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Correlation Between the 1-Minute Sit-to-Stand Test and 6-Minute Walk Test in Healthy Young Adults

Authors: **Khushi Dasi, Ancy Vincent, Dr. Medha Deo** (Principal, Terna Physiotherapy College)

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Abstract

Background: The 6-min walk test (6 MWT) is widely used to assess submaximal aerobic capacity; however, it requires a long corridor and considerable time to administer. The 1-min sit-to-stand test (1 MSTS) has been proposed as a quick and space-efficient alternative for evaluating functional exercise capacity. This study aimed to examine the performance of healthy young adults on the 1 MSTS test and determine its correlation with the 6 MWT distance.

Methods: Ninety healthy volunteers aged 18–25 years participated in this cross-sectional study. Participants underwent one 6-MWT and one 1-MSTS test on a standard chair with arms crossed, in accordance with the American Thoracic Society guidelines. Dyspnea and leg fatigue were rated using the Borg CR-10 scale before and after each test. The association between 1 MSTS test repetitions and 6 MWT distance was assessed using Spearman's correlation. Gender differences and the relationship between age and test outcomes were also analyzed.

Results: The participants completed an average of 49 ± 8 sit-to-stand repetitions and walked 618 ± 85 m during the 6 MWT. A moderate positive correlation was observed between 1 MSTS test repetitions and 6 MWT distance ($\rho \approx 0.65$, $p < 0.001$). Men performed slightly better than women in both tests, whereas age within the 18–25-year range showed no significant association with performance.

Conclusion: The 1-minute sit-to-stand test showed a moderate association with the 6-minute walk test in healthy young adults and may serve as a practical alternative for assessing functional exercise capacity when the 6 min walk test is not feasible.

Introduction

Functional exercise capacity reflects an individual's ability to perform activities of daily living that require sustained aerobic metabolism and coordinated functioning of the cardiovascular, respiratory, and skeletal muscle systems (1). Maximal oxygen uptake (VO_2max) obtained from cardiopulmonary exercise testing is considered the gold-standard measure of functional capacity because it provides an objective assessment of the integrated physiological responses involved in oxygen transport and utilization during exercise (2,3). However, many daily activities are performed at submaximal exertion levels; therefore, functional capacity is often evaluated using simpler field tests that better reflect everyday functional performance (4).

The 6-min walk test (6 MWT) is a submaximal test that is widely used to assess aerobic endurance in clinical and research settings (4). It is easy to administer and highly reproducible, and the 6-min walk distance (6 MWD) is a well-established predictor of morbidity and mortality in several populations (5,6). However, the 6 MWT requires a standardized 30-m corridor and supervision, which may limit its feasibility in busy clinics, primary care settings, or situations in which in-person testing is restricted (4).

The 1-min sit-to-stand test (1MSTS) has emerged as a practical alternative for evaluating functional capacity because it can be performed almost anywhere with minimal equipment (7). The test involves repeated sit-to-stand movements over 1 min and primarily reflects lower-limb muscular endurance and functional mobility. Previous studies have shown that sit-to-stand tests are useful indicators of functional performance in rehabilitation settings (8). In addition, perceived exertion during functional testing can be assessed using standardized tools, such as the Borg rating of perceived exertion scale (9).

Compared with the 6 MWT, the 1MSTS emphasizes repeated activation of the lower limb musculature and may therefore reflect peripheral muscle performance to a greater extent. Studies in individuals with chronic respiratory disease have demonstrated significant associations between 1MSTS performance and 6 MWD, suggesting that the test captures important aspects of functional exercise capacity (10,11). Owing to its simplicity and minimal space requirements, the 1MSTS has also been explored in home-based rehabilitation and remote assessment settings (11).

Sex-related physiological differences may also influence performance in functional exercise tests. Women generally have smaller lung volumes and lower maximal aerobic capacity than men of similar age and body size, which may contribute to differences in walking-based assessments, such as the 6-min walk test (12). In contrast, shorter functional tests such as the 1MSTS may show different patterns of variation because they depend more heavily on lower-limb muscular endurance. Previous studies in young adults have reported higher sit-to-stand repetition counts in men than in women (13).

