30sec] and 1-*minute* [STS1min] *protocols* e o teste de caminhada de 6 minutos (TC6min), bem como com a atividade física na vida diária (AFVD) em jovens saudáveis. Neste estudo transversal, a AFVD foi quantificada por um pedômetro validado para contagem de passos, e a média de sete dias consecutivos durante o tempo acordado foi considerada. A capacidade funcional foi avaliada pelo TUG, 4MGS, STS5rep, STS30sec, STS1min e TC6min. 79 pessoas sem comprometimento pulmonar foram incluídas (49% homens, idade média de 28 anos). O desempenho nos testes

[1]Universidade Norte do Paraná (UNOPAR), Londrina (PR), Brazil. joice.mara.oli@gmail.com. ORCID-0000-0003-3387-2940
[2]Universidade Estadual de Londrina (UEL), Londrina (PR), Brazil
[3]Universidade Norte do Paraná (UNOPAR), Londrina (PR), Brazil. jessicaamanda2001@hotmail.com. ORCID-0000-0002-0086-973X
[4]Universidade Norte do Paraná (UNOPAR), Londrina (PR), Brazil. natiellysoarescorreia@gmail.com. ORCID-0000-0002-4757-6651
[5]Universidade Norte do Paraná (UNOPAR), Londrina (PR), Brazil. itsvini.s@outlook.com. ORCID-0000-0002-4308-8415
[6]Universidade Norte do Paraná (UNOPAR), Londrina (PR), Brazil. dieryrugila@gmail.com. ORCID-0000-0002-0397-114X
[7]Universidade Norte do Paraná (UNOPAR), Londrina (PR), Brazil. ka_furlanetto@hotmail.com. ORCID-0000-0002-7496-7228

Corresponding address: Karina Couto Furlanetto – Rua Marselha, 591, Jardim Piza – Londrina (PR), Brazil – Zip code: 86041-140 – E-mail: ka_furlanetto@hotmail.com – Financing source: Coordination for the Improvement of Higher Education Personnel and the Graduation Support Program for Private Education Institutions CAPES/PROSUP, Brazil; National Council for Scientific and Technological Development (CNPq); National Foundation for the Development of Private Higher Education (FUNADESP), no. 5301164 – Conflict of interests: nothing to declare – Presentation: July. 9th, 2020 – Accepted for publication: May. 25th, 2022 – Approved by the Research Ethics Committee: Protocol No. 2,009,139.

funcionais correlacionou-se com o TC6min (0,23< r <0,56; p<0,05 para todos) e o TUG apresentou a melhor associação (R^2=0,34). Entretanto, os testes funcionais simples não se correlacionaram com a AFVD (0,03<r<0,13; p>0,05 para todos). Os testes funcionais de curta duração foram fracos, moderadamente relacionados ao TC6min em jovens saudáveis. O TUG apresentou a melhor associação e explicou até 34% do TC6min; no entanto, este não pode ser substituído por nenhum dos testes funcionais simples. Por fim, a capacidade funcional não se relacionou com a atividade física na vida diária avaliada pelos pedômetros nessa população.
Descritores | Atividade Motora; Exercício; Comportamento Sedentário.

RESUMEN | Teniendo en cuenta el amplio uso de los tests funcionales y que son preferibles evaluaciones más rápidas y sencillas, el objetivo de este estudio fue verificar la asociación entre cinco protocolos de tests funcionales, a saber, *timed up and go* [TUG], 4-*meter gait speed* [4MGS] and *sit to stand* [STS] in 5-*repetitions* [STS5rep], 30-*seconds* [STS30sec] and 1-*minute* [STS1min] *protocols* y la prueba de caminata de 6 minutos (6MWT), con la actividad física de la vida diaria (AFVD) en jóvenes sanos. En este estudio transversal, la AFVD se cuantificó mediante un podómetro validado para el conteo de pasos, y se consideró el promedio de siete días consecutivos durante el tiempo acordado. La capacidad funcional se evaluó mediante TUG, 4MGS, STS5rep, STS30sec, STS1min y 6MWT. Se incluyeron a 79 personas sin afectación pulmonar (49% hombres, edad media 28 años). El desempeño en los tests funcionales se correlacionó con la 6MWT (0,23< r <0,56; p<0,05 para todos), y el TUG tuvo la mejor asociación (R^2=0,34). Sin embargo, los tests funcionales simples no se correlacionaron con la AFVD (0,03<r<0,13; p>0,05 para todos). Los tests funcionales a corto plazo fueron insuficientes, moderadamente relacionados con la 6MWT en jóvenes sanos. El TUG mostró la mejor asociación y explicó hasta el 34% de la 6MWT, pero este no puede reemplazarse por ninguno de los tests funcionales simples. Por último, la capacidad funcional no se relacionó con la actividad física en la vida diaria evaluada por podómetros en esta población.
Palabras clave | Actividad Motora; Ejercicio; Comportamiento Sedentario.

