Mobility performance among community-dwelling older Filipinos who lived in urban and rural settings: A preliminary study

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Received 3 April 2018; Accepted 3 October 2018; Published 11 December 2018

Background: The impact of residential setting on the performance of older adults on commonly used instruments of mobility has not been closely investigated.

Objective: This study aimed to (1) explore whether mobility test performance differed between those who lived in urban and rural communities, and (2) report preliminary reference values for these tests according to residential setting.

Methods: The study used a descriptive design. Individuals who were aged 60 years and above, had no significant disability, and resided in urban and rural areas in the Philippines (n = 180), participated in the study. Researchers measured mobility performance using the 10-Meter Walk Test (10MWT) (both comfortable gait velocity (CGV) and fast gait velocity (FGV)), Five Times Sit to Stand Test (FTSST), and
Six-Minute Walk Test (6MWT). Preliminary reference values for the mobility tests were presented as means, standard deviations, and 95% confidence intervals. Scores were compared based on residential setting (urban versus rural).

**Results:** Urban-dwellers scored consistently better compared to their rural counterparts on the CGV, FGV, FTSST, and 6MWT using independent samples t-test ($p < 0.001$). Data were further divided according to age and sex, and comparison of the mobility test scores between urban- and rural-dwellers within each subgroup showed similar differences ($p < 0.01$).

**Conclusion:** Results provide preliminary evidence for the influence of residential setting on the mobility test performance of Filipino older adults. The study provides a good starting point for confirmatory research with a representative sample to (1) illustrate differences in mobility performance according to residential setting, (2) investigate how specific factors associated with residential settings contribute to differences in mobility performance, and (3) determine the extent to which clinicians should consider an older person’s residential setting when interpreting mobility test results.

**Keywords:** Aged; geriatric assessment; mobility limitation; rural population; urban population; walking.

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**Introduction**

Mobility is defined in the International Classification of Functioning, Disability and Health (ICF) as “moving by changing body position or by transferring from one place to another, by carrying, moving or manipulating objects, by walking, running or climbing, and by using various forms of transportation”.\(^1\) It is a key component of healthy aging and fundamental to involvement in life situations.\(^2,3\) Frailty and loss of function associated with aging negatively impact mobility and increase risk for injuries and further disability.\(^4\) As a result, frailty can potentially restrict participation and impair quality of life.

A scoping review published in 2015 found that environmental characteristics such as proximity to resources and recreational facilities, social support, public transportation, and neighborhood security are associated with greater mobility in older adults.\(^5\) The review also highlighted that poor user-friendliness of the walking environment and neighborhood insecurity can negatively impact mobility.\(^6\) Such factors may be argued to relate to whether a person lives in a rural or urban setting. Older adults in rural settings have been found to have poorer health compared to their urban-dwelling peers due to greater difficulty in accessing health care and resources.\(^6\) Walking behavior, found to be linked to mobility, also differs since rural-dwelling individuals take less steps per day and engage in less walking compared to urban-dwelling individuals.\(^7,8\) Walkability, which refers to proximity of environmental destinations and the degree to which these are connected through a street network,\(^9\) may also be higher in urban communities compared to rural areas.\(^8\)

Because mobility is multidimensional, its assessment requires a variety of construct-specific instruments that relate to its dimensions (e.g. time constraints, distance, and postural transitions, etc.).\(^2\) These instruments play an important role in diagnosing mobility limitations, aiding prognosis, and measuring progress following intervention.\(^10\) While reference values for these instruments are widely available for interpreting patient scores, most have only considered differences related to age, sex, and ethnicity.\(^10–13\) Little is known if such reference values are influenced by residential setting. One study compared functional performance between urban- and rural-dwelling older people using the 7-item Physical Performance Test, an objective measure that includes mobility-related items (i.e., walking and turning).\(^14\) However, only cumulative scores representing overall physical function were reported, thus limiting usefulness as reference data for mobility-specific performance.

This study primarily aimed to explore whether the performance of Filipino older adults on commonly used mobility-specific assessment instruments differed based on residential setting. The secondary aim is to report preliminary reference values according to residential setting. This
knowledge will eventually aid clinicians in assessing and interpreting mobility-specific assessment instruments.

Methods
This study used a descriptive design. The Ethical Review Committee of the University of the Philippines Manila — College of Allied Medical Professions approved the research protocol. All participants provided written informed consent.

