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Measurement of Gait Speed in Daily Life as a Physiological Metric of Aging: A Systematic Review and Meta-Analysis

Nguyen, TML; Cheng, CH.

Corresponding author:
Lien Nguyen Thi My

ntmlien@ctump.edu.vn

Author Affiliation:
School of Physical Therapy and Graduate Institute of Rehabilitation Science, College of Medicine, Chang Gung University, Taoyuan, Taiwan, ROC.

ADMINISTRATIVE INFORMATION

Support - None.

Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 14 November 2025 and was last updated on 14 November 2025.

INTRODUCTION

Review question / Objective The aim of this systematic review and meta-analysis was to: (1) Summarize instruments and data-processing methods used to measure real-world gait speed, and compare real-world and supervised gait speed in healthy older adults. (2) Examine age-related changes and sex differences in real-world gait speed among healthy older adults.

Rationale Gait speed is a key biomarker of aging, yet most measurements come from supervised laboratory tests that may not reflect how older adults walk in daily life. With the rise of wearable technologies, real-world gait speed can now be quantified under natural conditions, but measurement methods and data-processing approaches remain highly variable. Importantly, the extent to which real-world gait speed differs from supervised (laboratory-based) assessments in healthy older adults has not been systematically examined. It also remains unclear how age, sex, and device-related characteristics contribute to these differences, as well as how gait speed changes with aging in real-world environments. Therefore, a systematic review and meta-analysis are needed to synthesize current measurement methods, compare real-world and supervised gait speed, and use meta-regression to evaluate the influence of age and device factors on real-world gait speed and its divergence from laboratory assessments.

Condition being studied This review focuses on healthy older adults, examining real-world gait speed measured using wearable sensors during daily-life walking, in comparison with supervised or laboratory-based gait speed assessments. The outcomes of interest include differences between real-world and supervised gait speed, as well as age-related and sex-related variations in real-world gait speed.

METHODS

Search strategy A systematic literature search was conducted in October 2025 across three electronic databases: PubMed, Web of Science, and Scopus, using combinations of the following keywords: “healthy older adults” AND (“wearable sensors” OR “accelerometer” OR “inertial measurement unit”) AND (“real-world gait speed” OR "digital mobility outcome" OR "gait"), and only studies published in English will be included.

Participant or population Healthy older adults.

Intervention The exposure of interest is gait speed measured in real-world daily-life environments using wearable sensors.

Comparator Supervised or laboratory-based gait speed.

Study designs to be included Observational study designs such as cross-sectional studies and cohort studies.

Eligibility criteria Studies were eligible if: (1) participants were healthy older adults (typically aged ≥ 65 years) or the study included a healthy older adult subgroup; (2) gait speed was measured in both supervised laboratory settings and real-world daily-life environments; and (3) real-world gait speed was assessed using wearable sensors such as accelerometers or inertial measurement units. Only studies published in English were included.

Information sources The primary information sources for this systematic review will be three electronic databases: PubMed, Web of Science, and Scopus. These databases will be searched for peer-reviewed studies published in English up to October 2025. Reference lists of all included articles and relevant review papers will be manually screened to identify additional eligible studies. No grey literature, conference abstracts, or non-peer-reviewed sources will be included.

Main outcome(s) The primary outcomes include: overview of real-world gait speed measurement approaches and the mean difference in gait speed between real-world and laboratory settings, quantified through meta-analysis and meta-regression.

Additional outcome(s) Age-related and sex-related variations in real-world gait speed among healthy older adults.

Data management Two independent reviewers extracted data, including study characteristics (sample size, age, wearable device, sampling rate, monitoring duration, walking-bout definition), measurement protocols, and gait speed values in both laboratory and real-world settings. Special attention was given to unit consistency and the direction of effect (i.e., whether real-world gait speed was lower or higher than laboratory gait speed) to avoid misinterpretation. All extracted data were organized in standardized spreadsheets and checked for accuracy before statistical synthesis.

Quality assessment / Risk of bias analysis The methodological quality of the included observational and cross-sectional studies was assessed independently by two reviewers using a customized quality appraisal checklist adapted from the NHLBI Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies.

Strategy of data synthesis A random-effects meta-analysis will be conducted to compare gait speed measured in laboratory and real-world environments. The weighted mean difference in gait speed and its corresponding 95% confidence interval (CI) will be calculated using R software (version 4.5.1). Between-study heterogeneity will be assessed using Cochran’s Q test and quantified with the I^2 statistic, with approximately 25%, 50%, and 75% interpreted as low, moderate, and high heterogeneity.

Subgroup analysis Subgroup analyses (usual vs fast walking) will be conducted to explore potential sources of heterogeneity.
Meta-regression will be carried out to examine whether study-level variables - such as mean participant age, monitoring duration, and device wear location - explain part of the between-study variability in gait speed outcomes.

Sensitivity analysis Sensitivity analysis will be performed by removing one study at a time to evaluate the robustness of the pooled effect size.

Language restriction Only studies published in English will be included in this review.

Country(ies) involved Taiwan.

Other relevant information None

Keywords Real-world gait speed, older adults, wearable sensors, accelerometer, aging.

Contributions of each author

Author 1 - Lien Nguyen Thi My.
Author 2 - Chih-Hsiu Cheng.