Although reference equations for the 6 MWT have been established in healthy adults (6), most studies examining the 1MSTS have focused on clinical populations. Consequently, the relationship between 1MSTS performance and 6 MWT distance in healthy young adults remains insufficiently explored. Therefore, this study aimed to examine the association between the 1MSTS and 6 MWT in healthy individuals aged 18–25 years. In addition, we compared performance according to sex and explored whether age within this young-adult range was associated with outcomes on these functional tests.

Methods

Study Design and Participants A cross-sectional observational study was conducted at a tertiary physiotherapy college after approval by the Institutional Ethics Committee. A priori sample size estimation indicated that a minimum of 36 participants was required to detect a moderate correlation with 80% power at a 95% confidence level. To improve precision and allow subgroup analyses, 90 healthy young adults aged 18–25 years were recruited using convenience sampling.

The inclusion criteria were age between 18 and 25 years, absence of known cardiopulmonary, neuromuscular, or musculoskeletal disorders affecting exercise performance, and ability to safely perform vigorous physical activity.

Individuals who were competitive athletes or had a recent injury, hospitalization, or acute illness within the previous 3 months were excluded. Written informed consent was obtained from all participants.

The demographic and anthropometric characteristics of the participants were recorded. Habitual physical activity was assessed using the International Physical Activity Questionnaire–Short Form (IPAQ-SF), and participants were classified as having low, moderate, or high physical activity according to standard scoring guidelines (14).

Test Procedures

Each participant underwent two functional tests on the same day: the 6 MWT and the 1MSTS. The 6 MWT was performed first in a well-ventilated indoor 30-m corridor in accordance with the American Thoracic Society guidelines (4). Participants were instructed to walk as far as possible in six minutes, with standardized encouragement provided at regular intervals. The distance walked was recorded in meters. Heart rate, oxygen saturation, blood pressure, respiratory rate, and Borg ratings were measured before and immediately after testing.

After a 30-min rest period, the 1 MSTS was performed using a standard armless chair with a seat height of 45 cm. Participants began in a seated position with their feet flat on the floor and their arms crossed over their chest. They were instructed to stand up fully and sit down repeatedly for 60 s as quickly as possible. One to two practice repetitions were allowed before testing. The total number of completed repetitions was recorded. Borg CR-10 ratings for dyspnea and leg fatigue were recorded before and after both tests (9).

Outcome Measures

The primary outcomes were 6MWD (meters) and 1MSTS repetitions (count). Secondary outcomes included post-test Borg fatigue and dyspnea scores, IPAQ-SF total MET-min/week, and associations of age, height, weight, and physical activity with test performance.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), as appropriate, and categorical variables were presented as frequencies and percentages. Normality was assessed using the Kolmogorov–Smirnov test. The association between 1MSTS repetitions and 6 MWT distance was examined using Spearman's rank correlation coefficient. Independent-samples t-tests were used to compare 6 MWD between men and women, whereas the Mann–Whitney U test was used for 1MSTS repetitions. Associations of age, height, weight, and IPAQ-derived physical activity with test outcomes were explored using Pearson's or Spearman's correlation, as appropriate. Statistical significance was set at $P < 0.05$.

Results

Participant Characteristics

All 90 participants (45 men and 45 women) completed both tests without adverse events. The mean age of the sample was 21.7 ± 1.2 years, with no significant difference between sexes. The mean height was 170.3 ± 9.2 cm (men: 176.5 ± 6.8 cm; women: 164.0 ± 5.7 cm), and the mean body mass was 64.7 ± 10.5 kg (men: 70.8 ± 8.9 kg; women: 58.6 ± 7.8 kg). Most participants (approximately 80%) reported moderate physical activity levels based on the IPAQ classification, while the remaining participants were classified as highly active. None of them fell into the low-activity category. Baseline resting values were within normal limits for all participants (heart rate 76 ± 8 bpm; SpO_2 98–99%), and Borg ratings for fatigue and breathlessness were zero before testing.

The summary statistics for the 1 MSTS and 6MWT are presented in Table 1. Overall, men demonstrated slightly higher performance than women on both tests. Men completed more sit-to-stand repetitions (51.9 ± 7.5 vs. 46.9 ± 7.9

repetitions) and walked a greater distance during the 6 MWT (633.0 ± 79.5 m vs. 601.8 ± 85.4 m). The overall mean 6 MWT distance was 618 ± 85 m, with a median of 619 m (range: 467–756 m). The mean number of sit-to-stand repetitions was 49.5 ± 8.0 (median: 49; range: 36–61). Height was moderately correlated with 6 MWD ($r \approx 0.45$, $p < 0.001$).