Participants
Volunteers from urban areas in the National Capital Region and rural areas in southern provinces of the Luzon island in the Philippines participated in the study. Participants were sourced through public announcements, active recruitment from various senior citizen communities, church and leisure groups, and the researchers’ networks. The inclusion and exclusion criteria detailed in Table 1 guided participant recruitment.

Target sample size was calculated using 10-Meter Walk Test (10MWT), comprising comfortable gait velocity (CGV) and fast gait velocity (FGV), as the main assessment instrument of interest. The hypothesized mean difference between urban- and rural-dwelling older adults was based on reference values from the existing literature. Within-group standard deviation was set to 0.2, desired significance level to 0.05, and power to 0.8. For CGV, the hypothesized true mean difference was 0.1 m/s, and the approximate sample size required per group was 64 urban- and rural-dwelling older adults. For FGV, the hypothesized true mean difference was 0.23 m/s and the approximate sample size per group was 13.

Tests and procedures
Data were collected from October 2011 to October 2012. Researchers gathered demographic and health-related information from volunteers through individual interviews to screen for eligibility. Height and weight were measured using a wall-mounted measuring tape and a calibrated weighing scale, respectively. Performance on standardized mobility tests were assessed in the following order to minimize fatigue: 10MWT, Five Times Sit to Stand Test (FTSST), and Six-Minute Walk Test (6MWT). For the 10MWT, researchers tested for CGV first, followed by FGV. Participants underwent two test trials for the FTSST and 10MWT after one demonstration from the researchers and a practice trial. Researchers recorded each participant’s average score from the two test trials for each test for data analysis. For the 6MWT, researchers implemented a modified practice trial by asking participants to do one round on the walking course to minimize fatigue. Participants then underwent one test trial for the 6MWT, with the researchers recording the scores from this trial for data analysis. Participants wore comfortable clothing and their usual footwear.

The 10MWT was selected as the primary assessment instrument as it is considered a predictor of mobility disability, mortality, and function in older adults. The test determines a person’s gait velocity which can provide information on ability to perform time-constrained tasks encountered in community mobility. Testing for CGV has high to very high test-retest reliability in older adults and interrater reliability among individuals with stroke. Testing for FGV has good test-retest and inter rater reliability among individuals with neurologic conditions. CGV predicts mobility decline in older adults.

| Inclusion criteria | Exclusion criteria |
|--------------------|-------------------|
| aged 60 years and higher | required an assistive device in standing or walking |
| able to walk outdoors without need for physical assistance or supervision | had uncorrected visual impairment |
| able to walk for at least six minutes without experiencing shortness of breath or pain | had any significant or uncontrolled neurologic, cardiopulmonary, or musculoskeletal condition known to affect balance and mobility (including surgery, chemotherapy, or radiation therapy within the previous six months; acute illness or injury at the time of testing; history of loss of consciousness or falling within the previous three months) |
| able to follow simple instructions in English or Filipino | |
| able to provide informed consent | |
FGV has been moderately associated with the Timed Up and Go (TUG) test, a widely-used measure of mobility in older adults \( (r = -0.67) \). Researchers administered the 10MWT by instructing participants to walk over a 10-meter level walkway, at a usual or comfortable speed for CGV and as fast as possible without running or losing balance for FGV. Using a stopwatch and while walking with the participant, the rater started the timer as soon as a foot of the participant crossed the second-meter mark and ended it after the foot passed the eighth-meter mark. Thus, the testing protocol recorded the middle six meters of the 10-meter walkway. The reason for the use of this procedure was to facilitate comparison with protocols used in reference values for the 10MWT.

The FTSST, while conventionally used to evaluate an older adult’s functional lower extremity strength and dynamic balance, also measures mobility as defined in the ICF because it involves transition from a seated position into a standing position and vice versa. Among older adults, the test has excellent test-retest reliability \( (ICC = 0.89) \) and correlation with the TUG \( (r = 0.64) \). Researchers obtained scores on the FTSST by recording the time in seconds taken by the participants to stand up five times from a chair as fast as possible with arms folded across the chest. Timing started as soon as the participant’s buttocks were lifted off the chair and ended upon contact during the fifth repetition. A chair that allowed approximately 90 degrees of hip and knee flexion was used for the test.

