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Original Study

History of falls, mild cognitive impairment, and the presence of home environmental hazards among community-dwelling older persons in District V, Manila

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Abstract

Introduction: It is important to investigate factors that may increase the fall risk in the geriatric population in the Philippines. This study aimed to determine the relationship between 1) mild cognitive impairments (MCI) and history of falls; 2) home environmental hazards (HEH) and history of falls; and 3) MCI and HEHs among older adults.

Methods: Community-dwelling older persons of District V, Manila were random sampled to participate in this cross-sectional correlational study. The Home Falls and Accidents Screening Tool for Health Professionals (HOMEFAST-HP) and Fall History Questionnaire were used to collect information on the presence of HEH and history of falls, respectively. Chi-Square test was used to determine the relationships between variables.

Results: Thirty-seven (37) older adults, with a mean age of 69.8 + 8.1 years (range = 60-95), 84% female, participated. Majority (78.4%) have MCI. Seven (18.9%) have a history of falls. However, no significant association (p=0.12) exists between MCI and history of falls. About 68.2% of fallers were noted to have HEH, with improper bed (p=.04), inaccessible kitchen items (p=.02) and unidentifiable step edges (p<.01) as HEH which are significantly associated with fallers. While HEH are more observed (72.73%) in MCI older adults' homes compared to their peers, only loose mats (p=.04) and improper bed (p=.01) as HEH reached significant association with MCI.

Discussion: In this study, MCI is not associated with the history of falls. HEH are more common in MCI and fallers, particularly the inaccessible kitchen items, improper bed, loose mats, and unidentifiable edges of steps. Home modifications to address these identified HEH may decrease the fall risk of Filipino older adults with and without MCI. Further investigation using a bigger sample size across different dwelling situations should be considered.

***Keywords*:** home environmental hazards, mild cognitive impairment, fall

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Introduction

It is estimated that 30-40% of individuals aged over 65 years will incur a fall at least once in a year (Ambrose et al., 2013). Falling is the second leading cause of death worldwide in this population (WHO, 2021). In the Philippines, falls occurred in 53.6% of older persons living in the community (Romli et al., 2017). Based on the Risk Factor Model for Falls among Elderly, the interaction of four risk factor domains, namely: (1) biological, (2) behavioral, (3) environmental and (4) socioeconomic can lead to falls and fall-related injuries (WHO, 2007). Biological risk factors include non-modifiable factors such as age, gender, and race, physical factors (such as muscle weakness, visual and gait problem, impaired balance, limited mobility and activities of daily living, and lower body mass index), cognitive and emotional abilities and chronic medical conditions or diseases (i.e. diabetes, Parkinson's disease, depression, incontinence and Alzheimer's disease). The presence of cognitive impairment, a biological risk factor, is a predictor of falls among community-dwelling older persons (Delbaere et al., 2012). Mild Cognitive Impairment (MCI) is part of the cognitive decline continuum. This condition is defined as a transitional zone between normal age-related cognitive changes and dementia (Feldman & Jacova, 2005). MCI is associated with the pre-dementia stage of cognitive decline (Sachdev, et. al, 2012). The reported prevalence of MCI in the different countries ranged from 0.3% to 63.3% (McGrattan et al., 2021). In a population-based cohort study, the prevalence of MCI in the Philippines is 23.2 % (Dominguez et al., 2018). On the other hand, environmental risk factors comprise home hazards and risk features in the public environment. Some examples of home hazards are the presence of narrow steps, slippery surfaces and poor lighting. Exposure to different home hazards and their interaction to other risk factors (behavioral, socio-economic, and biological) causes falls (WHO, 2007). Qian et al. (2011) found that there were significant differences between fallers and non-fallers in most variables from the four risk factor domains.