Normality testing indicated that the 6 MWT distances were normally distributed (Kolmogorov–Smirnov $p = 0.200$), whereas 1MSTS repetitions showed mild non-normality ($p = 0.042$). Accordingly, nonparametric methods were used for the correlation analysis involving 1MSTS.

Gender comparisons revealed that males performed significantly more sit-to-stand repetitions than females (Mann–Whitney $U = 728$, $p < 0.001$), with a moderate effect size ($r = 0.45$). Similarly, males walked significantly farther during the 6 MWT ($t = 2.97$, $p = 0.004$), although the effect size was smaller (Cohen's $d = 0.38$). Boxplots illustrating the distribution of the results by sex are presented in Figure 2.

Within the narrow age range of the participants (18–25 years), age was not significantly correlated with either test outcome (6 MWD: $\rho = -0.13$, $p = 0.23$; 1MSTS: $\rho = 0.02$, $p = 0.86$).

Correlation Between 1MSTS and 6MWT

A moderate positive correlation was observed between 1 MSTS repetition and 6 MWT distance (Spearman's $\rho = 0.65$, $p < 0.001$). Participants who achieved a higher number of sit-to-stand repetitions generally walked longer distances during the 6 MWT. The correlation was similar when analyzed separately for males ($\rho \approx 0.63$) and females ($\rho \approx 0.59$). A parametric analysis using Pearson's correlation produced a comparable result ($r = 0.68$), confirming the presence of a linear relationship between the two tests.

Although the tests were significantly correlated, considerable inter-individual variability was observed, suggesting that each test captured different aspects of functional capacity. The observed correlation indicates that approximately 42% of the variance in the 6 MWT distance can be explained by performance on the 1MSTS test ($R^2 \approx 0.42$).

IPAQ-derived physical activity levels were moderately correlated with both 6 MWT distance ($\rho \approx 0.55$, $p < 0.001$) and 1 MSTS repetitions ($\rho \approx 0.50–0.60$, $p < 0.001$), indicating that participants with higher habitual physical activity tended to perform better on both tests.

Median Borg ratings after testing were 3 for the 6MWT and 2–3 for the 1MSTS, with no significant difference between the tests (Wilcoxon $p = 0.19$). The Borg fatigue scores after the two tests showed a weak correlation ($\rho \approx 0.35$, $p = 0.001$).

Overall, these findings demonstrate a significant relationship between lower limb functional endurance measured by the 1-mTS and walking endurance measured by the 6 MWT in healthy young adults.

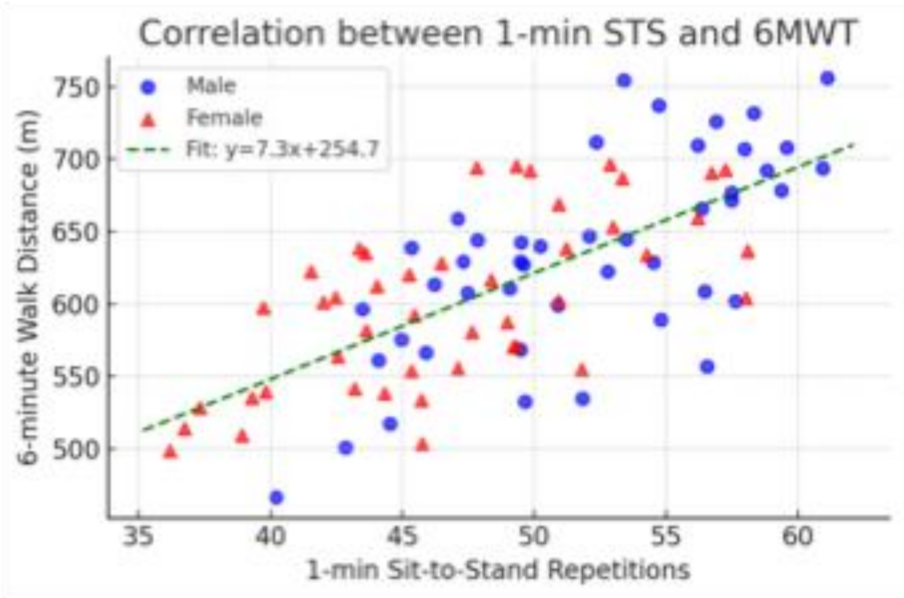

Figure 1. Scatter plot illustrating the relationship between 1MSTS repetitions and 6 MWD. Each point represents one participant (blue = men, red = women). A moderate positive correlation was observed (Spearman 's rho ≈ 0.65).