INTRODUCTION

Functional capacity is commonly assessed by field tests, which better reflect daily life than laboratory tests[1,2]. The six-minute walk test (6MWT) is the most known and used functional test worldwide[1]. However, a 30-meter ground level corridor must be available and it requires at least eight minutes[1]. Although the 6MWT offer many advantages, clinical applicability can be compromised because clinicians and researchers usually have difficulties to find the required place.

As an alternative, functional tests such as timed up and go (TUG), four-meter gait speed (4MGS) and sit-to-stand (STS) have been used to assess functional capacity, probably due to their similarity with daily tasks and use of simple and cheap equipment. Moreover, they are less time-consuming tests, easily performed in small spaces. Despite simplicity, these tests show prognostic value and have been used to predict frailty in older adults and hospitalization and mortality in people with respiratory disease[2-4].

On the other hand, direct observation, energy expenditure assessment, and motion sensors[6] can quantify physical activity in daily life (PADL), which is the total voluntary movement produced by skeletal muscles during daily life[5]. Motion sensors are used to detect movement of the body over a period and include pedometers (which quantify number of steps) and accelerometers (which detect acceleration and body movements)[6].

Some authors have already studied the association between functional capacity and PADL; however, most studies focused on older subjects and in people with disease conditions[7–10]. Besides, since faster and simpler evaluations are preferable, we hypothesized that less time-consuming functional tests may reflect the most used field test (i.e., 6MWT) to assess functional capacity in this population. If functional tests are strongly associated with 6MWT and PADL, researchers and clinicians might use simple and quick tests to assess functional capacity and still understand the PADL level of healthy young subjects. Therefore, our study aimed to verify the association between five protocols of simple functional tests (TUG, 4MGS and STS in the protocols of five repetitions [STS5rep], 30 seconds [STS30sec] and one minute [STS1min]) and the 6MWT, as well as with the number of steps/day (i.e., PADL) in healthy young subjects.

METHODOLOGY

Design and sample

A cross-sectional study composed of a convenience sample was conducted. Participants aged 20–40 years,

must be able to perform the proposed evaluations, no severe and/or unstable disease that could limit exercise capacity, and show normal lung function, therefore, they were considered "healthy." The exclusion criteria were body mass index (BMI) <18 kg/m² or >40 kg/m² and who wished to leave the study for any reason.

The study was conducted at the Research Center of the Pitágoras Unopar, Londrina, Brazil. The participants were assessed in two visits after signing the informed consent form.

Outcomes

Weight and height were measured by a balance and a stadiometer for anthropometric evaluation (Ítaca Com. Equip. LTDA, model MIC2/BA of São Paulo, Brazil). BMI was calculated by weight/height². Lung function was assessed using a calibrated spirometer (Datospir Micro-Sibelmed), which determined forced expiratory volume in the first second (FEV_1), forced vital capacity (FVC) and FEV_1/FVC index[11]. Reference values for the Brazilian population were considered[12].

The 6MWT was assessed in a 30-meter ground level corridor. Participants were instructed to walk the longest distance in six minutes. Two tests were performed with a minimum interval of 30 minutes between them and the best distance of the two measurements was used as the primary outcome[1]. Reference values for the Brazilian population were considered[13].