The presence of HEH is a risk factor associated with falls among older persons (Leclerc et al., 2010). Older persons with a history of falls are commonly residing in residences with one or more HEH (Pfortmueller et al., 2014). In a review of 12 retrospective studies on falls among older persons, 30-50% of the most commonly cited causes of falls were environment-related(Rubenstein, 2006). Majority of the reported falls happened inside the house, particularly in the bathroom and stairs (Sazlina et. al, 2008). There is also a higher incidence of injuries related to falls inside the house (Rosen et al., 2013). In a systematic review by Valipoor (2020) on falls of older adults, an overall finding indicates that there is a positive relationship between the presence of HEH and the occurrence of falls and injuries. These home environmental factors have been reported to increase the risk of falls include throw rugs and loose carpets, electrical cords along pathways, door ridges or thresholds, cluttered and slippery floors, dim lighting, poorly designed tubs, toilets and bathroom, and pets getting under the feet of individuals (Public Health Agency of Canada. Seniors Falls in Canada. Second Report, 2014). In the Philippines, the Guevarra and Evangelista (2010) found the following HEH related to falls in older persons in nursing home settings: presence of slippery floors in the bathroom or bedroom (67%) in private homes, and the presence of slippery hallways, corridors, stairs or bedrooms (65%).

Older persons with MCI may have impaired judgment related to problem solving and decision-making as to the course of action, uncertain events and consequences (Capucho & Brucki, 2011) and limitation of their ability to recognize and avoid HEH because they have higher time spent on walk and dual-task tests that were associated with falls (Ansai et al., 2019). In a study of Feldman and Chaudhury (2008), it was argued that the presence of environmental falls was due to poor judgement and not merely on environmental features. In addition, more HEH are present among older persons with cognitive impairment who had fallen as compared to older persons with cognitive impairment who had not fallen (Feldman & Chaudhury, 2008). Corollary to this, there are no known studies that have specifically identified where in the cognitive decline continuum would significant home environmental hazards begin to be seen.

Therefore, this study was conducted to determine the relationship between 1) MCI and history of falls, 2) the presence of HEH and history of falls, and 3) MCI and the presence of HEH in Filipino community-dwelling older adults. The findings of this study will be important to health professionals in geriatric care and to families and caretakers of older persons with and without MCI when making informed decisions about implementing home modifications in relation to risk of falling in their private households.

Methods

Study Design

This study employed a cross sectional-correlational design. This type of study design is aimed at describing the characteristics of a population or the differences between two or more populations at one point in time (Dawson & Trapp, 2004; Kumar, 2011). Ethical approval was sought from the University of Santo Tomas-Graduate School-Ethics Review Committee. Informed consent was obtained from all participants. In cases where the participant could not read or write, a legal guardian provided the consent.

Study Participants

The participants were community-dwelling older persons residing in District V of the city of Manila. This district was chosen because it is one of the districts with the highest number of older

persons in the city with a geriatric population of 13,708 according to the Office of Senior Citizens Affairs. They were randomly selected via draw lots from the list of 230 participants in a previous cross-sectional study by Lipardo and Tsang (2021). Community-dwellers are persons who are living alone or with others in a private household. They were included if they are persons aged 60 years or above as based from s. 3.a of the Expanded Senior Citizens Act of 2010 (R.A. 9994), currently residing in their private household for at least 12 months, and independent in performing activities of daily living with a score of 6/6 in the Katz Activities of Daily Living (Shelkey and Wallace, 2001) and a score of at least 5 for males and at least 8 for females in the Lawton Instrumental Activities of Daily Living Scale (Graf, 2009). The exclusion criteria were: 1) older persons living in an institution, nursing homes or structured facilities within the district; 2) medically diagnosed with dementia (Diagnostic and Statistical Manual of Mental Disorders, 4th Edition or DSM-IV) or Alzheimer's disease); 3) presence of any of the following medical conditions: neurological diseases (stroke, Parkinson disease), cardiopulmonary conditions (heart attack, chronic pulmonary disease), severe musculoskeletal disorder (arthritis, lower extremity amputation), cancer, psychiatric conditions (schizophrenia or major depressive disorder), major visual and/or hearing impairment; and 4) taking sedatives, antidepressants, diuretics or anti-epilepsy drugs. The presence of medical diagnosis and the medications taken were gathered through an interview.