The 6MWT assesses the farthest distance an individual can traverse in six minutes while providing information on the interaction of musculoskeletal, cardiovascular, and neurologic systems. The test has excellent test-retest reliability \( (ICC = 0.94–0.96) \), and concurrent validity with chair stands \( (r = 0.67) \), standing balance \( (r = 0.52) \), and gait speed \( (r = -0.73) \) in older adults. Application of the 6MWT adhered to the guidelines of the American Thoracic Society, in which a straight 20-meter level-surface walkway was used to measure distance covered at a self-selected pace continuously for six minutes.

### Data analysis

Researchers used SPSS 20 for Windows (IBM Corporation, Armonk, NY, USA) for statistical analysis. Data were analyzed based on residential setting (urban versus rural). Overall, mobility test scores followed a normal distribution (Kolmogorov–Smirnov test, \( p > 0.05 \)) and therefore means, standard deviations, and 95% confidence intervals were reported. Levene’s test revealed generally equal variance across all datasets \( (p > 0.05) \). Thus, mobility test performance between urban and rural groups was compared using an independent samples \( t \)-test, with significance level set at 0.05. For data to be clinically useful and to facilitate comparisons with existing reference values, age- and sex-related descriptive data were reported as well.

### RESULTS

A total of 180 Filipino older adults participated in the study. Demographic characteristics are

| Variable    | Entire sample \( (n = 180) \) | Rural \( (n = 55) \) | Urban \( (n = 125) \) |
|-------------|-------------------------------|----------------|-------------------|
| Age (year)  | 67.58 (5.41) 66.78–68.37     | 67.16 (5.30) 65.73–68.60 | 67.76 (5.46) 66.79–68.73 |
| Height (cm) | 155.85 (10.45) 154.31–157.39 | 157.56 (7.57) 155.71–159.80 | 155.01 (11.42) 152.99–157.03 |
| Weight (kg) | 53.18 (10.58) 51.63–54.74    | 53.10 (7.85) 50.98–55.22  | 53.22 (11.60) 51.17–55.28  |
| Body mass index | 21.87 (3.89) 21.3–22.44 | 21.30 (1.87) 20.80–21.81 | 22.12 (4.49) 21.33–22.92 |

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Table 3. Participant scores according to residential setting.

|                | Entire sample (n = 180) | Rural (n = 55) | Urban (n = 125) | Rural versus urban comparison (t-test p-value) |
|----------------|-------------------------|----------------|----------------|-----------------------------------------------|
|                | Mean (SD) 95% CI        | Mean (SD) 95% CI | Mean (SD) 95% CI |                                                                |
| FTSST          | 9.29 (2.64) 8.90–9.68   | 11.06 (2.57) 10.36–11.75 | 8.51 (2.27) 8.11–8.92 | <0.001                                        |
| 6MWT           | 409.8 (96.0) 395.7–423.9 | 303.1 (54.4) 288.4–317.8 | 456.7 (69.0) 444.5–468.9 | <0.001                                        |
| CGV            | 1.17 (0.21) 1.14–1.20   | 1.01 (0.12) 0.98–1.04   | 1.23 (0.20) 1.20–1.27  | <0.001                                        |
| FGV            | 1.50 (0.27) 1.46–1.53   | 1.34 (0.21) 1.28–1.39   | 1.57 (0.26) 1.52–1.61  | <0.001                                        |

Notes: CGV = Comfortable gait velocity; CI = Confidence Interval; FGV = Fast gait velocity; FTSST = Five Times Sit to Stand Test; SD = Standard Deviation; 6MWT = Six-Minute Walk Test.

Discussion

Findings suggest a consistent pattern of higher performance across mobility-specific assessment instruments among urban-dwellers compared to rural-dwellers. To our knowledge, this is the first study that compared mobility-specific test scores between urban- and rural-dwelling older adults. Thus, direct comparison of findings to existing literature is limited. However, overall findings relate with those of a probability study that found higher functional status among urban-dwelling compared to rural-dwelling Filipinos on the 7-item Physical Performance Test. As highlighted in the literature, proximity to resources and recreational facilities, social support, public transportation, and neighborhood security positively impact mobility of older adults. On the other hand, poor user-friendliness of the walking environment and neighborhood insecurity limit mobility. Rural areas in the Philippines, being generally less-developed compared to urban areas, offer limited key walking destinations such as public transits, neighborhood shops, and services. Walking routes may also be perceived as less safe because of inadequate street lighting and traffic control. All of these have been linked to less walking activity and likely impact on mobility in a negative way. Differences in social roles between older adult cohorts in different residential settings should also be considered, for example among women in rural areas who often engage in caregiver/home management duties. Such responsibilities have been found to be a barrier for leisure-time physical activity and thus may negatively affect physical performance.