Simple functional tests were performed twice in a randomized order and the best performance was considered in the analysis of each test[14]. A recovery time between the tests was considered to reduce the perceived exertion grade (Borg scale) and/or heart rate to baseline values, considering a variation <10%. In the TUG test, the subjects were instructed to get up from a chair, to walk as fast as possible on a three-meter line marked on the floor, turn around in the cone, walk back to the chair and sit down[14].

The 4MGS was assessed with two cones positioned four meters apart and the subjects were instructed to "walk at the usual pace" from one cone to another[15]. The time used to walk the four meters was recorded by a stopwatch.

Three STS protocols were performed and all the subjects were instructed to start seated on a chair (a 46cm-high seat), with the feet flat on the floor and their arms crossed over their chest. From the command "go," the subjects were encouraged to fully stand up and sit down as fast as possible without using the arms. The subjects were instructed to perform five repetitions[16] (STS5rep) in one protocol and a stopwatch was used to register the total time until the fifth stand; the second protocol consisted of performing the maximum number of repetitions in 30 seconds (STS30sec) and the third was performed in one minute (STS1min). The number of repetitions was considered as the primary outcome for the two last protocols[17].

The pedometer Yamax SW-701 DigiWalker was used to assess PADL[18]. Subjects wore the pedometer on the right side of the waist, attached to the waistband of the pants. The wearing time and the total number of steps at the end of each day was recorded in a diary. The mean of seven consecutive days during the time awake was considered a valid measurement and the number of steps/day was used as primary outcome to quantify the level of PADL[19].

Statistical analysis

Data distribution was analyzed by the Shapiro-Wilk test. The results were described as mean ± standard deviation or median [interquartile range 25–75%], according to data distribution. The Pearson's or Spearman's correlation coefficients were used to verify correlations between the variables. Correlations were interpreted according to the cutoff points: <0.40= weak; 0.40–0.70= moderate; >0.70= strong[20]. Linear regression analyses were performed to verify the association between the variables that were statistically correlated. Statistical significance was determined at $p<0.05$. The IBM SPSS® Statistics 22.0 and GraphPad Prism® 6.0 were used for the analyses.

RESULTS

Of the 79 subjects included in the study, 12 did not wear the pedometer properly or did not deliver the completed physical activity diary on the second appointment, therefore, only 67 subjects completed the assessment of PADL. All 79 subjects performed the other proposed evaluations. Table 1 describes the subjects' characteristics. The number of steps/day was 6,379 [4,954–9,131] and the distance covered in the 6MWT was 620±88 meters, which corresponds to 98±13% predicted. Most subjects (58%) were

classified as sedentary (<5,000 steps/day) or poor active (5,000–7,500 steps/day)[21], despite presenting preserved exercise capacity (i.e., 6MWT of 98±13%).

We observed the following results in the functional tests: TUG=5.85[5.19–6.47] seconds; 4MGS=3.84[3.37–4.11] seconds; STS5rep=8.57±2.08 seconds; STS30sec=18[16–21] repetitions; STS1min=35[30–42] repetitions.

Most of the simple functional tests were significantly correlated and associated with the walked distance in the 6MWT (Figure 1). However, the functional tests did not correlate with PADL (0.03<r<0.13; p>0.05 for all; Figure 2).

Table 1. Characteristics of the sample

	n = 79
Gender (M / W [%])	39/40 [49/51]
Age (years)	28 [23-36]
Weight (kg)	71 [62/82]
Height (cm)	169±10
BMI (kg/m^2)	24±5
FEV_1 (% predicted)	95±13
FVC (% predicted)	93±12
FEV_1 / FVC	84±7
PEF (% predicted)	84±17

Source: Elaborated by the authors.
Legend: Gender is described as absolute and relative frequency; numerical variables are described as mean ± standard deviation or median [interquartile range 25–75%], according to data distribution. M: men; W: women; BMI: Body Mass Index; FEV_1: Forced Expiratory Volume in the first second; FVC: Forced Vital Capacity; PEF: Peak Expiratory Flow.