Sample Size Computation

The sample size was completed using OpenEpi (Version 3). In consideration of the use of 1) measures of association of environmental factors with multiple falls (Nevitt et al., 1989; Liu-Ambrose, 2008); and 2) the reported prevalence of MCI of 10.86-17.9% (Roberts & Knopman, 2013), at least 37 older adult community-dwelling residents with and without MCI are required to attain 90% power of study with 90% two-sided level of significance (Kelsey et al., 1996).

Data Collection

Prior to actual data collection, a pilot test was scheduled to determine the feasibility of the use of the assessment tools and identify any problems that might arise during the actual implementation. Four older persons, who met the eligibility criteria participated in the pilot study. Their data were not included in the main research findings.

Eligible participants were interviewed using a questionnaire to obtain their socio-demographic information and fall history which were confirmed to be true by their respective family members or relatives. The validated Montreal Cognitive Assessment-Philippines (MOCA-P) was administered to determine their cognitive level and to establish the presence of MCI (Dominguez et al., 2018). Those with MOCA scores of 18 to 25 were diagnosed to have MCI (Nasreddine, 2005). A neuropsychiatrist gave the final diagnosis of MCI.

The Home Falls and Accidents Screening Tool for Health Professionals (HOMEFAST-HP) was used to assess the presence of HEH. HOMEFAST-HP is a 25-item checklist and focuses on functional tasks and mobility assessments within the home (Mackenzie et al., 2002). It has a good face and content validity with strong predictive validity for falls (OR: 1.016, $p = 0.006$). The interrater reliability of the tool is moderate ($k = 0.62–0.85$), and the test-retest reliability (ICC = 0.77–0.92) is excellent (Romli, et. al, 2021). Direct observation of the living environment of the eligible participants to assess the presence of HEH using the HOMEFAST-HP was conducted by a licensed physical therapist. The participants were visited at their private households for 20-30 minutes for this purpose.

Statistical Analysis

Stata v2013 was used to analyze the gathered data. Descriptive statistics were used to summarize demographic information. Chi-Square test was used to determine the relationships between variables. A p-value < 0.05 was considered significant. Responses in the HOMEFAST-HP marked as "not applicable", meaning hazards items did not exist or were not observed in the home (no shower recess), were excluded from analysis.

Results

Socio-demographic Profile and History of Falls among Older Adults

From a list of 230 older persons, 37 were randomly drawn to participate in the current study. All were deemed eligible to participate by the primary investigator, who is a licensed physical therapist. All the participants completed their written informed consent. The mean age of participants was 69.76 + 8.13 years, of which, 31 (83.8%) were females. Among the participants, 16 (43.4%) were married and 34 (91.9%) were living with companions. Three (8.1%) of the participants used assistive devices (cane) for ambulation. There were no significant differences in demographic characteristics between the fallers and non-fallers. Table 1 shows the socio-demographic profile of the participants.

Mild Cognitive Impairment and History of Falls

Majority (78.4%) of the participants have MCI. Seven (18.9%) reported having a history of falls in the past 12 months. All fallers were diagnosed with MCI. The Chi-Square test showed that

Table 1. Socio-demographic Profile of the Older Adults

	All (N=37)	Fallers (n=7)	Non-Fallers (n=30)	*p*-value
Age in years (mean ± SD)	69.76 ± 8.13	70.86 ± 8.32	69.50 ± 8.21	0.63
Sex (n, %)				
Male	6 (16.2)	0	6 (20.0)	0.20
Female	31 (83.8)	7 (100.0)	24 (80.0)	
Living Situation (n, %)				
Alone	3 (8.1)	1 (14.3)	2 (6.7)	0.51
With companion	34 (91.9)	6 (85.7)	28 (93.3)	
Civil status (n, %)				
Single	5 (13.5)	0	5 (16.7)	0.28
Married	16 (43.2)	2 (28.6)	14 (46.7)	
Separated	1 (2.7)	0	1 (3.3)	
Widowed	15 (40.5)	5 (71.4)	10 (33.3)	
Years of education (mean ± SD)	9.43 ± 4.39	7.71 ± 2.75	9.83 ± 4.64	0.15
Assistive device use (n, %)	3 (8.1)	0	3 (10.0)	0.83

Table 2. Association between MCI and history of falls

	With Falls (n=7)	Without Falls (n=30)	*p* value
With MCI (n=29)	7 (100.00)	22 (73.33)	0.12
Without MCI (n=8)	0	8 (26.67)	

there was no significant association between MCI and history of falls (p = 0.12). Table 2 shows the association between MCI and the history of falls.

