Research Brief Series : 2

Predictors of Falls Among Older Singaporeans

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Predictors of Falls Among Older Singaporeans

Tuo-Yu Chen

Key Findings:

- The prevalence of falls among community-dwelling older Singaporeans age 65 or older in 2010 is 13.4%, or 326, in terms of total fall events.
- There are demographic factors that affect the likelihood of falls occurring, such as age, gender and ethnicity. Individuals who are significantly older (85 and above), women, and ethnic minorities (Indians and Malays) face a higher risk of falling.
- There are clear indicators of fall risk amongst older adults. These indicators are effective levers for fall prevention efforts.
- Fall risk factors include :
  - Ethnic background
  - Difficulties with mobility
  - Hearing impairments
  - Pain

Introduction

About 28% to 35% of older adults aged 65 years and above fall at least once every year worldwide (1). Falls, for the individual, may lead to severe physical and psychological consequences (2). Falls also place an enormous burden on the healthcare system and society as a whole; families, workplaces and communities are all duly affected. In terms of national costs, the estimated annual cost for managing falls among older adults in the community in the United States is USD 23 billion, and USD 1.6 billion in the United Kingdom (3). Preventing falls is a pressing issue that has both economic and social implications. In order to prevent falls, it is vital to identify factors associated with falls, so that the design and implementation of prevention programmes may be more accurately targeted.

Multiple fall-risk factors often occur in a single older adult individual at the same time (4). These can be generally classified as intrinsic (e.g., mobility, chronic conditions) or extrinsic (e.g., environment hazards, foot wear) risk factors (5). Among these risk factors, some are modifiable (e.g., balance), while others are not (e.g., age). The best approach to reducing and preventing falls is to manage these modifiable risk factors (4, 6).

This brief presents findings from a national sample of older adults (65+) who fell at least once in the year prior to the survey. The data shows us which individuals fall in Singapore, and the risk factors associated with falls. The variables examined in this brief were self-reported and based on major risk factors identified in the literature (4).

Method

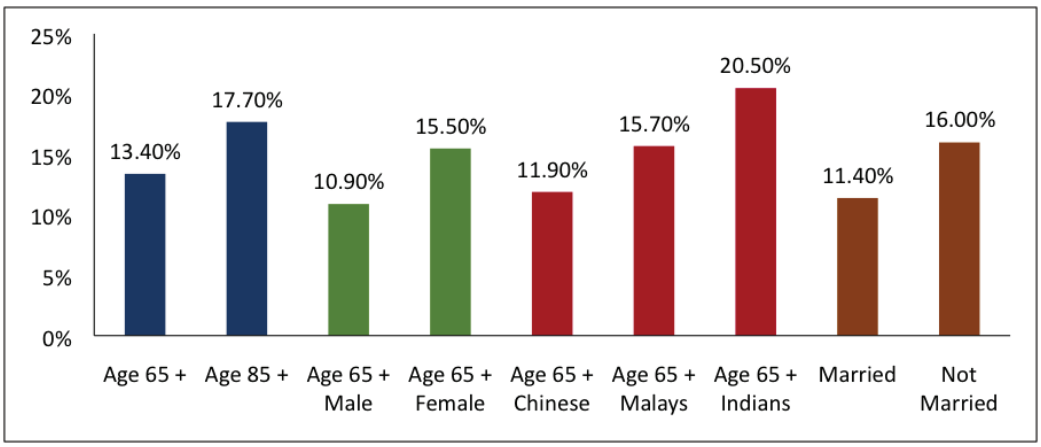
Data for the brief is drawn from Wave II of the Panel on Health and Ageing of Singaporean Elderly (PHASE) study conducted in 2011. The aim of the PHASE study was to develop a profile of changes in the physical, social and mental health of Singaporeans aged 60 years or older. A total of 4990 participants (or proxy respondents) were interviewed in 2009, and 3103 of them were re-contacted in 2011. The analytic sample consisted of 2435 older adults aged 65 and above in 2011 who completed the PHASE survey without a proxy and were of Chinese, Malay, or Indian ethnicity. We selected and examined variables that have been previously reported to be principle risk factors of falling among older adults, which will be detailed below (4).