When preliminary reference values were presented according to age- and sex-based subgroups, the pattern of higher mobility test scores among urban-dwellers compared to rural-dwellers was still consistently observed. Further division of the data into subgroups allowed comparison with existing reference values. Overall, mobility performance of the rural-dwelling participants on the 10MWT (both CGV and FGV) and 6MWT aligns with the reference values obtained from rural-dwelling South East Asian and North East Asian cohorts. Aoyagi et al. obtained CGV and FGV from 151 rural-dwelling Japanese older adults, although only women were recruited in their study. Thaweevannakij et al. recruited most of the 1030 well-functioning older adults in their study from rural and semi-rural communities in Thailand (Thaweevannakij T, PhD, 2014, e-mail communication, 15th August). In comparison, mobility performance of urban-dwelling participants on the CGV and FGV was similar to that of 604 urban-dwellers in the same study involving Japanese older women by Aoyagi et al. Interestingly, the means and confidence intervals of the urban-dwelling participants’ 10MWT and 6MWT scores were closer to the reference values reported for
Table 4. Age-related reference values according to residential setting.

| Age Group | Rural (n = 37; females = 25 (68%)) | Urban (n = 80; females = 45 (56%)) | Rural versus urban comparison within 60–69 age group | 70–79 years | Rural versus urban comparison within 70–79 age group |
|-----------|----------------------------------|-----------------------------------|-----------------------------------------------|-------------|-----------------------------------------------|
|           | Mean (SD) 95% CI                  | Mean (SD) 95% CI                  | Mean (SD) 95% CI                               | Mean (SD) 95% CI | Mean (SD) 95% CI |
| FTSST     | 11.18 (2.48) 10.35–12.01          | 8.30 (2.22) 7.81–8.80             | <0.001                                        | 10.80 (2.79) 9.41–12.19 | 8.89 (2.22) 8.31–8.80 |
| 6MWT      | 313.22 (53.04) 295.54–330.90      | 465.93 (61.23) 452.30–479.55      | <0.001                                        | 282.40 (52.50) 256.29–308.51 | 440.29 (78.98) 416.56–464.02 |
| CGV       | 1.03 (0.13) 0.96–1.08             | 1.24 (0.18) 1.20–1.28             | <0.001                                        | 0.96 (0.11) 0.91–1.02 | 1.22 (0.23) 1.15–1.29 |
| FGV       | 1.40 (0.22) 1.32–1.47             | 1.59 (0.24) 1.54–1.64             | <0.001                                        | 1.21 (0.14) 1.14–1.28 | 1.52 (0.29) 1.43–1.61 |

*Notes: CGV = Comfortable gait velocity; CI = Confidence Interval; FGV = Fast gait velocity; FTSST = Five Times Sit to Stand Test; SD = Standard Deviation; 6MWT = Six-Minute Walk Test.*

Table 5. Sex-related reference values according to residential setting.

| Gender | Rural (n = 15; mean age = 66 ± 5.78) | Urban (n = 57; mean age = 67.60 ± 5.58) | Rural versus urban comparison within male group | Female (n = 40; mean age = 67.6 ± 5.11) | Urban (n = 68; mean age = 67.90 ± 5.40) | Rural versus urban comparison within female group |
|--------|----------------------------------|-----------------------------------|-----------------------------------------------|---------------------------------|---------------------------------|-----------------------------------------------|
|        | Mean (SD) 95% CI                  | Mean (SD) 95% CI                  | Mean (SD) 95% CI                               | Mean (SD) 95% CI | Mean (SD) 95% CI | Mean (SD) 95% CI |
| FTSST  | 12.01 (2.23) 10.78–13.25          | 7.71 (1.88) 7.21–8.21             | <0.001                                        | 10.70 (2.62) 9.86–11.54 | 9.19 (2.34) 8.62–9.76 |
| 6MWT   | 327.58 (47.76) 301.13–354.02      | 491.12 (63.12) 474.37–507.86      | <0.001                                        | 293.97 (54.39) 276.57–311.36 | 427.85 (60.15) 413.29–442.41 |
| CGV    | 1.08 (0.12) 1.01–1.14             | 1.23 (0.19) 1.25–1.36             | <0.001                                        | 0.99 (0.12) 0.95–1.03 | 1.18 (0.19) 1.13–1.22 |
| FGV    | 1.49 (0.21) 1.38–1.61             | 1.72 (0.24) 1.65–1.78             | 0.002                                         | 1.28 (0.19) 1.22–1.33 | 1.44 (0.20) 1.39–1.49 |

