



LETTERS TO THE EDITOR

PREDICTING INJURY FROM FALLS IN OLDER ADULTS: COMPARISON OF VOLUNTARY STEP REACTION TIMES IN INJURED AND NONINJURED FALLERS—A PROSPECTIVE STUDY

To the Editor: Falls in old age have a high risk of injury. It has been reported that 24% of falls in community-dwelling older persons resulted in serious injury.¹ Another study found that 12.5% of older men and 27.3% of older women who fell were injured.² It has also been found that, of older community dwellers who fell, 8% received a major injury and 49% minor injuries.³ The current study aimed to prospectively determine the capacity of voluntary stepping performance under single- and dual-task conditions to predict future injuries resulting from falls in older community-dwelling persons. It is important for fall prediction to focus on stepping responses, because it is the inability to step rapidly in response to a loss of balance that ultimately determines whether a fall occurs.^{4,5} Another factor potentially limiting an effective and rapid stepping response in elderly people is the simultaneous performance of a secondary attention-demanding task.⁶ Two retrospective studies found that older people, and more so those at risk of falling, have an impaired ability to initiate and execute quick voluntary steps, particularly in situations in which their attention is divided.^{7,8} Step characteristics (e.g., step initiation phase, foot-off and -contact time, preparatory and swing phases) were extracted from center of pressure and ground reaction force data as described in detail in previous studies.^{5,7} Prospective 1-year fall incidence and injuries were monitored in 100 older adults (aged ≥ 65). Fallers were divided into two groups: seriously injured (SI; needed medical attention) and not seriously injured (NSI; did not need medical attention).

Of 100 participants, 98 completed the 1-year follow-up, 49 nonfallers, 32 who fell once, and 17 recurrent fallers (≥ 2), generally resembling past studies. Of those who fell in the present study, the incidence of SI was 26.5% (13/49)

and of NSI was 73.5% (36/49). As Figure 1 shows, there were no statistically significant differences between SI and NI across all step execution parameters during the single-task condition. When an attention-demanding task was added, statistically significant differences ($P < .05$) between SI and NI were found in step initiation phase (503 ms vs 367 ms), foot-off (998 ms vs 819 ms), and foot-contact times (1,394 ms vs 1,177 ms).

A stepwise regression model was used with the underlying purpose of predicting fall severity, using predictors for falls—foot contact times during single- or dual-task conditions and including the Timed Up and Go and the occurrence of two or more falls 1 year before the beginning of the study. It was found that foot-contact time during dual task was the best predictor for prospective severity of falls (odds ratio = 4.56, 95% confidence interval = 1.3–23.6, $P = .03$).

To the authors' knowledge, this study is the first to demonstrate prospectively differences in voluntary stepping response in dual-task conditions between older adults who subsequently were or were not injured as a result of a fall. A significant difference between SI and NI in the step initiation phase during dual-task stepping only may have resulted largely from an increase in central neural processing time in SI. These may well be markers for greater risk of serious injury resulting from falling. Consequently, the results from the present study add to a growing body of evidence^{5–9} showing that central processing factors and attentional capacity are important limitations for volitional postural reactions in older adults. The results demonstrate that dual-task stepping is more attentionally demanding and taxing of the available cognitive resources for SI and that the dual-task stepping paradigm is sensitive to changes in balance function, something single-task measures did not do as well. This illustrates that older fallers who are at risk of injury may be at a considerably greater risk of falling during an attention-demanding task, a situation commonly encountered in real life.

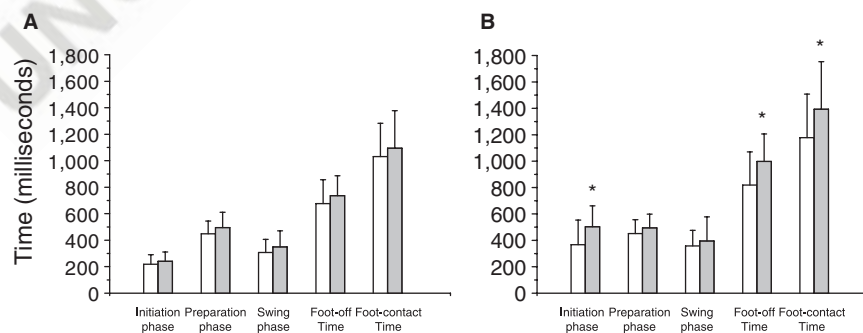


Figure 1. Analysis of variance (2 × 2) two groups and two task conditions of the average step execution times in milliseconds (white represents old adults who were Not seriously injured as a result of fall and filled represents older adults who were seriously injured as a result of fall (± 1 standard deviation). Nine trials (A) single-task condition—left; (B) dual-task condition—right. *Significant differences between older adults who were seriously injured and those who were not seriously injured ($P < .05$).

In conclusion, the evidence indicates that the dual-task paradigm of the voluntary step execution test may be a simple and safe test to detect the probability of being seriously injured from a fall. The results of the present study also provide specific target areas for clinical interventions to prevent falls. It seems that specific and progressive training to improve the speed of stepping, in single- but especially in dual-task conditions, may be improved after specific dual-task training, as reported previously,¹⁰ and thus may reduce the risk of falls and their related injuries in older adults.

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