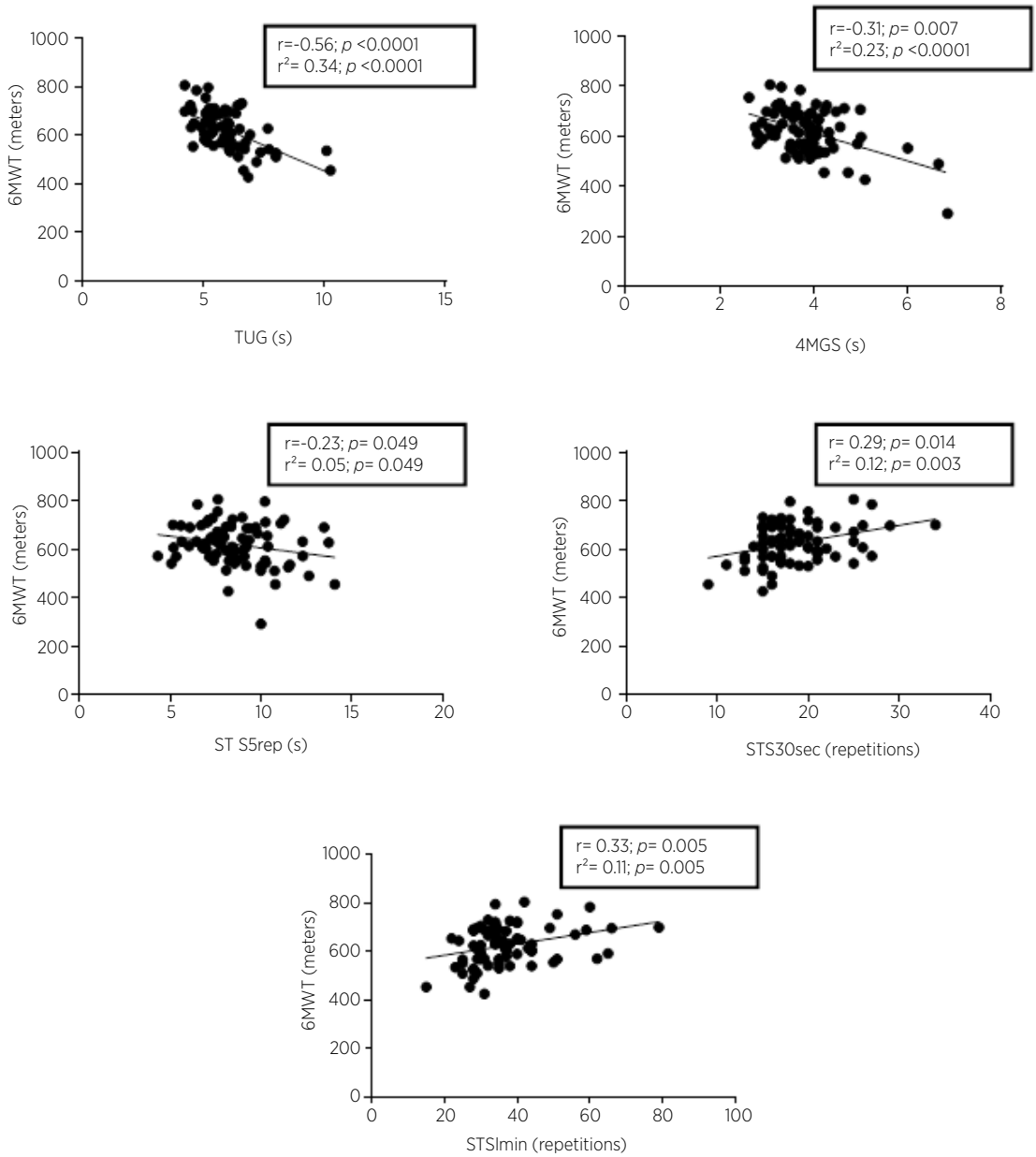

Figure 1.

Source: Elaborated by the authors.
Legend: Correlations and linear regressions between the six-minute walk test (6MWT) and the functional tests: (A) timed up and go (TUG), (B) four-meter gait speed (4MGS), (C) five-repetition sit-to-stand (STS5rep), (D) 30-second sit-to-stand (STS30sec) and (E) one-minute sit-to-stand (STS1min).