*Notes: CGV = Comfortable gait velocity; CI = Confidence Interval; FGV = Fast gait velocity; FTSST = Five Times Sit to Stand Test; SD = Standard Deviation; 6MWT = Six-Minute Walk Test.*
Caucasian cohorts than for the Thai cohort.\textsuperscript{10,13,21,30} However, it was unclear from which residential setting the Caucasian cohorts had been recruited.\textsuperscript{10,21,30} These patterns in mobility performance on the 10MWT and 6MWT support the hypothesis that residential setting may be an influencing factor in the mobility performance of community-dwelling older adults.

Urban-dwellers in the present study had similar FTSST scores to the urban-dwelling Japanese women in the study by Aoyagi \textit{et al.}, although they found that the scores of urban- and rural-dwelling Japanese older women on the FTSST were not different.\textsuperscript{11} An important factor that might have contributed to their observation would be the Japanese culture of squatting which had been linked to better sit-to-stand performance.\textsuperscript{11} FTSST scores from rural-dwellers in this study were similar to those reported by Thaweewannakij \textit{et al.} for rural- and semi-rural-dwelling Thai older adults, and by Bohannon in a meta-analysis of study results obtained mostly from American older adults.\textsuperscript{13,20} While similarity of scores with the Thai cohort may be attributed to similarities in participant characteristics, it would be difficult to elucidate the similarities with the findings of the meta-analysis because residential setting was not specified in most of the included studies.\textsuperscript{20}

The study results serve as a good foundation for confirmatory research that can provide a more precise picture of the extent to which mobility test performance differs according to residential setting. Results also provide a basis for studies that will clarify the need to consider residential setting in addition to the already-established age, sex, and ethnic (i.e., anthropometric) factors. Clinicians may then acquire a better understanding of mobility in older adults and more accurate interpretation of scores on mobility assessment instruments. It would also be worthwhile to investigate whether a similar extent of rural–urban difference exists in different regions in consideration of inter-region differences in socio-cultural and environmental characteristics. Should future research confirm residential setting as a critical factor in interpreting mobility test scores, population-specific reference values must be revisited as well. In developing countries, a larger population of older adults live in rural communities than in urban communities, while the opposite has been observed in more developed areas.\textsuperscript{31} Existing reference values that were obtained from majorly urban or rural samples or were from studies that did not report residential setting may need to be used with caution when making clinical judgments regarding the mobility of older people.

Lastly, the impact of environmental, socio-cultural, and health-related factors on mobility could not be confirmed in this preliminary investigation since it was beyond the objectives. Therefore, future research should endeavor to clarify whether some of these factors (e.g., specific environmental characteristics, social roles and level of physical activity) can explain why mobility test performance differs among older adults in urban and rural communities. Factors associated with residential setting that relate to better or worse normative performance on mobility tests may also be identified through further research. Such studies can widen clinicians’ perspectives of the range of mobility test performance that constitutes normal mobility in community-dwelling older adults.