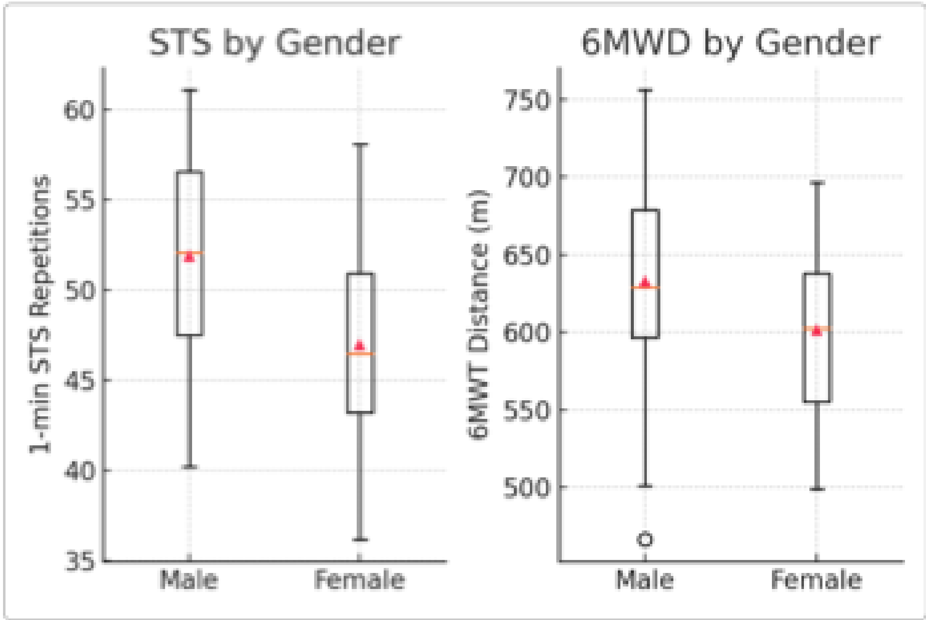

Figure 2. Boxplots comparing 1MSTS repetitions and 6MWD between men and women. The central line represents the median, the box indicates the interquartile range (IQR), and whiskers represent 1.5×IQR.

Table 1: Summary of Test Performance (1MSTS test and 6MWT) in Healthy Young Adults

Outcome	Total (N = 90)	Males (n = 45)	Females (n = 45)	P Value (M vs F)
1-min STS repetitions	49.5 ± 8.0 (median 49)	51.9 ± 7.5 (median 52)	46.9 ± 7.9 (median 47)	< 0.001†
6-min walk distance (m)	618 ± 85 (median 619)	633 ± 80 (median 630)	602 ± 85 (median 600)	0.004‡
Borg CR10 Fatigue (STS)	2.5 ± 1.4 (median 2)	2.4 ± 1.5 (median 2)	2.6 ± 1.3 (median 3)	0.52
Borg CR10 Fatigue (6MWT)	2.8 ± 1.6 (median 3)	2.7 ± 1.7 (median 3)	2.9 ± 1.6 (median 3)	0.68

Data are presented as mean ± SD and median (IQR). P-values are for †Mann–Whitney U test for STS (non-parametric) and ‡unpaired t-test for 6 MWD (parametric).

Discussion

This study examined the relationship between 1-mile standardized step test (1MSTS) performance and 6-minute walk test (6 MWT) distance in healthy young adults and explored the potential influence of sex and age on these functional measures. The findings demonstrated a moderate and statistically significant correlation between the two tests, indicating that individuals who performed better on one generally performed better on the other. This suggests that both assessments reflect a common component of functional exercise capacity. However, the correlation was not sufficiently high to indicate redundancy, implying that each test captures somewhat different aspects of physical performance.