The mean number of falls experienced by the participants with MCI was 2.43 + 0.79. Among the seven fallers, the majority (85.7%) have experienced falling twice or more in the last 12 months. The most common cause of their fall was slipping (35.3%) which usually occurred in the stairs (41.2%) and during the daytime (64.7%).

Home Environmental Hazards and History of Falls

There was a greater proportion of overall HEH (68.2%) noted among fallers compared to non-fallers. Out of 22 listed, 15 were seen to be more prevalent HEH among fallers. Chi-Square test indicates that the following HEH are significantly different in fallers compared to non-fallers: (1) inadequate height and firmness of the bed (p=.04); (2) inaccessible regularly used items in the kitchen (p=.02); and (3) edges of the stairs/steps that were not easily identified (p<.01). Table 3 shows the comparison of HEH among fallers and non-fallers.

Mild Cognitive Impairment and Home Environmental Hazards

Using Chi-square test, there was no statistically significant difference in HEH found for older persons with MCI compared to those without MCI, except for the presence of non-slip mat which was not securely fixed on the floor (p=0.04) and inadequate height and firmness of the bed (p=0.01). Twenty out of 29 (68.97%) with MCI reported to have loose mats. Among older persons with MCI, 18 have inadequate height and firmness of the bed. Two out of the seven fallers have rugs or narrow steps in their stairs, predisposing them to fall. Although other HEH were observed both with and without MCI, a greater proportion (72.73%) was noted among older persons with MCI. This, however, did not reach statistical significance. Table 4 shows the comparison of HEH among older adults with MCI and without MCI.

Table 3. Comparison of Home Environment Hazards among fallers and non-fallers

	All (n=37)	Fallers (n=7)	Non-Fallers (n=30)	*p*-value
Floors				
With cords and clutter	23 (62.16)	5 (71.43)	18 (60.00)	0.58
Without floor coverings in good condition	7 (18.92)	3 (42.86)	4 (13.33)	0.07
Without non-slip floor surfaces	15 (40.54)	2 (28.57)	13 (43.33)	0.37
Loose mat not securely fixed (n=34)	23 (67.65)	4 (80.00)	19 (65.52)	0.52
Furniture (Cannot get out safely?)				
Bed (inadequate height and firmness)	19 (51.35)	6 (85.71)	13 (13.33)	0.04*
Lounge (inadequate height, chair arms, & seat)	17 (45.95)	3 (42.86)	14 (46.47)	0.86
Lighting				
No Accessible switch	13 (35.14)	2 (28.57)	11 (36.67)	0.69
None (Outside paths, steps and entrances) (n=31)	7 (22.58)	2 (50.00)	5 (18.52)	0.16
Bathroom				
Toilet (Cannot get out safely? (n=36)	13 (36.11)	4 (66.67)	9 (30.00)	0.09
Bath (Cannot get out safely?)	11 (29.73)	2 (28.57)	9 (30.00)	0.94
Without slip-resistant mats	29 (78.38)	7 (100.00)	22 (73.33)	0.12
Toilet is not within close proximity to the bedroom	20 (54.05)	5 (71.43)	15 (50.00)	0.31
Storage				
Not Accessible regularly used kitchen items	12 (32.43)	5 (71.43)	7 (23.33)	0.02*
Not safe (Kitchen to dining area)	10 (28.57)	2 (33.33)	8 (27.59)	0.078
Stairways				
Indoor steps/stairs don't have accessible/sturdy grab rail (n=28)	11(39.29)	1 (25.00)	10 (41.67)	0.53
Outdoor steps/stairs do not have accessible/sturdy grab rail (n=8)	6 (75.00)	1 (100.00)	5 (71.43)	0.54
Not Safe stairways (n=30)	15 (50.00)	3 (60.00)	12 (48.00)	0.62
Edges of the steps/stairs not easily identified (n=30)	3 (10)	3 (60.00)	0	<0.01*
Not Safe entrance door/s	1 (2.70)	0	1 (3.33)	0.62
Mobility				
Paths around house not in good repair, and free of clutter (n=25)	7 (28.00)	2 (66.67)	5 (22.73)	0.11
Without well-fitting slippers and shoes	10 (27.03)	1 (14.29)	9 (30.00)	0.40
Without pets (without bending) (n=8)	2 (25.00)	1 (50.00)	1 (16.67)	0.35