Careful consideration of the study limitations is required when interpreting the study results. Due to the convenient nature of sampling and relatively small sample size, findings of this study may be a preliminary representation only of how urban- and rural-dwelling older persons comparatively perform on the mobility tests. While the sample size for urban-dwelling participants met the projections for CGV and FGV, the sample size for the rural-dwelling group met the projection for FGV only. Fewer participants aged 70–79 were also recruited. It should be noted too that the testing methods for the 10MWT and FTSST in this study aligned with some published studies and differed from others in the literature. This study’s protocol for the 10MWT involved measuring time over the middle six meters of the 10-meter walkway, similar to previous studies reporting reference data for mobility-specific tests for older adults.\textsuperscript{10,11} However, future studies may consider measuring time over the middle four meters of the walkway instead, similar to the methodology used by Thaweewannakij \textit{et al.}, to factor in acceleration and deceleration effects that may take up to three meters.\textsuperscript{13,32} The method for timing the FTSST in this study was consistent with previous studies,\textsuperscript{22,25} while other studies used a different methodology\textsuperscript{13} or did not provide sufficient details to allow comparison.\textsuperscript{11,21} Such methodological differences must be considered when using data from different studies. Future studies should use a uniform testing protocol to facilitate comparison across studies. Lastly,
because participants were recruited from the Philippines, the patterns observed in the mobility test performance of this cohort may not necessarily be generalizable to other countries that do not share similar characteristics of rural–urban settings with the Philippines.

In conclusion, this study provides preliminary evidence on the influence residential setting on mobility test performance of older adults. The study is useful in generating a hypothesis regarding mobility performance differences between urban- and rural-dwelling older adults. However, future research should test the hypothesis using an appropriate research design and sample size. This study also highlights the importance of examining further what underpins the differences in mobility performance among older adults based on residential setting. Results of the study serve as a good starting point for a series of studies that will lead to a better understanding of how environmental, socio-cultural, and health-related factors influence mobility among older adults.

Conflict of Interest

The authors have no conflict of interest relevant to this paper.

Funding/Support

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author Contributions

E. J. Gorgon was responsible for conception and design of the study. F. R. Lunar and E. J. Gorgon were involved with analysis/interpretation of data, and critical revision of the manuscript for important intellectual content. All authors were involved in acquisition of data, drafting the manuscript, and approval of the manuscript to be published.

Acknowledgments

The authors thank Cielo Marie Pereyra, Gelyn Dimaculangan, and Gerald Caesar Libranda for their contributions in data collection, and Maria Eliza Aguila for her specific contribution in the study methodology.

References

1. World Health Organization. International Classification of Functioning, Disability and Health: ICF. World Health Organization, 2001.
2. Patla AE, Shumway-Cook A. Dimensions of mobility: Defining the complexity and difficulty associated with community mobility. J Aging Phys Act 1999;7:7–19.
3. Satariano WA, Guralnik JM, Jackson RJ, Marottoli RA, Phelan EA, Prohaska TR. Mobility and aging: New directions for public health action. Am J Public Health 2012;102:1508–15.
4. Menezes KV, Auger C, de Souza Menezes WR, Guerra RO. Instruments to evaluate mobility capacity of older adults during hospitalization: A systematic review. Arch Gerontol Geriatr 2017;72:67–79.
5. Levasseur M, Généreux M, Bruneau JF, Vanasse A, Chabot É, Beaulec C, et al. Importance of proximity to resources, social support, transportation and neighborhood security for mobility and social participation in older adults: Results from a scoping study. BMC Public Health. 2015;15:503.
6. Zhang X, Dupre ME, Qiu L, Zhou W, Zhao Y, Gu D. Urban-rural differences in the association between access to healthcare and health outcomes among older adults in China. BMC Geriatr. 2017;17:151.
7. Alexander NB, Guire KE, Thelen DG, Ashton-Miller JA, Schultz, AB, Grunawalt JC, et al. Self-reported walking ability predicts functional mobility performance in frail older adults. J Am Geriatr Soc 2000;48:1408–13.
8. Van Dyck D, Cardon G, Deforche B, De Bourdeaudhuij I. Urban–rural differences in physical activity in Belgian adults and the importance of psychosocial factors. J Urban Health 2011;88:154–67.
9. Owen N, Cerin E, Leslie E, duToit L, Coffee N, Frank LD, et al. Neighborhood walkability and the walking behavior of Australian adults. Am J Prev Med 2007;33:387–95.
10. Steffen TM, Hacker TA, Mollinger L. Age-and gender-related test performance in community-dwelling elderly people: Six-minute walk test, berg balance scale, timed up & go test, and gait speeds. Phys Ther 2002;82:128–37.
11. Aoyagi K, Ross PD, Nevitt MC, Davis JW, Wasnich RD, Hayashi T, et al. Comparison of performance-based measures among native Japanese, Japanese-Americans in Hawaii and Caucasian women in the United States, ages 65 years and over: A cross-sectional study. BMC Geriatr 2001;1:3.
12. Butler AA, Menant JC, Tiedemann AC, Lord SR. Age and gender differences in seven tests of functional mobility. J Neuroeng Rehabil 2009;6:31.
13. Thaweewannakij T, Wilaichit S, Chuchot R, Yuenyong Y, Saengsuwan J, Siritaratiwat W, et al. Reference values of physical performance in Thai elderly people who are functioning well and dwelling in the community. Phys Ther 2013;93:1312–20.