Who Falls in Singapore?

Demographic characteristics

In 2010, 13.4% or 326 (out of 2435) of community-dwelling older Singaporeans aged 65 years or older fell at least once. This rate is lower compared to the fall rates in several Asian countries, for example, China (18%; 7), Hong Kong (19.3%; 8), Japan (23%; 9), and Malaysia (27.3%; 10).Fall rates were higher for those aged 85 years or older (17.7%; 36 out of 203). Among individuals aged above 65, gender and ethnicity seem to affect falls. Those who were female were more likely to fall than men (15.5% vs 10.9%); and Indians (20.5%) had the highest rate of falling, followed by Malays (15.7%), then Chinese (11.9%). In addition, older Singaporeans who were not married reported falling more frequently (16%) compared to those who were (11.4%) (Figure 1).

Figure 1: Percentage of older Singaporeans who fell at least once in 2010 based on age, gender, marital status and ethnicity

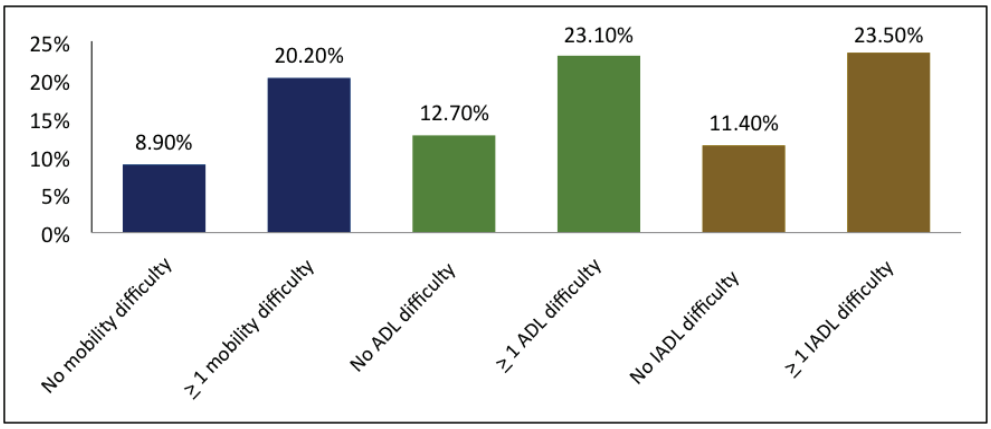


Source: 2011 Panel on Health and Ageing of Singaporean Elderly

Mobility and Daily Functions

Functional disability is associated with a higher risk of falling. Older Singaporeans who reported at least one mobility difficulty (such as walking 200 to 300 meters, or lifting an object weighing approximately 5 kilograms) had a higher fall rate (20.2%) than those who did not have mobility difficulties (8.9%; Figure 3). Individuals who expressed difficulty with any daily activities (such as dressing, taking a shower, cooking, shopping) also had a higher rate of falling (23.1%) than those who expressed no difficulty (12.7%) (Figure 2).

Figure 2: Percentage of older Singaporeans who fell at least once in 2010 based on functional status



Source: 2011 Panel on Health and Ageing of Singaporean Elderly.

Note: *ADL: activities of daily living (dressing, taking a shower);*
IADL: instrumental activities of daily living (cooking, shopping)

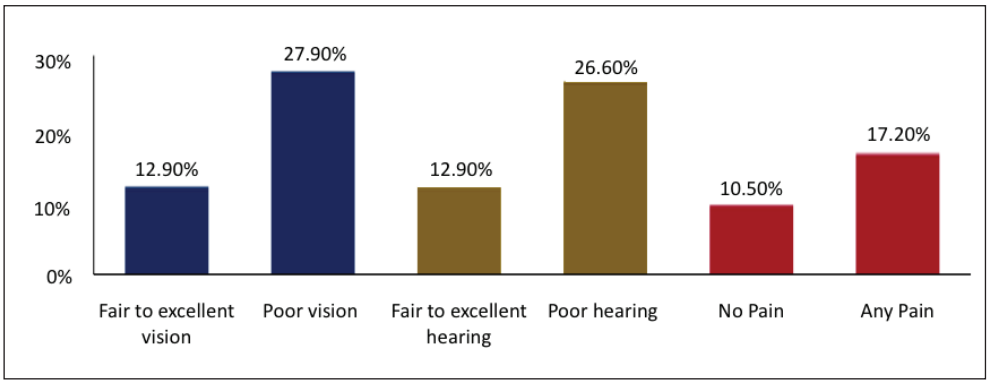
Sensory impairments

Vision and hearing impairments are associated with falls (Figure 4). Higher rates of falling were observed among older adults who reported poor vision (27.9%), compared to those with good vision (12.9%) and poor hearing (26.6%) versus good hearing (12.9%) (Figure 3).