** p value is statistically significant at .05*

Table 4. Comparison of Home Environment Hazards among older adults with MCI and without MCI

	All (n=37)	With MCI (n=29)	Without MCI (n=8)	*p*-value
Floors				
With cords and clutter	23 (62.16)	18 (62.07)	5 (62.50	0.98
Without floor coverings in good condition	7 (18.92)	6 (20.69)	1 (12.50)	0.60
Without non-slip floor surfaces	15 (40.54)	11 (37.93)	4 (50.00)	0.54
Loose mat not securely fixed (n=34)	23 (67.65)	20 (76.92)	3 (37.50)	0.04*
Furniture (Cannot get out safely?)				
Bed (inadequate height and firmness)	19 (51.35)	18 (62.07)	1 (12.50)	0.01*

Lounge (inadequate height, chair arms, & seat)	17(45.95)	14 (48.28)	3 (37.50)	0.59
Lighting				
No Accessible switch	13 (35.14)	11 (37.93)	2 (25.00)	0.50
None (Outside paths, steps and entrances) (n=31)	7 (22.58)	6 (26.09)	1 (12.50)	0.43
Bathroom				
Toilet (Cannot get out safely? (n=36)	13 (36.11)	11 (39.29)	2 (25.00)	0.46
Bath (Cannot get out safely?)	11 (29.73)	7 (24.14)	4 (50.00)	0.16
Without slip-resistant mats	34 (91.89)	27 (93.10)	7 (87.50)	0.61
Toilet is not within close proximity to the bedroom	29 (78.38)	23 (79.31)	6 (75.00)	0.79
Storage				
Not Accessible regularly used kitchen items	12 (32.43)	9 (31.03)	3 (37.50)	0.73
Not safe (Kitchen to dining area)	10 (28.57)	7 (25.93)	3 (37.50)	0.52
Stairways				
Indoor steps/stairs don't have accessible/sturdy grab rail (n=28)	11 (39.29)	10 (47.62)	1 (14.29)	0.12
Outdoor steps/stairs do not have accessible/sturdy grab rail (n=8)	6 (75.00)	4 (80.00)	2 (66.67)	0.67
Not Safe stairways (n=30)	15 (50.00)	13 (56.52)	2 (28.57)	0.20
Edges of the steps/stairs not easily identified (n=30)	3 (10.00)	3 (13.04)	0	0.31
Not Safe entrance door/s	1 (2.70)	0	1 (12.50)	0.05
Mobility				
Paths around house not in good repair, and free of clutter (n=25)	7(28.00)	6 (33.33)	1 (14.29)	0.34
Without well-fitting slippers and shoes	10 (27.03)	7 (24.14)	3 (37.50)	0.45
Without pets (without bending) (n=8)	2 (25.00)	2 (33.33)	0	0.35

** p value is statistically significant at .05*

Discussion

Majority of the seven fallers in the study experienced falling at least twice in the past year, with slipping as the most common cause of falling. All fallers have been diagnosed with MCI. Thus, MCI and HEH were seen among participants with a history of falls. These findings support the Risk Factor Model for Fall among Elderly by WHO (2007) that the presence of MCI is considered as a biological factor while HEH are environmental risk factors, both of which can lead to falls. Both history of falls and cognitive abilities and medical conditions such as MCI are known as risk factors for fall among older persons, (WHO, 2007). This is supported also by the Public Health Agency of Canada (2014) that the history of previous falls was known as one of the behavioral risk factors for falling and the strongest predictor of future fall. Impaired executive function (e.g., visuomotor coordination) among older persons with MCI that affects balance, as well as a problem in recognizing the presence of home hazards, were found to have a strong link with future falls (Delbaere et al., 2012). Individuals with MCI demonstrate impairment in everyday functioning that includes planning, organization and multitasking (Farias et al., 2006) that are needed in identifying and removing HEH that could eventually cause the occurrence of a fall. However, other potential intrinsic factors that may lead to problems on performance of daily functions such as muscle weakness, limitation of motion and balance problems were not investigated in this study. While fallers were only seen among older persons with MCI in this study, the relationship of MCI and history of falls was inconclusive, possibly due to small sample size. Although the current study obtained a sufficient number of participants based on the sample size calculation, it would be interesting to determine if the relationship between MCI and history of falls may change with a larger study sample.