14. Morala DT, Shiomi T, Maruyama H. Factors associated with the functional status of community-dwelling elderly. J Geriatr Phys Ther 2006;29:101–106.

15. Middleton A, Fritz SL, Lusardi M. Walking speed: The functional vital sign. J Aging Phys Act 2015;23:314–22.

16. Rydwik E, Bergland A, Forsen L, Frändin K. Investigation into the reliability and validity of the measurement of elderly people’s clinical walking speed: A systematic review. Physiother Theory Pract 2012;28:238–56.

17. Wolf SL, Catlin PA, Gage K, Gurucharri K, Robertson R, Stephen K. Establishing the reliability and validity of measurements of walking time using the Emory Functional Ambulation Profile. Phys Ther 1999;79:1122–33.

18. Tyson S, Connell L. The psychometric properties and clinical utility of measures of walking and mobility in neurological conditions: A systematic review. Clin Rehabil 2009;23:1018–33.

19. Langhammer B, Lindmark B. Performance-related values for gait velocity, timed up-and-go and functional reach in healthy older people and institutionalized geriatric patients. Phys Occup Ther Geriatr 2007;25:55–69.

20. Bohannon RW. Reference values for the five-repetition sit-to-stand test: A descriptive meta-analysis of data from elders. Percept Mot Skills 2006;103:215–22.

21. Lusardi MM, Pellecchia GL, Schulman M. Functional performance in community living older adults. J Geriatr Phys Ther 2003;26:14–22.

22. Tiedemann A, Shimada H, Sherrington C, Murray S, Lord S. The comparative ability of eight functional mobility tests for predicting falls in community-dwelling older people. Age Ageing 2008;37:430–35.

23. Goldberg A, Chavis M, Watkins J, Wilson T. The five-times-sit-to-stand test: Validity, reliability and detectable change in older females. Aging Clin Exp Res 2012;24:339–44.

24. Guralnik JM, Simonsick EM, Ferrucci L, Glynn RJ, Berkman LF, Blazer, DG, et al. A short physical performance battery assessing lower extremity function: Association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol 1994;49:M85–M94.

25. Whitney SL, Wrisley DM, Marchetti GF, Gee MA, Redfern MS, Furman JM. Clinical measurement of sit-to-stand performance in people with balance disorders: Validity of data for the Five-Times-Sit-to-Stand Test. Phys Ther 2005;85:1034–45.

26. Harada ND, Chiu V, Stewart AL. Mobility-related function in older adults: Assessment with a 6-minute walk test. Arch Phys Med Rehabil 1999;80:837–41.

27. ATS Statement. ATS committee on proficiency standards for clinical pulmonary function laboratories. Am J Respir Crit Care Med 2002;166:111–17.

28. Van Cauwenberg J, Clarys P, De Bourdeaudhuij I, Van Holle V, Verté D, De Witte N, et al. Physical environmental factors related to walking and cycling in older adults: The Belgian aging studies. BMC Public Health 2012;12:142.

29. Wilcox S, Castro C, King AC, Housemann R, Brownson RC. Determinants of leisure time physical activity in rural compared with urban older and ethnically diverse women in the United States. J Epidemiol Community Health 2000;54:667–72.

30. Bohannon RW. Six-Minute Walk Test: A meta-analysis of data from apparently healthy elders. Topics in Geriatric Rehabilitation 2007;23:155–60.

31. Kinsella K. Urban and rural dimensions of global population aging: An overview. J Rural Health 2001;17:314–22.

32. Finch E, Brooks D, Stratford PW, et al. Physical rehabilitation outcome measures: A guide to enhanced clinical decision making. 2nd ed. Hamilton, Ontario, Canada: Lippincott Williams & Wilkins, 2002.