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Group-based exercise combined with dual-task training improves gait but not vascular health in active older adults without dementia☆

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ABSTRACT

Background: Gait abnormalities and vascular disease risk factors are associated with cognitive impairment in aging.
Objective: To determine the impact of group-based exercise and dual-task training on gait and vascular health, in active community-dwelling older adults without dementia.
Methods: Participants [$n = 44$, mean (SD) age: 73.5 (7.2) years, 68% female] were randomized to either intervention (exercise + dual-task; EDT) or control (exercise only; EO). Each week, for 26 weeks, both groups accumulated 50 or 75 min of aerobic exercise from group-based classes and 45 min of beginner-level square stepping exercise (SSE). Participants accumulating only 50 min of aerobic exercise were instructed to participate in an additional 25 min each week outside of class. The EDT group also answered cognitively challenging questions while performing SSE (i.e., dual-task training). The effect of the interventions on gait and vascular health was compared between groups using linear mixed effects models.
Results: At 26 weeks, the EDT group demonstrated increased dual-task (DT) gait velocity [difference between groups in mean change from baseline (95% CI): 0.29 m/s (0.16–0.43), $p < 0.001$], DT step length [5.72 cm (2.19–9.24), $p = 0.002$], and carotid intima-media thickness [0.10 mm (0.003–0.20), $p = 0.04$], as well as reduced DT stride time variability [8.31 coefficient of variation percentage points (−12.92 to −3.70), $p < 0.001$], when compared to the EO group.
Conclusions: Group-based exercise combined with dual-task training can improve DT gait characteristics in active older adults without dementia.

Abbreviations: DT, dual-task; RCT, randomized controlled trial; CCAA, Canadian Centre for Activity and Aging; MoCA, Montreal cognitive assessment; MMSE, mini-mental status examination; $VO2_{max}$, maximal oxygen uptake; CoV, coefficient of variation; BP, blood pressure; CAC, carotid arterial compliance; cIMT, carotid intima-media thickness; EDT, exercise + dual-task; EO, exercise only; SSE, square-stepping exercise.

☆ This work was conducted at the Canadian Centre for Activity and Aging and at Lawson Health, Research Institute (Parkwood Institute Site), London, ON, Canada.

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1. Introduction

Mobility impairments, including gait dysfunction, are frequently observed in community-dwelling older adults prior to the diagnosis of cognitive impairment or dementia and may be an early indicator of cognitive decline. Specifically, gait variability (i.e., the stride-to-stride fluctuations in spatiotemporal gait parameters) increases with age and is associated with cognitive impairment (Montero-Odasso et al., 2014). Furthermore, gait variability under dual-task (DT) conditions (i.e., walking while talking) is exacerbated in those with cognitive impairment (Montero-Odasso et al., 2014). Gait disorders in older adults are also associated with pre-existing cardiovascular disease (i.e., stroke) (Hajjar et al., 2009) and vascular disease risk factors (i.e., hypertension) (Annweiler & Montero-Odasso, 2012), which appear to be mediated by the presence of subclinical cerebrovascular abnormalities (i.e., cerebral infarcts and white matter hyperintensities) (Rosano, Brach, Studenski, Longstreth, & Newman, 2007) in non-demented older adults. Taken together, these observations suggest that increased gait variability under usual and DT conditions can serve as an early indicator of cognitive impairment in community-dwelling older adults. Furthermore, the management and reduction of vascular risk factor burden might be an effective method to improve gait in older adults who are at increased risk for future functional and cognitive decline (Annweiler & Montero-Odasso, 2012).

A recent population-based study reported reductions in the incidence of dementia among high-income nations (Langa, 2015), and these findings have been attributed to advances in the treatment of vascular risk factors and an increased awareness of the importance of preserving vascular health for the prevention of chronic conditions in aging. Despite this promising trend, chronic cardiovascular conditions remain the leading cause of global mortality (The World Health Organization, 2012) and continue to contribute to cognitive decline and the development of Alzheimer's disease and related dementias. Cognitive and functional impairments are common among individuals with established cardiovascular disease; in fact, it is estimated that 3% and 5% of worldwide Alzheimer's disease cases are due to diabetes and hypertension, respectively, while an additional 13% of Alzheimer's disease cases can be attributed to physical inactivity (Norton, Matthews, Barnes, Yaffe, & Brayne, 2014).

