



## Systematic review

# Dual-task testing to predict falls in community-dwelling older adults: a systematic review

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## Abstract

**Background** Cognitive impairment increases fall risk in older adults. Dual-task testing is an accepted way to assess the interaction between cognition and mobility; however, there is a lack of evidence-based recommendations for dual-task testing to evaluate fall risk in clinical practice.

**Objectives** To evaluate the association between dual-task testing protocols and future fall risk, and to identify the specific dual-task test protocols associated with elevated risk.

**Data sources** MEDLINE, Pubmed and EMBASE electronic databases were searched from January 1988 to September 2013.

**Study selection** Two independent raters identified prospective cohort studies (duration of at least 1 year) of dual-task assessment in community-dwelling participants aged  $\geq 60$  years, with ‘falls’ as the primary outcome.

**Study appraisal and synthesis methods** Methodological quality was scored independently by two raters using a published checklist of criteria for evaluating threats to the validity of observational studies.

**Results** Deterioration in gait during dual-task testing compared with single-task performance was associated with increased fall risk. Shortcomings within the literature significantly limit knowledge translation of dual-task gait protocols into clinical practice.

**Limitations** There is a paucity of prospective studies on the association of dual-task gait assessment with fall risk.

**Conclusion and implications of key findings** Changes in gait under dual-task testing are associated with future fall risk, and this association is stronger than that for single-task conditions. Limitations in the available literature preclude development of detailed recommendations for dual-task gait testing procedures in clinical practice to identify and stratify fall risk in older adults.

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**Keywords:** Accidental falls; Aged; Gait; Cognitive function

## Introduction

Thirty-five percent of adults >65 years of age fall at least once per year [1,2]. The sequelae of falls for older adults include fear of falling, injury and death. While the importance of screening older adults for fall risk is well recognised

[3], the ability of fall prevention guidelines to identify and stratify risk is limited [4]. As the assessment of balance and gait features prominently in fall prevention guidelines, improving the precision of assessment would help to identify community-dwelling older adults at high risk.

Cognition has emerged as an important factor in the maintenance of postural stability. Cognitive impairment in older adults, including subtle changes in the absence of dementia, is associated with increased fall risk [5,6]. Importantly, impaired executive function is most consistently associated with increased fall risk [7–9].

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Observing people during a gait or balance task while they perform a secondary task (dual-task paradigm) is an accepted way to assess the interaction between cognition and mobility [10,11]. If the demands of executing two tasks simultaneously exceed cognitive capacity, overall performance will be degraded [10]. The dual-task paradigm is relevant as most activities of daily living involve the simultaneous performance of cognitive and motor tasks [11].

A review found that 79% of physiotherapists working in geriatrics included evaluation of cognitive contributions to balance [12]. Two systematic reviews have reported that dual-task gait tests are associated with increased risk of falling [13,14], but did not provide specific testing recommendations for use in clinical practice. The growing recognition of the role of cognition in postural stability and fall risk, and the lack of evidence-based recommendations for clinical practice, warrants a new review of the literature on dual-task testing.

The purpose of this review was to critically evaluate the evidence linking dual-task gait and balance testing to fall risk in community-dwelling older adults. The specific objectives were: (1) to evaluate the association between dual-task testing and future fall risk; (2) to explore how the dual-task test protocol used was associated with fall risk; and (3) to identify the most appropriate testing protocol and test outcome to evaluate fall risk in a clinical setting.

## Methods

### *Data sources and searches*

A detailed literature search without language restriction identified articles published between January 1988 and September 2013. The following electronic databases were searched: MEDLINE, Pubmed and EMBASE. The following MeSH subject terms and keywords in the abstract were used: accidental falls, falling, prospective studies, aged, aged 80 and over, elderly, aging, gait, postural balance, dual-task, cognition and attention. A hand search of the bibliographies from extracted articles and existing reviews was conducted to identify studies that were not captured in the electronic database searches.

### *Study selection*

Retrieved articles were evaluated independently by two people to determine if they met the following inclusion criteria for full review, with any disagreement resolved by consensus:

- (1) sample participants were aged  $\geq 60$  years;
- (2) prospective cohort design with a duration of at least 1 year;
- (3) samples comprised community-dwelling individuals alone;

- (4) ‘falls’ was the primary study outcome, including ‘any fall’, ‘recurrent falls’ and ‘injurious falls’, and the association between the dual-task test and future fall risk was evaluated in statistical analysis;
- (5) dual-task assessment had to be detailed explicitly in the methods section;
- (6) inclusion and exclusion criteria and demographic information were reported; and
- (7) confounding factors were reported and used in multi-variable regression analysis to generate adjusted risk estimates.

### *Quality assessment of articles*

Each article that met the inclusion criteria was assessed independently by two raters for reporting quality. Articles were rated using the scale by Tooth *et al.* [15], which is a validated and reliable list of criteria for evaluating threats to internal and external validity in observational studies. This scale has 33 questions covering the areas of recruitment, data collection, biases, data analysis, study population and generalisability. The maximum possible score is 33, with higher scores indicating greater reporting quality.

### *Data extraction and analysis*

Articles selected for full review had the following information extracted: authors, country, date of publication, sample size at baseline and follow-up, demographic information (percentage female, mean age, percentage with a history of falls reported at baseline assessment), inclusion/exclusion criteria, fall definition, method of fall ascertainment, type of fall outcome, dual-task test (specifics of gait and secondary task, details of how the test result variable was used in the analysis), length of follow-up and percentage of sample who sustained the fall outcome to determine annual fall risk. In the dual-task testing protocol, the activity that was measured for variation between a single and dual state was labelled the ‘primary task’, and the additional activity to be performed concurrently with the primary task was labelled the ‘secondary task’. The cognitive tasks used in the dual-task testing were classified using the system developed by Al-Yahya *et al.* [16]. The risk ratio or odds ratio values for the association between the dual-task test and future falls were abstracted from the eligible papers. There was no a priori outline for formal meta-analysis of data.

## Results

### *Study characteristics*

In total, 313 unique abstracts were identified as potentially relevant, and 24 full-text articles were retrieved for detailed analysis (Fig. A, see online supplementary material). Ten articles met the inclusion criteria [17–21] (Table 1). Appendix

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