Pain

Reporting pain is also associated with falls; older adults who reported pain in the last 30 days were associated with a higher prevalence of falling (17.2%) than those who reported no pain (10.5%) (Figure 3).

Figure 3: Percentage of older Singaporeans who fell at least once in 2010 based on sensory impairments and pain.

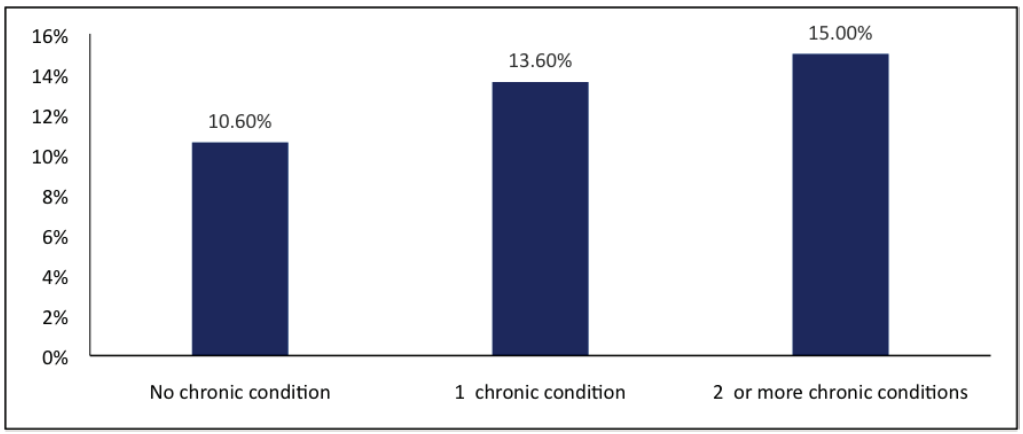


Source: 2011 Panel on Health and Ageing of Singaporean Elderly.

Chronic conditions

Older adults with multiple chronic medical conditions (15.0%) reported a higher prevalence of falls compared to those without any condition (10.6%) or only one condition (13.6%). The chronic conditions considered for this analysis included diagnosis of heart disease, hypertension, stroke, cancer (excluding skin cancer), diabetes, arthritis, and Parkinson's disease (Figure 4).

Figure 4: Percentage of older Singaporeans who fell at least once in 2010 based on number of chronic conditions



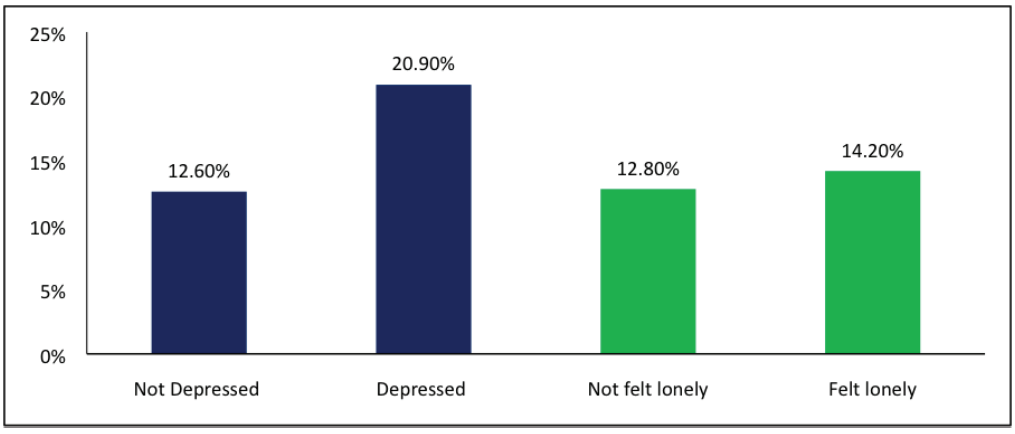
Source: The 2011 Panel on Health and Ageing of Singaporean Elderly study.