The physiological characteristics of these two tests explain this relationship. The 6 MWT primarily reflects submaximal aerobic endurance and sustained locomotor activity over six minutes, whereas the 1MSTS relies more heavily on repeated lower-limb muscular endurance and functional strength. Because both tests involve submaximal effort and movements relevant to everyday function, some degree of association is expected (4,8). Previous studies in individuals with chronic respiratory disease have reported moderate correlations between sit-to-stand performance and walking endurance (10,11). The present findings extend this evidence to a healthy young adult population.

The results support the practical utility of the 1MSTS as an alternative when the 6 MWT cannot be performed. The 6 MWT requires a standardized corridor and supervision, which may limit its use in primary care, community screening, or remote assessment settings. In contrast, the 1MSTS requires only a chair and minimal space, making it easier to administer. Previous studies have shown that the 1MSTS can elicit physiological responses comparable to those of walking-based tests in respiratory populations (15), supporting its role as a rapid field measure of functional capacity.

Sex differences were observed in both functional tests, with men performing slightly better than women overall, particularly in the 6 MWT. These findings are consistent with known physiological and anthropometric sex differences. Men generally have greater muscle mass, higher hemoglobin concentrations, and higher maximal aerobic capacity, which may contribute to superior walking endurance (16). In addition, a taller stature and longer stride length may facilitate greater walking distances during the 6 MWT (6). In contrast, the sit-to-stand task requires repeated lifting of body mass, and the balance between body weight and muscle strength may reduce the magnitude of sex differences. Previous studies examining sit-to-stand performance have also reported relatively modest sex differences in young adults (13).

Age was not significantly associated with performance on either test. This was expected because the age range studied represents a period during which physical capacity is generally stable and at near-peak levels. Previous work has similarly reported a minimal influence of age on walking performance in younger adult populations (17). These findings suggest that habitual activity and fitness may play a greater role than chronological age in determining functional performance in this group.

The present findings also have practical implications. Because the 1MSTS is simple, time-efficient, and requires minimal equipment, it may be useful for rapid functional screening in settings where conventional walking tests are impractical. Such applications may include community assessments, fitness screening, and remote rehabilitation programs. Growing interest in home-based and telehealth assessments has further highlighted the value of simple tests that can be performed outside specialized clinical environments (18).

Despite this correlation, it is important to recognize that the 1 MSTS and 6 MWT assess different physiological components. The 6 MWT primarily reflects sustained aerobic endurance and walking mechanics, whereas the 1 MSTS emphasizes lower-limb muscular endurance and repeated functional movements. Therefore, these tests should be considered complementary rather than interchangeable measures of functional capacity.

This study has some limitations. The sample consisted of healthy university-aged individuals, which may limit its generalizability to other age groups or clinical populations. The cross-sectional design precludes conclusions regarding causality or responsiveness over time. In addition, only a single trial of each functional test was performed, and objective physiological measures, such as VO2max or direct muscle strength testing, were not included. Future studies involving larger and more diverse samples may help further clarify the relationship between these tests and establish broader reference values.

In summary, this study demonstrated a moderate positive relationship between 1 MSTS performance and 6 MWT distance in healthy young adults. These findings suggest that the 1 MSTS may serve as a simple and practical indicator of functional exercise capacity when traditional walking tests are not feasible.

Future Research

Future studies should extend these findings by establishing reference values for the 1MSTS across broader age groups and more diverse populations. Examining the relationship between the 1MSTS and 6 MWT in individuals with lower physical activity levels or chronic health conditions may further clarify its clinical applicability. Longitudinal studies evaluating whether changes in one test correspond with changes in the other following exercise or rehabilitation programs would also help determine the usefulness of the 1MSTS for monitoring functional improvement. In addition, larger datasets may enable the development of predictive models to estimate 6 MWT performance from 1MSTS results. The integration of wearable technologies capable of recording repetitions and physiological responses may further enhance the use of the 1MSTS in telehealth and remote monitoring settings.

Conclusion

This study demonstrated a moderately positive association between the 1-minute sit-to-stand test and 6-minute walk test in healthy young adults. Individuals who performed better on one test generally performed better on the other, indicating that both assessments reflected a shared component of functional exercise capacity. Although men showed a slightly higher performance, especially in the 6 MWT, age within the range of 18–25 years was not associated with the outcomes. These findings suggest that the 1MSTS may serve as a practical and space-efficient alternative when the 6 MWT is not feasible. However, because the two tests emphasize different physiological demands, they should be considered complementary rather than interchangeable measures of functional fitness.

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