In this study, the majority of HEH were observed among fallers, which is in agreement with current literature which states that HEH are commonly seen among older persons with a history of falls (Pfortmueller et al., 2014). Previous related studies in the Philippine setting identified the (2010), the presence of slippery floors in the bathroom, bedroom, and in hallways as the common causes of falls among older persons Guevarra and Evangelista 2010). However, in this study, the presence of inadequate height and firmness of bed, inaccessible regularly used items in the kitchen and steps/stairs that are difficult to identify were found to be significantly different between fallers and non-fallers. Perhaps other intrinsic factors such as muscle weakness and balance

problems (which were not investigated in the current study) may have contributed to the difference in the results not considered in this study which may have affected the performance of getting in and out of the bed, accessing regular items in the kitchen, and using the stairs. It is interesting to note that although the inaccessibility of regularly used items in the kitchen had a significant relationship with history of falls, none of the participants reported a history of fall in the kitchen. This is likely due to the participants' relatives or caregivers performing these activities for them.

Home environmental hazards were found to be present in older persons with and without MCI. Older persons with MCI have a relatively greater proportion of HEH compared to older persons without MCI although the difference was not statistically significant. The presence of "loose mat not securely fixed" and "inadequate height or firmness of bed" were significantly associated with MCI. This association may be due to the inability of those with MCI to recognize or identify the presence of these HEH because of impaired executive function and not being aware that those can be home hazards (Ansai et al., 2019; Feldman & Chaudhury, 2008). Considering the nature of the required observation, particularly in assessing the adequacy of bed height, other potential intrinsic factors such as muscle weakness, limitation of motion and balance problems (WHO, 2007) may also have contributed to the resulting relationship between HEH and MCI, but these were not investigated in detail in this study. The HOMEFAST-HP tool not only assessed the home features that might cause falls but also the ability of the person to carry out everyday activities with the existing home facilities (Mackenzie & Higginbotham, 2000). Individuals with MCI demonstrate impairment in everyday functioning such as planning, organization and multitasking (Farias et al., 2006) that are needed in identifying and removing HEH that could eventually lead to a fall.

Home assessment and modification are advised to be incorporated into the interventions in reducing the incidence of falls among older persons, especially to those with a previous history of falls and cognitive impairment such as MCI. Taking into consideration the common causes of falling and location of falling, proper education among older persons about MCI and fall prevention involving HEH assessment and modification may be helpful. Also, it is recommended that when using HEH assessment tools, other potential intrinsic factors (e.g., muscle weakness, limitation of motion, impaired balance, etc.) that may affect the results of the assessment should also be considered.

Study Limitations

This research only involved one observer who did the home hazard assessment for all participants and may have affected the reliability of the assessment. Also, while a priori sample size was calculated and random sampling of the participants was conducted, this study only involved older adults from District V of Manila, thus, generalizing the findings to the entire population of older adults in the Philippines may be limited. It is therefore recommended that further investigations using a bigger sample size across different dwelling situations be considered.

Conclusions

Based on the results of this study, MCI is not associated with the history of falls. HEH are more common in MCI and fallers, particularly the inaccessible kitchen items, improper bed, loose mats, and unidentifiable edges of steps. Home modifications to address these identified HEH and incorporation of home assessment in a comprehensive fall prevention program may decrease the fall risk of Filipino older adults with and without MCI.

Conflict of interest statement

Donald S. Lipardo is a member of the Editorial Board of the Philippine Journal of Physical Therapy. The other author declares no competing interest.

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