Note: *The number of chronic conditions was calculated based on the total number of diagnoses of heart disease, hypertension, stroke, cancer (excluding skin cancer), diabetes, arthritis, and Parkinson's disease.*

Mobility and Daily Functions

Functional disability is associated with a higher risk of falling. Older Singaporeans who reported at least one mobility difficulty (such as walking 200 to 300 meters, or lifting an object weighing approximately 5 kilograms) have a higher fall rate (20.2%) than those who did not have mobility difficulties (8.9%; Figure 3). Individuals who expressed difficulty with any daily activities (such as dressing, taking a shower, cooking, shopping) also had a higher rate of falling (23.1%) than those who expressed no difficulty (12.7%) (Figure 2).

Figure 5: Percentage of older Singaporeans who fell at least once in 2010 based on mental health



Source: 2011 Panel on Health and Ageing of Singaporean Elderly

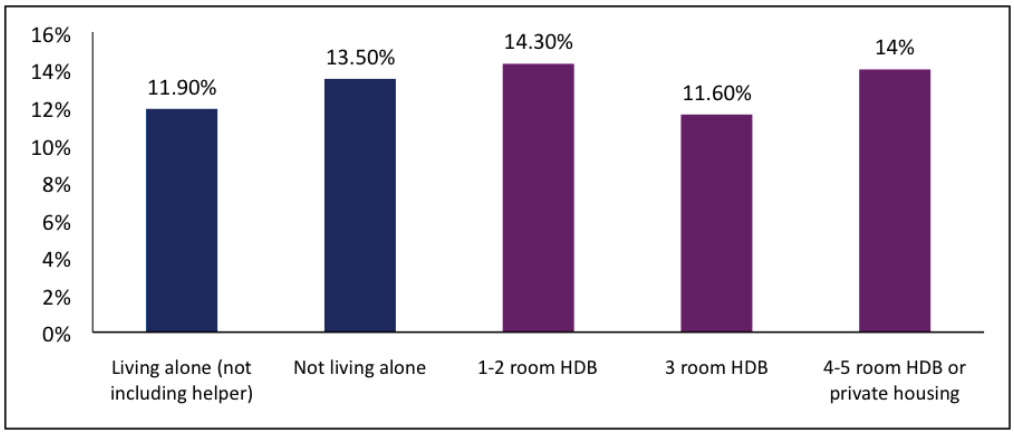
Living Arrangement

Living alone is not associated with a higher prevalence of falls. The results showed that living arrangements have no significant relationship to fall rate. The prevalence of falls among older Singaporeans who lived with someone was 13.5% compared to 11.9% for those living alone (Figure 6).

Housing Type

Housing type is also unrelated to fall rates amongst older Singaporeans. The comparative prevalence of falls by housing type was 14.3% for those living in 1-2 room HDBs, 11.6% for 3-room HDBs and 14.0% for 4-5-room HDBs and private housing (Figure 6).

Figure 6: Percentage of older Singaporeans who fell at least once in 2010 based on living arrangement and housing type



Source: 2011 Panel on Health and Ageing of Singaporean Elderly

What are the significant risk factors or predictors of falls?

To identify risk factors that have independent effects on falls, in other word, the predictors of falls, among older Singaporeans, a multivariate logistic regression model was used for the analysis. Factors considered in the model included demographics, mobility, daily function, sensory impairment, pain, chronic conditions, mental health, living arrangement, and housing type. Results presented in Table 1 show the relative risk of falling given the factors associated with an individual. Individuals are more likely to fall depending on their ethnicity, mobility, hearing, and the presence of pain.

Specifically, factors found to be most significant were:

- **Ethnicity:** Indians were almost twice as likely to fall (1.9 times) in the last year compared to Chinese. Malays were 1.5 times more likely to fall compared to Chinese.

