Original Research

Straight and Curved Path Walking Among Older Adults in Primary Care: Associations With Fall-Related Outcomes

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Abstract

Background: Most falls among community-dwelling older adults occur while walking. Simple walking tests that require little resources and can be interpreted quickly are advocated as useful screening tools for fall prone patients.
Objective: To investigate 2 clinically feasible walking tests consisting of straight- and curved-path walking and examine their associations with history of previous falls and fall-related outcomes among community-living older adults.
Design: A cross-sectional analysis was performed on baseline data from a longitudinal cohort study.
Setting: Participants were recruited through primary care practices.
Participants: Participants included 428 primary care patients ≥65 years of age at risk for mobility decline. Participants had a median age of 76.5 years, 67.8% were women, and 82.5% were white.
Methods: Straight-path walking performance was measured as the time needed to walk a 4-meter straight path at usual pace from standstill using a stopwatch (timed to 0.1 second). Curved-path walking performance was timed while participants walked from standstill in a figure-of-8 pattern around two cones placed 5 feet apart.
Main Outcome Measurements: Multivariable negative binomial regression analyses were performed to assess the relationship between straight-path walking or curved-path walking and self-reported history of number of falls. For fall-related injuries, and fall-related hospitalizations, logistic regression models were used.
Results: In the fully adjusted model, an increase of 1 second in straight path walking time was associated with 26% greater rate of falls (rate ratio 1.26, 95% confidence interval 1.10-1.45). An increase in curved-path walking time was associated with 8% greater rate of falls (rate ratio 1.08, 95% confidence interval = 1.03-1.14). Neither walk test was associated with history of fall-related injuries or hospitalizations.
Conclusions: Poor performance on straight- and curved-path walking performance was associated with a history of greater fall rates in the previous year but not with a history of fall-related injuries or hospitalizations. This information helps inform how previous fall history is related to performance on walking tests in the primary care setting.

Introduction

Approximately 35%-40% of community-dwelling older adults older than 65 years of age fall annually [1]. The yearly cost of falls in the older adult population is approximated at 19.2 billion dollars as the result of related injuries and hospitalizations [2]. Given that the U.S. older adult population is growing at a faster rate than the total population itself, understanding falls and screening for these events is of the utmost importance [3].

Walking performance tests are advocated for facilitating risk stratification of fall-prone patients. Previous research shows that most falls among community-dwelling older adults occur while walking [4]. For clinical applications, walking tests that require little resources and can be interpreted quickly are needed. Three tests that meet these criteria include the Timed Up and Go test (TUG), the 4-meter Walk Time test (4mWT), and the Figure of 8 Walk Test (F8WT). The TUG requires the older adult to stand up from a chair, walk 3 meters, turn around, walk back, then sit down in the

starting position [5]. The 4mWT is a walking test currently advocated for use in the clinical setting that requires simple walking in a straight path at a usual pace. The test assesses the time needed for the older adult to walk a 4-meter path from standstill [6]. Finally, the F8WT is a newer walking test, thought to be more representative of everyday walking. It assesses the time required to navigate a curved path in a figure-of-8 shape from standstill [7]. Prospective studies have demonstrated the predictive ability of TUG and 4mWT on the occurrence of a future fall in older adults [8-12]. The F8WT has yet to be evaluated in this context.

To understand how walking tests predict a future fall, it is important to also understand how a patient's baseline performance on such tests relates to a previous fall history, fall-related injury, or fall-related hospitalization. For example, previous studies have shown an association between TUG performance and a previous fall history [13-17]. Evidence exists to support a relationship between 4mWT performance and fall history [9,18]. No study has linked F8WT performance with fall number history. Previous work identified that the attributes most associated with F8WT performance were fall-related risk factors such as processing speed, self-efficacy, reaction time, and rapid leg coordination. Such evidence suggests that F8WT performance and fall-related outcomes may be associated [19].

In the present study, our aim was to identify associations between performance on straight- or curved-path walking (4mWT or F8WT) with fall outcomes in the previous year (self-reported recall of fall numbers, fall-related injuries, and fall-related hospitalizations). This information will inform the design and interpretation of future studies evaluating these walking tests and their ability to predict fall outcomes prospectively. Also, it will inform clinicians considering use of either or both tests for patient screening. Clinical experience would suggest that F8WT may provide more information than 4mWT about falls and fall-related outcomes because it includes motor planning, navigating obstacles, and turns. Our hypothesis was that poorer performance on curved path walking would show a stronger association with self-reported fall outcomes than straight-path walking.

Methods

We conducted a cross-sectional secondary analysis of baseline data from an ongoing longitudinal cohort study. The cohort consists of 430 older adult patients, age ≥65 years, recruited through primary care physicians' offices. The overall aim is to evaluate an array of neuromuscular attributes associated with mobility status at baseline and predictive of functional decline and disability after 2 years of follow-up. More detailed aims and methods have been published elsewhere [20,21].

Written informed consent took place before the first baseline visit during the eligibility screen.

Inclusion criteria for the study consisted of adults aged 65 or older, with the ability to understand and communicate the English Language, no planned major surgery, and expectation of living in the area for at least 2 years. The presence of preclinical disability was an additional inclusion factor, defined as a self-reported limitation or modification in the ability to walk half a mile or climb one flight of stairs (10 steps), or limitations in performing these mobility tasks due to health conditions [22]. Only those individuals who answered baseline questions related to falls were included in the study (n = 428); see the "Falls Assessment" section to follow. Exclusion criteria included the presence of a terminal disease, an episode of major surgery or myocardial infarction in the 6 months before enrollment, a planned upcoming major surgery, an anticipated move from the regional area within 2 years, major medical problems interfering with safe and successful testing, a mini-mental state exam (MMSE) score less than 18, and a Short Physical Performance Battery score less than 4 [23,24].

The overall aim of this secondary analysis was to identify associations between performance on straight- or curved-path walking (4mWT or F8WT) with fall outcomes in the previous year. Thus, fall history and performance measures collected at baseline were assessed. A visual demonstration was provided for all performance based tests before study participants completed them.

Falls Assessment

Our primary outcome measures included self-reported number of falls in the year before enrollment, self-reported occurrence of an injury from a fall (yes/no), and overnight stay in the hospital as the result of a fall (yes/no). The falls questionnaire was developed based on a population-based study of community-dwelling older adults [25]. Baseline questions related to falls included: "How many times have you fallen to the ground in the past year? (n = 428); As a result of your worst fall, were you injured? (answer yes, n = 88); Did you stay overnight in the hospital because of a fall in the last year? (answer yes, n = 19)." A fall was defined as an unexpected event in which any part of the participant's body above the ankle came to rest on the ground, floor, or lower level [26].

Four-Meter Walk Time

Time needed to walk a 4-meter straight path at usual pace from standstill was recorded with a stopwatch (timed to 0.1 second). 4mWT was defined as the time between the participant's first initiated movement of the feet and the first foot-fall after the 4-meter mark.