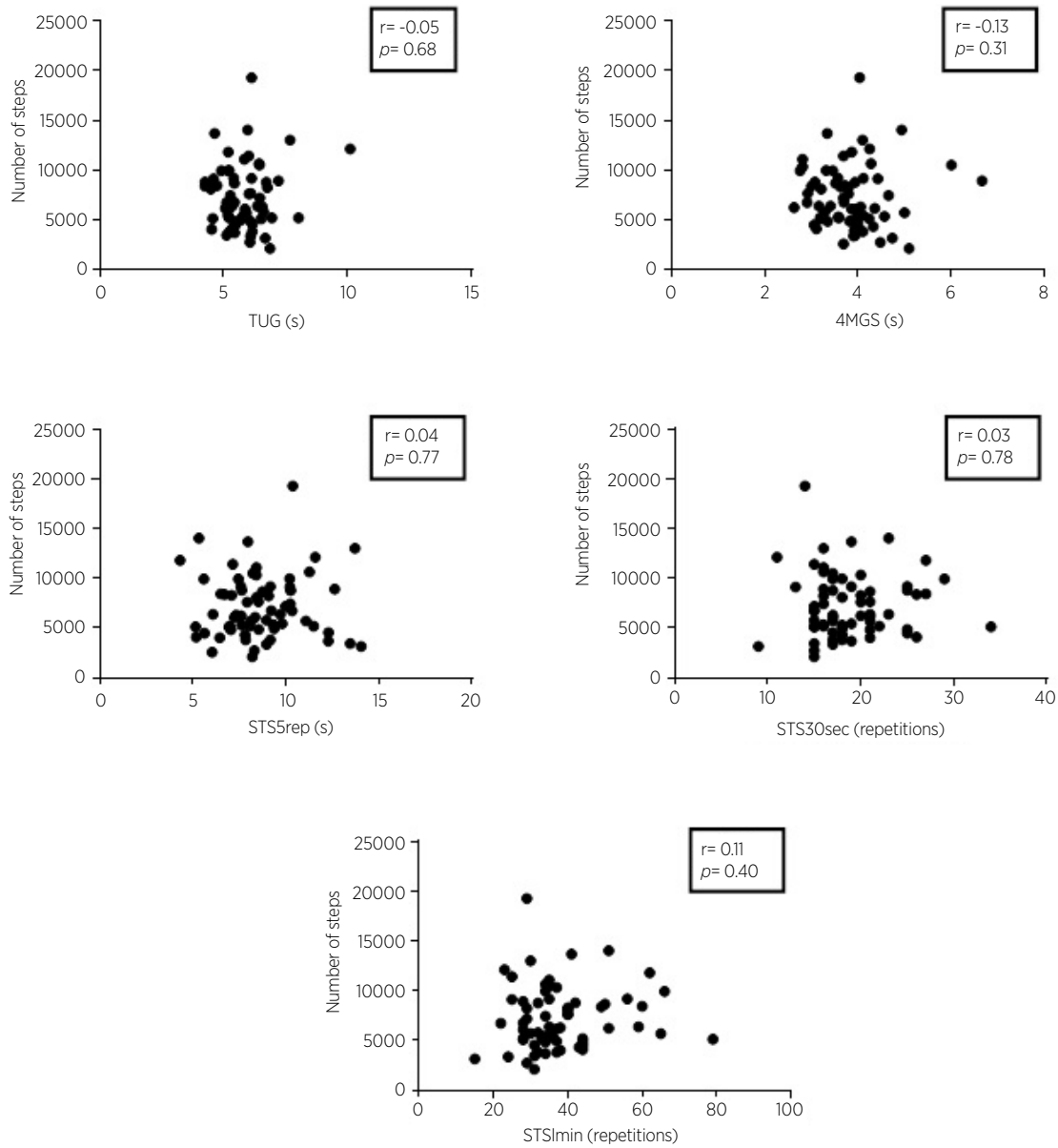

Figure 2.

Source: Elaborated by the authors.
Legend: Correlations between physical activity in daily life (number of steps/day) and functional tests: (A) timed-up-and-go (TUG), (B) four-meter gait speed, (C) five-repetition sit-to-stand (STS5rep), (D) 30-second sit-to-stand (STS30sec) and (E) one-minute sit-to-stand (STS1min).

