Comparing Balance among Elderly Fallers and Nonfallers Using Modified Romberg Test: A Case–Control Study

Sir,

Fall is a significant social and public health issue among older adults, mainly because it may result in physical injury, mortality or the psychological impact of a fall can result in loss of independence, institutionalization, which often leads to a decline in overall quality of life.[1]

Sensory inputs gathered through the somatosensory, visual and vestibular systems are important in updating the central nervous system about the body’s position and motion in space.[2] Advancing age accompanied by diverse changes in sensory components of postural control leading to instability and eventually falls.[2] Therefore, it is important to consider the somatosensory sensations in the evaluation and intervention processes in older adults.

The Modified Romberg Test of Standing Balance on Firm and Compliant Support Surfaces is a simple neurological test that is static in nature and uses multiple senses.[3] It examines the participant’s ability to stand unassisted under four Test Conditions which are as follows: (1) eyes open, firm surface, (2) eyes closed, firm surface, (3) eyes open, compliant surface, and (4) eyes closed, compliant surface.[3] Therefore, the aim of the study is to compare the performance among elderly fallers and nonfallers using the Modified Romberg Test.

70 community dwelling elderly residing in Pune city, 35 having a history of at least one fall in the previous year constituted the case group, other 35 subjects having no history of falls constituted the control group. There were 21 females and 14 males in both, the control group and the case group. The inclusion criteria were as follows: community dwelling elderly in the age group of 60–69 years, ability to follow the steps involved in the test, independently ambulant without an assistive device and free from significant pain that limits their functional mobility. The exclusion criteria were as follows: previous eye or ear surgery, any physical disability that limits their functional mobility, a history of neurological disorders (such as stroke, Parkinson’s disease, and diabetic neuropathy) or any orthopedic condition that rendered the individual unable to walk or stand even with an aid.

The demographic characteristics of all participants were collected. Before performing the Modified Romberg Test, each participant was taught how the test was executed to minimize variation in test performance. The participants were instructed to stand with feet together and arms folded across the chest. All the participants were restrained from wearing footwear during the assessment. They were asked to hold each test condition for at least 30 s. Test failure was defined as a subject needing to open their eyes, moving their arms or feet to achieve stability or beginning to fall or stepping within a 30 s interval.[1] Each participant proceeded with the successive test conditions even if they failed to pass the previous one.

Table 1 shows comparison of the scores between fallers and nonfallers for all four Test Conditions on the Modified Romberg Test.

It is important to understand the postural control and functional performance issues of the patient using functional balance tests which examines activities across multiple systems contributing to balance. This study reports comparative results of the Modified Romberg Test between elderly fallers and nonfallers. It was observed that only two participants of the control group were able to complete the Modified Romberg test with eyes open on a firm surface (Test Condition one) whereas none of the remaining participants of both the groups could complete any of the Test Conditions mentioned above. This could be due to several physiological and psychological differences between fallers and nonfallers that may have a potential effect on their performance on the Modified Romberg test.[4,5] It was observed that the scores of the Modified Romberg Test for Test Conditions one, two and three were statistically significantly lower in fallers as compared to nonfallers. This finding suggests that age related changes in the somatosensory, visual and vestibular systems appear to correlate with impaired postural control and an increased risk of falling.[1,4,5]

Table 1: Comparison of the scores between fallers and nonfallers for all 4 test conditions on the Modified Romberg test

| Groups                              | Mean±SD (values in seconds) | Statistical significance P |
|-------------------------------------|-----------------------------|----------------------------|
|                                     | Nonfallers (n=35)           | Fallers (n =35)            |                            |
| Eyes open, firm surface             | 19.3±5.598                  | 13.7±5.078                 | 0.001*                     |
| Eyes closed, firm surface           | 13.46±5.858                 | 9.97±5.238                 | 0.011*                     |
| Eyes open, compliant surface        | 13.80±6.282                 | 10.20±4.928                | 0.010*                     |
| Eyes closed, compliant surface      | 7.26±3.302                  | 6.06±3.940                 | 0.172                      |

*Independent t-test (P<0.05 was considered statistically significant). SD: Standard deviation
Both fallers and nonfallers had a significant decrease in time to failure while standing on foam with eyes closed (Test Condition four). This might be the result of reduced vestibular function resulting from increased age and chronic health problems but the lack of statistically significant difference for Test Condition four on the Modified Romberg Test suggests that vestibular dysfunction is less likely to influence the odds of falling in elderly as compared to the visual and somatosensory systems.\cite{1,3,5}

The greater difference in Test Condition one as compared to the other three Test Conditions suggests that somatosensory inputs appear to be more impaired than visual and vestibular system for elderly fallers.\cite{1-3} A decrease in the difference of the scores while standing on foam (Test Conditions three and four) as compared to standing on a firm surface suggests that fallers are less influenced by a reduction in somatosensory input from the feet and also that both proprioception and cutaneous inputs are impaired in elderly individuals who fall and that they are less likely to use somatosensory information.\cite{1} Similar results were found in a 1-year prospective study conducted by Stephen R. Lord et al., wherein they found that discriminant function analysis identified visual contrast sensitivity, lower limb proprioception, quadriceps strength, reaction time, and sway on foam with eyes open as the variables that significantly discriminated between subjects who experienced multiple falls and subjects who experienced no fall or one fall only. They also found that there was little difference in the mean scores for the tests of vestibular function in the nonfallers, once-only fallers, and multiple fallers.\cite{5}

Another possible variable that may affect the performance of fallers is fear of falling.\cite{6} Alice C. Scheffer et al. conducted a systemic review of 28 relevant studies among the community-dwelling elderly which showed that fear of falling is a major health problem among the elderly living in community and that it resulted in a decline in physical and mental performance, an increased risk of falling and progressive loss of health-related quality of life.\cite{6}

It is important to consider these physiological and psychological variables in the evaluation process to plan a multicomponent balance specific exercise program and for developing rational, targeted fall risk reduction therapies.

The study did not differentiate into single and multiple fallers, limiting the generalizability of results. Second, it did not investigate the medication use and diseases such as diabetes mellitus which could influence the incidence of falls. Finally, it showed that fallers exhibited significantly poor balance than nonfallers, assessed using the Modified Romberg Test.

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There are no conflict of interest.

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