CHAPTER 1

INTRODUCTION

Even though people of all ages may experience falls, the likelihood for injurious falls increases in people over the age of 65 (1, 2). Approximately 30% of people over 65 years of age fall at least once a year (3) and the falling rate increases to 40% among those over the age of 75 (4, 5). Falls in older adults often leads to devastating consequences such as physical injury, fear of falling, reduced mobility, limited independent living, decreased quality of life, and death (6-8). In addition, falls are costly and place a substantial burden on health care resources (9-11). The Center for Disease Control and Prevention reported that medical costs related to falls in older adults was 20 billion dollars in the year 2000 and will increase to 54 billion dollars in the year 2020 (10, 11).

Because falls in older adults are associated with considerable morbidity, mortality, and enormous financial and non-financial costs, preventive interventions to reduce the incidence of falls are a critical health care needed. Research suggests that interventions would be most efficient if training programs were aimed toward specific modifiable risk factors (12, 13). Although most falls often involve multiple factors, studies show that balance impairment is a major contributor to falling in older adults and that falls mostly occur during walking (1, 13, 14). Older adults tend to lose their balance and fall during walking while simultaneously performing an additional (secondary) task (i.e. a dual-task condition) such as walking while talking or walking while carrying a glass of water (15-17). Prior studies reported a decrease in gait performance under the dual-task conditions compared to the single-task condition (i.e. walking without any secondary tasks) such as decreased gait speed (7, 16, 18), increased stride velocity variability (19), increased stride time variability (20), and increased swing time variability (21). In addition, dual-task balance performance was associated with the number of retrospective and prospective falls in older adults (15-17, 20, 22, 23). For example, Beauchet et al. (22) determined whether dual-task related gait changes were associated with recurrent falls in 213 frail older adults. The results showed that a decrease in walking speed while dual tasking corresponded with an increase in the risk of recurrent falls by 66.7%. Thus, improving the ability to walk under dual-task conditions is essential to reduce fall risk in older adults.

Even though the mechanism underlying dual-task balance processing is still not known, several recent studies suggest that falls in older adults occurring under dual-task situations may be caused by the reduced ability to allocate attention between tasks, especially to prioritize postural stability over success on the secondary cognitive task (24-27). Yogev-Seligmann et al. (27) examined the ability to change prioritization and allocation of attention between a postural task (i.e. gait) and a cognitive task (i.e. verbal fluency task) under 3 prioritization conditions (i.e. no priority, cognitive priority, and gait priority) in 40 healthy young adults and 17 healthy older adults. The results showed that only young adults increased their gait speed in the "gait priority" condition compared to the "no priority" condition. In addition, gait speed was similar in the "no priority" and "cognitive priority" conditions for both age groups, though there was a tendency in young adults, not in older adults, toward a decrease in gait speed in the "cognitive priority" condition compared to the "no priority" condition. It was therefore suggested that there was an age-associated decline in the ability to flexibly allocate attention between tasks and that both healthy young and older adults may not give postural stability a top priority.

Siu et al. (24, 25) also investigated the ability to flexibly allocate attention between a postural task (i.e. obstacle avoidance task) and a cognitive task (i.e. auditory Stroop task) under 3 different instructional sets (i.e. non-focus, focus on cognitive task, and focus on postural task) in 12 healthy young adults, 12 healthy older adults, and 12 older adults with balance impairments. In contrast to Yogev-Seligmann and colleague's study (27), the results revealed that both healthy young and older adults decreased their gait speed when the priority was shifted to the obstacle avoidance task and increased their gait speed when priority was given to the auditory Stroop task. Thus, it was suggested that both healthy young and older adults were able to shift their attention between the obstacle avoidance task and the auditory Stroop task according to instructions. Only older adults with balance impairment showed deficits in flexibly allocating their attention between the two tasks.

Thus, to date, there is no conclusive finding whether older adults, especially older adults with balance impairment, are able to flexibly allocate attention between a gait task and a cognitive task. In addition, participants in Siu and colleague's study (24, 25) increased their gait speed when priority was given to the auditory Stroop task whereas those in Yogev-Seligmann and colleague's study (27) tended to decrease their gait speed when priority was given to the verbal fluency task. Therefore, whether the type of secondary task used and level of task difficulty affect the ability to allocate attention is still not known. Thus, the purpose of this study was to investigate the ability to allocate attention during gait as a function of age, balance ability, and secondary task characteristics. A better understanding of dual-task balance processing, specifically the ability to allocate attention, would lead to the development of an optimal strategy to prevent falls in the older population.

Aims and hypotheses of the study

1.1 Aims of the study

To determine the effects of ability to allocate attention on gait as a function of age, balance ability, and secondary task characteristics

1.2 Hypotheses

1) Only healthy young adults and healthy older adults will show the ability to allocate attention between a walking task and an easy cognitive secondary task, whereas all participants will not be able to allocate attention between a walking task and a difficult cognitive secondary task. In addition, all participants will be able to allocate attention between a walking task and a manual secondary task.