- **Mobility:** Compared to older Singaporeans who reported no difficulty with mobility, those with at least one mobility were almost twice as likely to fall (1.93).

- **Hearing:** Compared to older Singaporeans who reported fair to excellent hearing, those with poor hearing were 1.89 times as likely to fall.

- **Pain:** Compared to older Singaporeans who reported no pain, those who reported pain were 1.32 times more likely to fall.

Other variables, including age, gender, marital status, mobility, difficulty with ADL and IADL, vision, chronic conditions, mental health, living arrangement, and housing type, were not found to be independently significant fall risk factors in the model.

Table 1: Significant factors associated with falls among older Singaporeans

Variables	Falls
	Odds ratio
Ethnicity	
Chinese	Reference
Malays	1.49*
Indians	1.90**
Mobility difficulty (Reference: no mobility difficulty)	1.93**
Poor hearing (Reference: fair to excellent hearing)	1.89*
Any pain (Reference: no pain)	1.32*

*p < .05; **p < .001

Discussion

Overall, our study highlighted that aspects of both demographics and health factors correlate with fall risk amongst community-dwelling older Singaporeans, the most significant of which are ethnicity, mobility difficulty, hearing, and pain. Mobility difficulty, hearing, and pain have also been reported as significant factors in other similar studies with Western populations (4, 11). However, our analysis also highlights ethnic differences, which need to be further explored. Ethnicity may be associated with different sociocultural contexts, health status, lifestyles and behaviours, all of which may have ramifications for the risk of falling.

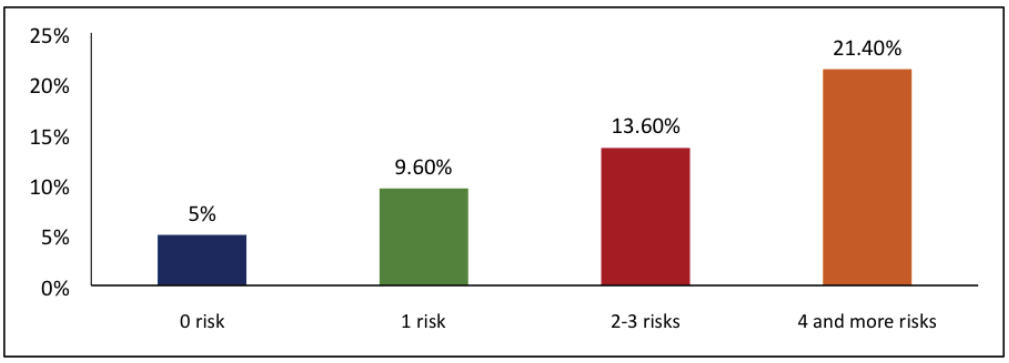
Demographics

Demographically, age, gender and ethnicity all affect falls risk. Persons who are older (85 years and above), women and those from the ethnic minority groups who are aged above 65, reported falling more often. Those who were not married reported a higher prevalence of falling than married individuals. The findings are consistent with wider findings on the health and functional status of older Singaporeans where it is found that those of more advanced age, women, from minority ethnic groups and those who are unmarried tend to have poorer health and functional status. As such, the fall risks of these groups can be assumed to be correlated with their general poorer health in comparison to their counterparts (4, 12, 13).

Mobility, Function, Sensory Impairment, Pain and Health Status

Older Singaporeans' mobility, functional abilities, sensory impairments, pain, as well as their physical and mental health status, as expected, are strongly related to falls. In terms of physical health, the higher the cumulative number of chronic conditions, mobility difficulties and sensory impairments, the more susceptible they are to falls. Older adults' mental health status, such as reported feelings of depression, also affect their fall risks. These findings are consistent with other international findings on the impact of functions and health status on fall risk (4, 14). Also consistent with findings elsewhere is the increase in older adults' fall risks when their functional and health limitations are compounded (4) (Figure 7).

Figure 7: Percentage of older Singaporeans who fell at least once in 2010 based on accumulation of functional and health risks



Source: The 2011 Panel on Health and Ageing of Singaporean Elderly study.

The number of risks was calculated based on chronic conditions, vision, hearing, pain, mobility, difficulty with activities of daily living, and depressive symptoms.