The statistical power (1-β) of the analysis was estimated using the G-Power 3.1 software. Considering the best correlation (r=0.56) and an α error of 0.05, we estimated the power with the sample size n=79 and n=67, since we have missing data for some analyses. Both analyses had statistical power of 0.99.

DISCUSSION

Our study identified that less time-consuming functional tests (TUG, 4MGS, and STS) were weakly-moderately related with the 6MWT in healthy young subjects. The simple functional tests reflected up to 34% of the 6MWT and the TUG showed the best association. However, none of the simple functional tests correlated with the PADL assessed by the pedometers in this population. Moreover, despite showing preserved functional capacity (i.e., 6MWT %pred=98±13), most subjects were sedentary or poor active, since the median of steps/day was 6,379[4,954–9,131].

To the best of our knowledge, this is the first study to assess these associations in healthy young subjects. A study with healthy older subjects (72±7 years old) showed a strong correlation between 4MGS and 6MWT (r=0.80)[22]. Karpman C et al. also found a strong correlation between usual and maximal 4MGS with the 6MWT

(r=0.77 and 0.80, respectively) in patients with chronic obstructive pulmonary disease (COPD)[23]. The 6MWT was also correlated with the STS30sec in a study including people with head and neck cancer (r=0.41)[24] and with the STS1min in a study in patients with COPD (r=0.40)[25]. The correlations between 6MWT and 4MGS were stronger than those with STS, possibly because of the test characteristics, since 6MWT and 4MGS are performed walking, while STS is performed by sitting and raising.

The TUG test showed the best correlation with the 6MWT in the population of our study (r=–0.56). This result is in accordance with the study by Pedrosa and Holand[26], with a sample of hypertensive older subjects, which showed a moderate correlation between 6MWT and TUG (r=–0.59). Cho et al.[27] also found a strong correlation between the 6MWT and the TUG test (r=–0.75) in older subjects, with a slight impairment in balance. Both TUG and 6MWT were performed walking as fast as possible with the instruction to turn around in the cone, which might explain the significant association found in our study.

Simple functional tests showed significant correlations with 6MWT despite being less-time consuming. These results differed from the mentioned studies[22,23,27]. Previous studies have included older subjects and/or people with chronic diseases, while we evaluated healthy younger adults. The latter shows better functional and exercise capacity, and perhaps quick tests such as TUG, 4MGS and STS show ceiling effect. Therefore, we suggested that 6MWT cannot be replaced by any of the simple tests in this study.

Regarding PADL, our study did not show a significant correlation between functional tests and steps/day. Possibly because although it is expected that young adults have a satisfactory functional capacity, physical activity and sedentary behavior patterns have changed over the decades. Technological advances and its facilitations have contributed to increase sedentary behavior worldwide[28]. Moreover, simple functional tests performance, as obtained with STS, TUG and 4MGS, are weekly related to anthropometric characteristics in healthy subjects[29]. Therefore, the multifactorial characteristic observed in simple functional tests might contribute to understand the recent results.

Previous studies have focused on subjects with different characteristics, such as the study by Alves MAS et al.[9], which found an association (r^2=0.26) between the 6MWT and the number of steps/day assessed by an accelerometer, in healthy adults aged 64±7 years. Moreover, a significant correlation between the number of steps/day measured by the accelerometer SenseWear Pro and the number of repetitions during the STS1min (r=0.51) and also with the 6MWT (r=0.69) has been reported in patients with COPD[30]. Besides, correlations between PADL and STS30sec (r=0.37), as well as with the STS1min (r=0.47), have been reported in the same population with COPD[25]. These results differ from our study due to different sample age, subjects' conditions and devices used to measure steps/day.

This study has limitations, such as the small sample size. On the other hand, statistical power was considered satisfactory. Besides, although technologically advanced PADL monitors are currently available, we used pedometers to assess PADL. However, step count devices are more accessible and recognized as a valid measurement[18]. Finally, the cross-sectional design does not allow to conclude about causality between simple functional tests and 6MWT or PADL.