Leading a physically active lifestyle has been consistently associated with improved cardiovascular health and functioning (Seals, Desouza, Donato, & Tanaka, 2008), preserved mobility (Ho, Woo, Yuen, Sham, & Chan, 1997), and improved cognitive function (Gregory, Gill, & Petrella, 2013) among older adults. Programs that incorporate both physical exercise and cognitive training have been associated with a number of health benefits in older adults without dementia including: preserved structure and function within regions of the brain associated with memory performance (Tian et al., 2014); improved objective cognitive performance (Gregory et al., 2013) and DT performance (Theill, Schumacher, Adelsberger, Martin, & Jancke, 2013); and improved vascular health (Garcia-Mesa et al., 2015). Further, evidence suggests that older adults who simultaneously perform physical and cognitive training (i.e., DT training) experience greater improvements in cognition, specifically in executive functioning, compared to those performing cognitive training alone (Theill et al., 2013). Nonetheless, a specific exercise modality that most effectively addresses the cardiovascular, mobility, and cognitive concerns in aging has yet to be determined, and the specific effects of exercise combined

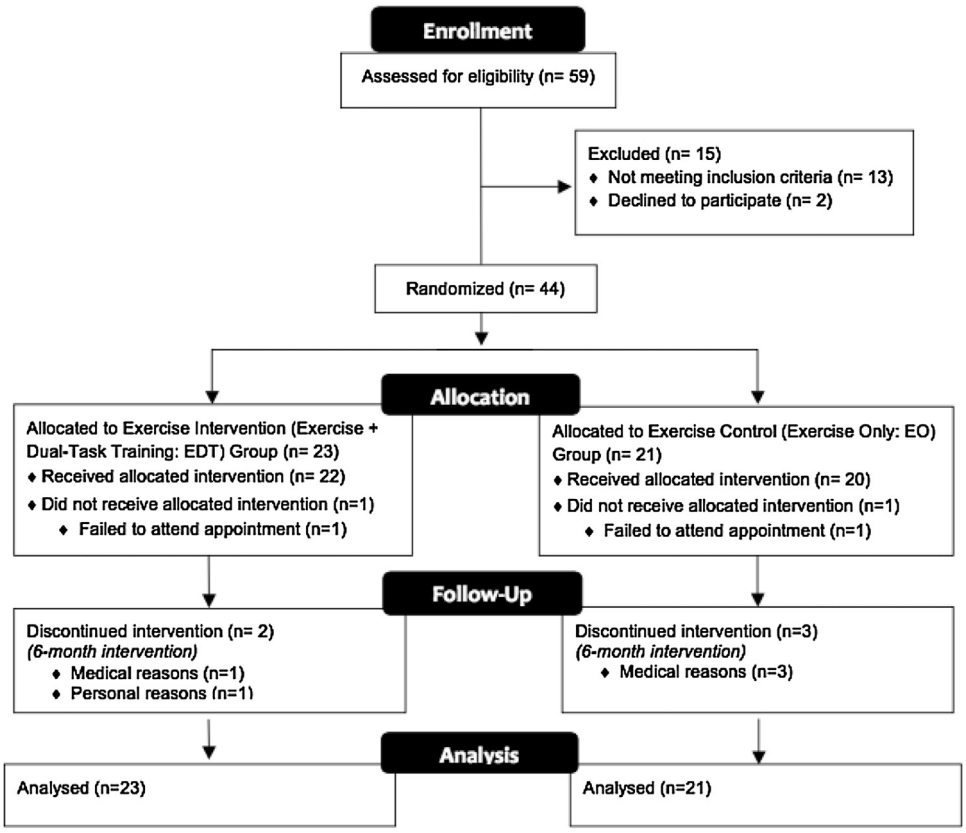

Fig. 1. Study flow. Participant flow for the 26-week parallel-groups randomized controlled trial.