Living Arrangement and Housing Type

Our findings as highlighted did not indicate that either living arrangement or housing type had a significant impact on fall risk. These are consistent with the mixed findings in the literature on these subjects (6, 15, 16, 18, 19)

Thus, for instance, regarding living arrangement, living alone is associated with more depressive symptoms, which is an important predictor of fall risk (4, 17). On the other hand, living alone has also been associated with having fewer environmental hazards, hence reducing fall risk (16). There are also studies which argue that individuals who live alone may be more aware of their health status and, therefore, fall less than those who live with someone (14). Research on housing environments indicate that falls are the consequence of the ways the individuals interact with the environments rather than solely because of the environments (20). Overall findings seem to suggest that neither living arrangement nor housing environment are singular risk factors for falls amongst older adults. Further investigations would be needed to understand how the interplay of these factors with other risk factors may result in falls.

Policy and Practice Recommendations

Falls amongst older adults, as both this study and others have illustrated, are multifactorial in origin. Factors that are associated with fall risk as illustrated include one's demographic, functional, and health status (4). Understanding these risk factors is a first step to tackling the complexities of this nuanced issue.

Our study showed that there are several demographic factors that relate to fall risks amongst older Singaporeans including age, gender and ethnicity. These can be important alert points for practitioners who are assessing older adults for fall-risk. Actions can then be taken to further investigate the underlying issues faced by these individuals with a view to identifying their modifiable risk factors, such health behaviours and environmental impediments or hazards.

The study also indicated that older Singaporeans' mobility, functional abilities, sensory impairments, pain, chronic conditions, and mental health are also related to fall-risk. As such, fall-risk assessment should be part of the key protocol for both health and social service professionals dealing with those living with these health challenges.

Beyond fall-risk assessment, it is advantageous to develop interventions that go beyond raising awareness, to actively engaging with and altering modifiable factors closely correlated with fall-risks that are detailed above.

Currently, Singapore does not have a nation-wide community-based fall-prevention programme. Efforts have for the most part been at the hospital level. Examples of these include the Step It Up programme offered by Tan Tock Seng Hospital aiming to prevent falls among older adults living in community; and the Steps to Avoid Falls in Elderly (SAFE) programme developed by a research team from the Duke-NUS Medical School, Singapore General Hospital, Changi General Hospital, and Agency for Integrated Care. In addition to this, some of the hospitals, including Singapore General Hospital, Changi General Hospital, and Khoo Teck Puat Hospital, also run clinics to provide direct consultation and treatment to reduce falls amongst their patient population. The majority of these programmes were implemented for a defined and limited period of time, at different locations and with varying specific objectives. Among these programmes, only the SAFE programme has been clinically proven to be effective in reducing falls among older Singaporeans recruited from emergency departments.

At the community level, establishing evidence-based fall-prevention programmes has been proven to be effective in reducing falls. Typically, the goals of these programmes are to increase awareness of falls among older adults and to teach them exercises that can improve strength and balance. Such programmes are less costly compared to hospital-based programmes because they can be conducted by trained layperson leaders or volunteers. There is also a need for more research to be done in investigating the effectiveness of local and localized fall-prevention programmes incorporating the initial significant risk factors found in this study. The development of a more consolidated evidence-based fall prevention effort at the national level would be timely, given Singapore's rapidly ageing population.

Reference

1. World Health Organization. WHO global report on falls prevention in older age. Geneva: World Health Organization; 2008. Available from: http://www.who.int/ageing/publications/Falls_prevention7March.pdf.

2. Fabrício SCC, Rodrigues RAP, Costa Junior ML. Falls among older adults seen at a São Paulo State public hospital: Causes and consequences. Rev Saude Publica. 2004;38:93-9.

3. Davis JC, Robertson MC, Ashe MC, Liu-Ambrose T, Khan KM, Marra CA. International comparison of cost of falls in older adults living in the community: A systematic review. Osteoporos Int. 2010 2010/08/01;21:1295-306. English.

4. Ambrose AF, Paul G, Hausdorff JM. Risk factors for falls among older adults: A review of the literature. Maturitas. 2013;75:51-61.

