

## Cognition and Lower Limb Strength among Older Female Fallers and Non-fallers with a Visual Impairment

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### ABSTRACT

*This study investigates cognition and lower limb strength among older female fallers and non-fallers with a visual impairment. A total of 33 female elderly with visual impairment aged from 68 to 102 years old were recruited. Their vision, cognition, and lower body strength were assessed. Results showed scores in both cognitive assessments were significantly lower in fallers than non-fallers. Lower limb strength in various muscle groups, however, did not differ significantly between the two groups. Cognitive performance may be a potentially effective predictor for risk of falls in older female adults with a visual impairment.*

**Keywords:** cognition; MMT; falls; visual impairment

### INTRODUCTION

Falls among older adults is a very common problem which points to a public health issue. According to a report, nearly 30% of people aged 65 and older fall on yearly basis [1]. The risk increases to 45% for those over 80 years old [2]. Most falls are a result of intrinsic (i.e., personal such as physical strength) and extrinsic (i.e., environmental such as lighting) risk factors or a combination of both. Having a fall will likely worsen or produce a loss of functional independence and mobility, with fractures as one of the most severe consequences.

One important risk factors for falls in older adults is the presence of poor visual acuity (VA) [2-4], which makes them up to two times more likely to fall than elderly without [1,5]. The association was present in people living in the community or in an institution. Older women are especially prone to a high risk of falling if they have both visual and hearing impairments when compared with those without a sensory impairment [6].

Interestingly, in an investigation that compared visually impaired older fallers and non-fallers by Lamoureux, et al. [7], it was found that higher incidence of falls was not independently associated with any of the visual factors. Other factors, such as participation in physical activity or cognition, were suggested to play a more

significant role in assessing risk of falls in this population. Thus, this study investigates general cognition and lower limb strength among female seniors with a visual impairment (VI).

### MATERIALS AND METHODS

A total of 33 participants (18 fallers with 1 to 3 falls and 15 non-fallers in the last three years), female elderly with VI aged from 68 to 102 years old, were recruited from Hong Kong Society for the Blind. Informed consent was obtained from all participants or their family members. Their vision, cognition, and lower body strength were assessed after collecting the demographic information including age, gender, education level, and history of falls within the last three years. Near Vision Test and Tumbling E Chart, administered through Eye Chart Pro (Dok, 2010), were used to test and confirm participants' level of VI. They were examined with corrective lenses in both tests. If the levels of VA of the participant were different between the eyes, the side with better function was taken and considered as the binocular VA level. According to World Health Organization [8], 20/70 to 20/160 is considered as moderate VI, 20/200 to 20/400 as severe VI, and 20/500 to 20/1000 as profound VI.

Cantonese version of Mini-Mental State Examination (MMSE)-VI (cMMSE-VI) and The Hong Kong Version Montreal Cognitive

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Assessment - VI (HK MOCA-VI) were chosen to assess individual's cognitive function. These assessments evaluate domains of orientation, attention, memory and language. They have been modified to suit people with VI. The cMMSE-VI and HK MOCA-VI have a total score of 28 and 22, respectively. Manual Muscle Testing (MMT) was used on participant's lower extremities to evaluate their muscle strength through performing movements in relation to the gravity and manual resistance. The muscles evaluated include hip flexors, extensors, abductors, and adductors, knee flexors and extensors, and ankle dorsi- and plantar-flexors. The grading is from grade 1 to grade 10[9]. Data obtained were analyzed by XLSTAT[10].

## RESULTS

All of the 33 participants had profound or severe VI based on results from the visual tests. Both cMMSE-VI (fallers vs. non-fallers:  $18 \pm 3.4$  vs.  $20 \pm 3.0$ ) and HK MOCA-VI (fallers vs. non-fallers:  $9.1 \pm 4.0$  vs.  $11.8 \pm 4.1$ ) were significantly lower in fallers than non-fallers (independent samples t-tests;  $p$ 's < 0.05; see figure 1). Test scores correlated with number of falls weakly (Pearson's correlation coefficient; cMMSE-VI  $r = -0.37$ ; HK MOCA-VI  $r = -0.38$ ). Hip flexor, extensor, abductor and adductor, knee flexor and extensor, and dorsi- and plantar-flexor strength did not differ between the two groups (ordinal log it model; probability of the Chi-square test on the log ratio > 0.05).

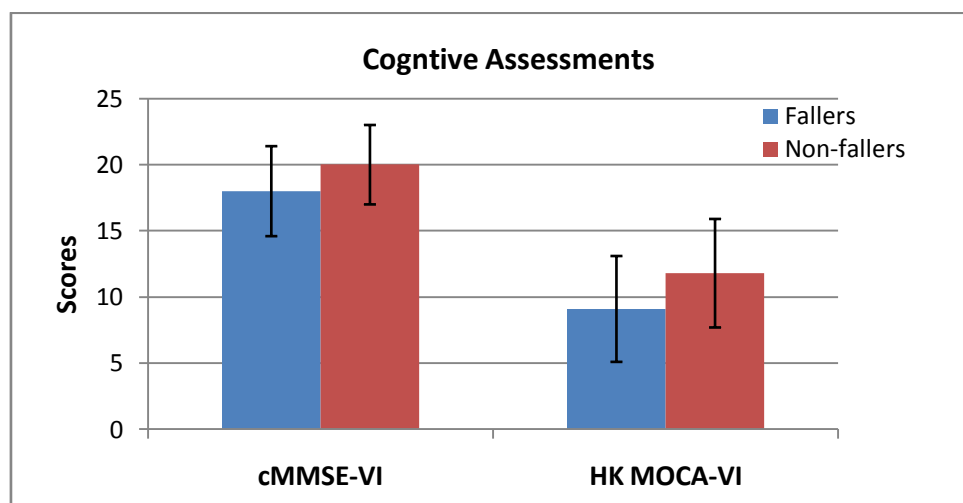


Figure 1. Cognitive assessments and their scores

## DISCUSSIONS

This study investigates cognition and lower limb strength among older female fallers and non-fallers with a visual impairment. The results from cMMSE-VI and HK MOCA-VI suggested that cognitive performance may be a potentially effective predictor for risk of falls in older female adults with a VI. Both cognitive assessments seemed equally sensitive to differences between fallers and non-fallers. Previous studies have made a connection between falls and cognition. In people over 75, an impairment in memory is found to be one of the risk factors for falls [11]. In addition, the probability of falling doubles in those residing in an institution and have a diagnosis of dementia[11]. To perform the walking movements, certain amount of cognitive resources has to be allocated to this task. In the cases of an interfering event or dual tasking (e.g., talking or holding an object while

walking), a visually impaired elderly with already reduced cognitive resources may not be able to allocate sufficient resources required by the walking movements and, thus, the performance would reduce. This is one of the possible explanations to link their falls and cognition. As we only have a small sample size, the cut-off score, though useful, to determine those with increased risks of falls cannot be suggested.

Strength in the lower limbs typically correlates positively with balance, postural control and mobility [1]. In this investigation, the lower limb strength was not significantly different between the two groups of participants even though there seemed to be a trend that fallers demonstrated a lowered strength in various muscle groups. Therefore, lower limb strength and its relationship with falls in this population will need to be further evaluated in study with a larger sample size.

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