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REVIEW ARTICLE

Home Environmental Hazards and Ageing in Place: A Scoping Review

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ABSTRACT

Introduction	Ageing in place is a preferable choice for the elderly and it has been adopted as a response to population ageing. The elderly may remain in their own homes so that they can retain connections with friends and family in their community. However, the places in which people grow old often have home environmental hazards that may affect ageing in place. This scoping review aimed to identify environmental hazards that existed in the home of the elderly, factors that were associated with home environmental hazards, and the impact of home environmental hazards on the elderly ageing in place.
Methods	We used PRISMA-ScR to search PubMed, Web of Science, and Scopus databases. We included all English-language research on home environmental hazards, their associated factors, and impacts on elderly ageing in place. We analysed the study data and summarised the results. 30 records were reviewed, yielding 18 included studies.
Results	There was a high prevalence of home environmental hazards in the home of the elderly with the bathroom being the most common location with environmental hazards. Certain factors such as socio-demographic, socioeconomic, living arrangement/house-related factors, and individuals' health-related factors were associated with the presence of home environmental hazards. Fall was one of the impacts of home environmental hazards though its contribution to the risk of falling remained uncertain.
Conclusions	Improved understanding of home environmental hazards and their impact on elderly ageing in place is important so that interventions can be done to reduce the presence and impact of home environmental hazards, and ultimately to protect the elderly's health.
Keywords	Home Environmental Hazards; Elderly; Ageing in Place

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INTRODUCTION

Countries worldwide have been seeing a transition in distribution of a country's population towards older ages. The population of elderly is growing faster than all other age groups, and according to the World Health Organization (WHO), by 2050, the world's population of people aged 60 years and older will be double. [1] Certain countries and regions are experiencing ageing faster than the others. The current proportion of older persons is projected to double in four regions; Northern Africa and Western Asia, Central and Southern Asia, Latin America and the Caribbean, and Eastern and South-Eastern Asia, with these changes expected to happen by 2050.[2] Ageing is a long-term result from the effect of the accumulation of a wide variety of molecular and cellular damage over time.[1] Ageing process is associated with gradual decline in physical and mental capacity as well as a growing risk of diseases and disabilities. Consequently, elderly population often has increased demand for health and social care services. Furthermore, frailty, which develops as a consequence of age-related decline in multiple physiological systems, will result in vulnerability among older people.[3]

Living arrangement for older people is vital as it has been shown to be associated with their economic well-being, their physical and psycho-social health, and life satisfaction.[4] Amid the increasing number of the elderly, the policymakers have been planning on different strategies in ensuring optimum care and living arrangement of the elderly. Different countries came up with different plans on their long-term care policies with most of the countries have been shifting towards elderly ageing in their community. For example, China has implemented the 9073 or 9064 model since 2009, with the aim to reach 90% of the older adults ageing in their local communities, taken care by their families, while governments will be caring for 6-7% elder as home care package providers and 3- 4% as nursing home cares.[5,6] From an economic point of view, an ageing population is associated with decreasing productivity and higher government spending[7,8] and a large proportion of this increased spending by governments relates to the provision of long-term care and other health services for the elderly.[9] Therefore, sustained living at home for older people has become a priority on the agenda of governments in countries such as Australia and the UK.[10,11] In addition, studies have found that elderly prefer to stay in their own homes, or ageing in place, rather than relocate to care accommodation as they age.[12,13]

However, ageing in place poses its own challenges and difficulties to older people. The home living environment has impacts on the health, welfare, and safety of the elderly. Due to differences in functional status, certain environmental factors in home may become home hazard to the elderly and these hazards include slippery floors, inadequate lighting, loose rugs, unstable furniture and obstructed walkways.[14] The presence of these hazards may affect older people's health and safety as well as their abilities to age in place. For instance, environmental hazards are shown as a contributory factor in a large proportion of falls in older people and the interaction between an elderly's physical abilities and their exposure to environmental stressors appears to be an important factor.[15] This review aimed to identify home environmental hazards that existed in the home of the elderly, factors that were associated with home environmental hazards, and the impact of home environmental hazards on the elderly ageing in place.

METHODS

Search Strategy

Environmental hazards that existed in the home of the elderly, factors that were associated with home environmental hazards, and the impact of home environmental hazards on the elderly ageing in place were explored using a scoping review guided by the methodology of Arksey and O'Malley[16] and Levac et al.[17] This paper adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR).[18] A comprehensive search strategy was developed for 3 electronic citation databases: PubMed, Scopus, and Web of Science. The search strategies used terms to capture the following concepts: (1) Environmental hazards, environmental safety, environmental factors; (2) Elderly, older people, aged, senior, geriatric; and (3) Home, house, dwelling, residence.

Study Selection and Eligibility Criteria

Articles were determined eligible for inclusion if they discussed the environmental hazards that existed in the home of the elderly, factors that were associated with home environmental hazards, and/or the impact of home environmental hazards on the elderly ageing in place. All article types were included, including dissertations, conference abstracts, and opinion pieces, except for systematic or scoping reviews, books, or book chapters. Articles were excluded if they were written in a language other than English. No time limitation was set for the article inclusion. Articles described home environmental hazards located in other places like nursing home or day care centres were not included.

Data Extraction

The screening process was conducted using the PRISMA extension for scoping reviews (Figure 1).[18] Records in the form of titles and abstracts identified from the search strategy were collected and duplicated papers were removed. Subsequently, the titles and abstract of the studies were screened according to the inclusion and exclusion criteria.

