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Review

Single and dual task tests of gait speed are equivalent in the prediction of falls in older people: A systematic review and meta-analysis

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ABSTRACT

Although simple assessments of gait speed have been shown to predict falls as well as hospitalisation, functional decline and mortality in older people, dual task gait speed paradigms have been increasingly evaluated with respect to fall prediction. Some studies have found that dual task walking paradigms can predict falls in older people. A systematic review and meta-analysis was conducted to determine whether dual task walking paradigms involving a secondary cognitive task have greater ability to predict falls than single walking tasks. The meta-analytic findings indicate single and dual task tests of gait speed are equivalent in the prediction of falls in older people and sub-group analyses revealed similar findings for studies that included only cognitively impaired participants, slow walkers or used secondary mental-tracking or verbal fluency tasks.

Contents

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1. Introduction

Over the past two decades, an extensive body of research has shown that walking is not an automatic activity and that cognition, in particular attention and executive functioning, contributes significantly to balance and locomotor control (Yogev-Seligmann et al., 2008; Woollacott and Shumway-Cook, 2002). Much of this work has involved dual task paradigms which typically require participants to divide their attention and concurrently undertake two or more tasks, usually a cognitive and a motor task. In 1997, Lundin-Olsson et al. (1997) used a dual task assessment, the "stops walking while talking test", in a seminal study of fall risk in residents of senior housing facilities. They found that residents who stopped walking in order to engage in a conversation had significantly shorter times to a future fall than residents who could talk without stopping walking.

Since then, many studies have investigated cognitive/motor interference while walking and its relationship to fall risk in elderly and clinical populations. Some of these findings have been pooled in previous systematic reviews (Al-Yahya et al., 2011; Beauchet et al., 2009; Chu et al., 2013; Zijlstra et al., 2008). An early review (Zijlstra et al., 2008) included 19 studies with various protocols involving postural control, dynamic balance and gait tasks performed with and without secondary motor or cognitive tasks. This led to a high level of heterogeneity preventing a meaningful meta-analysis. The second review of 15 studies, by Beauchet et al. (2009) found that large dual task costs (i.e. the percentage difference between single and dual task performance in cognitive and/or motor tasks) were associated with a significant increased odds of falling in older people living in community and residential aged care settings. Al-Yahya and colleagues (2011) included 66 studies and focused on the effect of cognitive task type on gait. The main conclusions were that gait performance was most affected when cognitive tasks involving internal interfering factors (such as mental tracking tasks) were concurrently performed, and that older age and poorer cognitive function were both strongly associated with gait speed reduction in the dual task conditions. Finally, a meta-analysis of 15 studies demonstrated that mental-tracking tasks yielded significant dual task costs for fall prediction in older adults while verbal fluency or manual tasks did not (Chu et al., 2013).

Due to differing study aims, search strategies and review periods, the above systematic reviews have contained relatively few as well as different sets of the studies now available on the ability of dual task assessments to predict falls in older people. The findings of two previous meta-analyses (Beauchet et al., 2009; Chu et al., 2013) should also be interpreted with some caution as they pooled studies that used various walking tasks (some including transfers and turns), differing secondary cognitive or motor tasks and study populations varying with respect to residential settings and co-morbidities.

Despite the methodological limitations, there appears to be good evidence that dual task changes in gait performance are associated with significantly increased risk of falls in older people. However, the ability of simple measures of walking speed to predict falls has also been well-documented (Abellan van Kan et al., 2009; Deandrea et al., 2010), and the added value of dual task protocols as opposed to single walking tasks in predicting falls in older people has not been systematically evaluated in a meta-analysis.

The primary aim of this systematic review and meta-analysis, therefore, was to determine whether dual task walking paradigms involving a secondary cognitive task are superior to single walking tasks in predicting falls in older people. Additional aims were to compare the value of single and dual task walking speed measures for predicting falls in participant subgroups (i.e. those with and without cognitive impairment, slower and faster walkers) and whether a dual task: single task walking speed differential with respect to fall prediction is only apparent for particular secondary cognitive tasks (i.e. mental-tracking or verbal fluency tasks). We focussed on walking speed as this is the most widely used gait measure in clinical settings as well as the gait measure most often described in published studies of fall risk in older people.

2. Methods

2.1. Literature search

We conducted a systematic review of the literature to identify studies which had investigated the relationship between gait and falls in older people using a dual task paradigm involving a secondary cognitive task. Initially, we updated previous systematic reviews on the topic by combining their searches (Al-Yahya et al., 2011; Beauchet et al., 2009; Chu et al., 2013; Zijlstra et al., 2008). We then searched for articles in the following seven electronic databases: PubMed, Ovid MEDLINE, EMBASE, PsycINFO, CINAHL, Scopus and Cochrane Central Register of Controlled Trials. Individual search strategies were tailored to each database using the following Medical Subjects Headings (MeSH; in bold) and key terms:

1. **gait** OR **walking** OR locomotion
2. Falls OR **Accidental falls** OR falling OR faller
3. **aged** OR **aged**, **80 and over** OR aging OR ageing
4. dual task* OR dual-task* OR cognition OR attention
5. #1 AND #2 AND #3 AND #4

The search was performed without language restrictions and results were filtered to produce all publications from 2008 to February 2013 (inclusive of publications published electronically ahead of print). To identify further possible studies, reference lists of the previous systematic reviews (Al-Yahya et al., 2011; Beauchet et al., 2009; Chu et al., 2013; Zijlstra et al., 2008) and all other relevant articles were hand-searched.

2.2. Inclusion and exclusion criteria

To be included, articles had to describe studies which evaluated gait at self-selected speed under single and dual task conditions in older people to either: (i) predict falls, or (ii) discriminate between fallers and non-fallers based on retrospective data collection.

Articles were excluded if: (i) they were individual abstracts, case studies or reviews; (ii) the focus was on patient groups (for example: Parkinson's disease, stroke, etc.) other than cognitive impairment; (iii) participants' mean age was less than 65 years or all participants were younger than 60 years of age; (iv) the walking task did not involve time or gait speed as an outcome; (v) the secondary task was not a cognitive task; (vi) subjective scoring systems were used to assess dual task performance; (vii) they