5. Rubenstein LZ, Josephson KR. Falls and their prevention in elderly people: What does the evidence show? The Medical clinics of North America. 2006;90:807-24.

6. Tinetti M, Speechley M, Ginter S. Risk factors for falls among elderly persons living in the community. N Engl J Med. 1988 December 29, 1988;319(26):1701-7.

7. Yu P-L, Qin Z-H, Shi J, Zhang J, Xin M-Z, Wu Z-L, et al. Prevalence and Related Factors of Falls among the Elderly in an Urban Community of Beijing. Biomed Environ Sci. 2009 6//;22(3):179-87.

8. Chu L-W, Chi I, Chiu A. Incidence and predictors of falls in the Chinese elderly. Ann Acad Med Singapore. 2005;34(1):60-72.

9. Muraki S, Akune T, Oka H, Ishimoto Y, Nagata K, Yoshida M, et al. Physical performance, bone and joint diseases, and incidence of falls in Japanese men and women: a longitudinal cohort study. Osteoporos Int. 2013 2013/02/01;24(2):459-66. English.

10. Rizawati M. Home environment and fall at home among the elderly in Masjid Tanah Province. Journal of Health and Translational Medicine. 2012;11(2).

11. Jiam NT-L, Li C, Agrawal Y. Hearing loss and falls: A systematic review and meta-analysis. The Laryngoscope. 2016:n/a-n/a.

12. Rosso AL, Taylor JA, Tabb LP, Michael YL. Mobility, disability, and social engagement in older adults. J Aging Health. 2013;25:617-37.

13. Tey NP, Siraj SB, Kamaruzzaman SBB, Chin AV, Tan MP, Sinnappan GS, et al. Aging in Multi-ethnic Malaysia. The Gerontologist. 2016;56(4):603-9.

14. Fong KNK, Siu AMH, Yeung KA, Cheung SWS, Chan CCH. Falls among the community-living elderly people in Hong Kong: A retrospective study. HKJOT. 2011 6//;21:33-40.
15. Kharicha K, Iliffe S, Harari D, Swift C, Gillmann G, Stuck AE. Health risk appraisal in older people 1: Are older people living alone an 'at-risk'group? Br J Gen Pract. 2007;57:271-6.

16. Leung A, Chi I, Lou VWQ, Chan KS. Psychosocial risk factors associated with falls among Chinese community-dwelling older adults in Hong Kong. Health Soc Care Community. 2010;18:272-81.

17. Chan A, Malhotra C, Malhotra R, Østbye T. Living arrangements, social networks and depressive symptoms among older men and women in Singapore. Int J Geriatr Psychiatry. 2011;26:630-9.

18. Campbell AJ, Borrie MJ, Spears GF, Jackson SL, Brown JS, Fitzgerald JL. Circumstances and consequences of falls experienced by a community population 70 years and over during a prospective study. Age Ageing. 1990 March 1, 1990;19:136-41.

19. Nevitt MC, Cummings SR, Kidd S, Black D. Risk factors for recurrent nonsyncopal falls: A prospective study. JAMA. 1989 May 12, 1989;261:2663-8.

20. Connell BR, Wolf SL. Environmental and behavioral circumstances associated with falls at home among healthy elderly individuals. Arch Phys Med Rehabil. 1997;78:179-86.

21. Colligan EM, Tomoyasu N, Howell B. Community-based wellness and prevention programs: The role of Medicare. Frontiers in Public Health. 2015 2015-April-27;3. English.

Publisher

The Centre for Ageing Research and Education (CARE) is an academic research centre based in Duke-NUS Medical School. It aims to harness the potentials of population ageing both in Singapore and the region through its interdisciplinary expertise and collaborations across medical, social, psychological, economic and environmental perspectives. Recognising the need for a consolidated and long term approach towards longevity, CARE spearheads educational programmes to build competencies on ageing amongst researchers, policy and programme professionals. CARE also actively engages with government and industry partners to meet the needs of population ageing.

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- Implement and evaluate best practices to improve health and function of older adults
- Inform policy and practice agenda on ageing

Centre for Ageing Research and Education (CARE)
Duke-NUS Medical School

8 College Road, Singapore 169857
www.duke-nus.edu.sg/care
Tel: 6601 1131