CONCLUSION

Simple and less time-consuming functional tests may be weakly related to the 6MWT in healthy young subjects. The TUG test explained up to 34% of the 6MWT while the 4MGS and STS protocols showed poorer associations. Besides, the level of PADL was not correlated with the functional tests in healthy young subjects, which suggests that the preserved physical performance is not a determinant factor of sedentary or active lifestyle in this population.

REFERENCES

1. 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.
2. Bui K-L, Nyberg A, Maltais F, Saey D. Functional tests in chronic obstructive pulmonary disease, part 1: clinical relevance and links to the International Classification of Functioning, Disability, and Health. Ann Am Thorac Soc. 2017;14(5):778-84. doi: 10.1513/annalsats.201609-733as.
3. Vermeulen J, Neyens JCL, van Rossum E, Spreeuwenberg MD, de Witte LP. Predicting ADL disability in community-dwelling elderly people using physical frailty indicators: a systematic review. BMC Geriatr. 2011;11(33):1-11. doi: 10.1186/1471-2318-11-33.
4. Nolan CM, Maddocks M, Maher TM, Banya W, Patel S, Barker RE, et al. Gait speed and prognosis in patients with idiopathic

pulmonary fibrosis: a prospective cohort study. Eur Respir J. 2019;53(2):1-10. doi: 10.1183/13993003.01186-2018.

5. Steele BG, Belza B, Cain K, Warms C, Coppersmith J, Howard J. Bodies in motion: monitoring daily activity and exercise with motion sensors in people with chronic pulmonary disease. J Rehabil Res Dev. 2003;40(5 suppl 2):45-58. doi: 10.1682/jrrd.2003.10.0045.
6. Ainsworth B, Cahalin L, Buman M, Ross R. The current state of physical activity assessment tools. Prog Cardiovasc Dis. 2015;57(4):387-95. doi: 10.1016/j.pcad.2014.10.005
7. Santos DA, Silva AM, Baptista F, Santos R, Vale S, Mota J, et al. Sedentary behavior and physical activity are independently related to functional fitness in older adults. Exp Gerontol. 2012;47(12):908-12. doi: 10.1016/j.exger.2012.07.011.
8. Wu F, Wills K, Laslett LL, Oldenburg B, Jones G, Winzenberg T. Moderate-to-vigorous physical activity but not sedentary time is associated with musculoskeletal health outcomes in a cohort of australian middle-aged women. J Bone Miner Res. 2017;32(4):708-15. doi: 10.1002/jbmr.3028.
9. Alves MAS, Bueno FR, Haraguchi LIH, Corrêa FR, Dourado VZ. Correlação entre a média do número de passos diário e o teste de caminhada de seis minutos em adultos e idosos assintomáticos. Fisioter e Pesqui. 2013;20(2):123-9. doi: 10.1590/s1809-29502013000200005.
10. Pitta F, Troosters T, Spruit MA, Probst VS, Decramer M, Gosselink R. Characteristics of physical activities in daily life in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2005;171(9):972-7. doi: 10.1164/rccm.200407-855OC.
11. Miller MR. General considerations for lung function testing. Eur Respir J. 2005;26(1):153-61. doi: 10.1183/09031936.05.00034505.
12. Pereira CAC, Sato T, Rodrigues SC. New reference values for forced spirometry in white adults in Brazil. J Bras Pneumol. 2007;33(4):397-406. doi: 10.1590/s1806-37132007000400008
13. Britto RR, Probst VS, Andrade AFD, Samora GAR, Hernandes NA, Marinho PEM, et al. Reference equations for the six-minute walk distance based on a Brazilian multicenter study. Brazilian J Phys Ther. 2013;17(6):556-63. doi: 10.1590/S1413-35552012005000122.
14. Podsiadlo D, Richardson S. The timed "Up & Go": A test of basic functional mobility for frail elderly persons. J Am Geriatr Soc. 1991;39(2):142-8. doi: 10.1111/j.1532-5415.1991.tb01616.x.
15. Kon SSC, Patel MS, Canavan JL, Clark AL, Jones SE, Nolan CM, et al. Reliability and validity of 4-metre gait speed in COPD. Eur Respir J. 2013;42:333-40. doi: 10.1183/09031936.00162712.
16. Jones SE, Kon SSC, Canavan JL, Patel MS, Clark AL, Nolan CM, et al. The five-repetition sit-to-stand test as a functional outcome measure in COPD. Thorax. 2013;68(11):1015-20. doi: 10.1136/thoraxjnl-2013-203576.
17. Ozalevli S, Ozden A, Itil O, Akkoclu A. Comparison of the sit-to-stand test with 6 min walk test in patients with chronic obstructive pulmonary disease. Respir Med. 2007;101(2):286-93. doi: 10.1016/j.rmed.2006.05.007.
18. Crouter SE, Schneider PL, Karabulut M, Bassett Jr DR. Validity of 10 electronic pedometers for measuring steps, distance, and energy cost. Med Sci Sports Exerc. 2003;35(8):1455-60. doi: 10.1249/01.MSS.0000078932.61440.A2.
19. Tudor-Locke C, Burkett L, Reis JP, Ainsworth BE, Macera CA, Wilson DK. How many days of pedometer monitoring predict weekly physical activity in adults? Prev Med. 2005;40(3):293-8. doi: 10.1016/j.ypmed.2004.06.003.
20. Schober P, Schwarte LA. Correlation coefficients: appropriate use and interpretation. Anesth Analg. 2018;126(5):1763-8. doi: 10.1213/ANE.0000000000002864.
21. Tudor-Locke C, Craig CL, Brown WJ, Clemes SA, de Cocker K, Giles-Corti B, et al. How many steps/day are enough? For adults. Int J Behav Nutr Phys Act. 2011;8(79):1-17. doi: 10.1186/1479-5868-8-79.
22. Kamiya K, Hamazaki N, Matsue Y, Mezzani A, Corrà U, Matsuzawa R, et al. Gait speed has comparable prognostic capability to six-minute walk distance in older patients with cardiovascular disease. Eur J Prev Cardiol. 2018;25(2):212-9. doi: 10.1177/2047487317735715.
23. Karpman C, DePew ZS, LeBrasseur NK, Novotny PJ, Benzo RP. Determinants of gait speed in COPD. Chest. 2014;146(1):104–10. doi: 10.1378/chest.13-2017.
24. Eden MM, Tompkins J, Verheijde JL. Reliability and a correlational analysis of the 6MWT, ten-meter walk test, thirty second sit to stand, and the linear analog scale of function in patients with head and neck cancer. Physiother Theory Pract. 2018;34(3):202–11. doi: 10.1080/09593985.2017.1390803.
25. Morita AA, Bisca GW, Machado FVC, Hernandes NA, Pitta F, Probst VS. Best protocol for the sit-to-stand test in subjects with COPD. Respir Care. 2018;67(6):1040–9. doi: 10.4187/respcare.05100.
26. Pedrosa R, Holanda G. Correlação entre os testes da caminhada, marcha estacionária e TUG em hipertensas idosas. Brazilian J Phys Ther. 2009;13(3):252–6. doi: 10.1590/S1413-35552009005000030.
27. Cho B, Scarpace D, Alexander NB. Tests of stepping as indicators of mobility, balance, and fall risk in balance-impaired older adults. J Am Geriatr Soc. 2004;52(7):1168–73. doi: 10.1111/j.1532-5415.2004.52317.x.
28. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1-9 million participants. Lancet Glob Health. 2018;6:e1077–86. doi: 10.1016/S2214-109X(18)30357-7.
29. Furlanetto KC, Correia NS, Mesquita R, Morita AA, Amaral DP, Mont'Alverne DGB, et al. Reference values for 7 different protocols of simple functional tests: a multicenter study. Arch Phys Med Rehabil. 2022;103(1):20-28. doi: 10.1016/j.apmr.2021.08.009.
30. van Gestel AJR, Clarenbach CF, Stöwhas AC, Rossi VA, Sievi NA, Camen G, et al. Predicting daily physical activity in patients with chronic obstructive pulmonary disease. PLoS One. 2012;7(11):e48081. doi: 10.1371/journal.pone.0048081.