Once the status of inclusion or exclusion of the study had been assessed, the full text of selected studies was retrieved for review and reassessed to confirm their eligibility and suitability. Finally, the data from the selected studies that were included in the review were extracted to a Microsoft Excel spreadsheet. These data included the citation information, year of publication, type of study, setting, study population, and the main findings.

Method of synthesis

The strategy for data synthesis was narrative description and thematic synthesis of the selected studies in the form of tables and text. Evidence was synthesised based on the setting, population as well as findings on environmental hazards that existed in the home of the elderly, factors that were associated with home environmental hazards, and the impact of home environmental hazards on the elderly ageing in place. The descriptive themes were developed based on the findings and aimed to answer the questions specific to the review and provide a thematic structure for the descriptions of the selected studies.

Data analysis

The data extracted from the selected studies were summarised and organised into relevant topics based on thematic analysis. Similarities within the type of home environmental hazards, the factors associated with home environmental hazards and its impact on ageing in place were identified and grouped within the narrative summary accordingly.

RESULTS

Study Selection

On the basis of the initial search, 1133 articles were identified, with 1080 articles left after duplicates were removed. At the title and abstract screening stage, 1046 articles were excluded. A total of 30 articles were screened as full text, and a further 12 articles were excluded for reasons outlined in Figure 1.

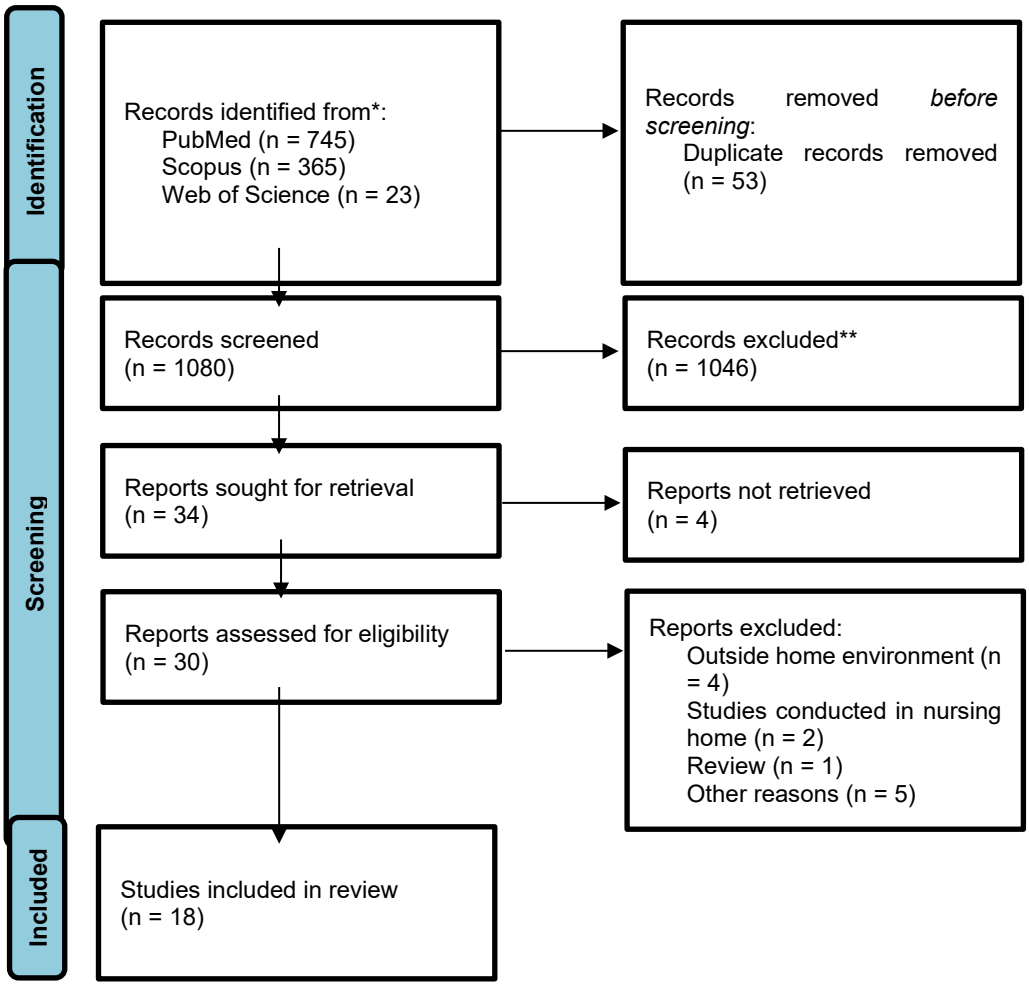

Figure 1 Screening process for scoping review

Table 1 Summary of the study designs

Study Design	Authors
Cross sectional	Carter et al, Gill et al,[19] Gitlin et al,[20] Huang,[21] Lan et al,[22] Lee et al, Lytras et al,[24] Morfitt,[25] Romli et al,[26] Romli et al,[27] Tsuchiya-Ito et al,[28] Wang et al,[29]
Case-control studies	Chen et al,[30] Clemson et al,[31] Sattin et al,[32]
Cohort studies	Lecrec et al,[33] Northridge et al,[34]
Qualitative study	Randstrom et al,[35]

Table 2 Summary of the study locations

Study Location	Studies
USA	Gill et al,[19] Gitlin et al,[20] Lee et al,[23] Sattin et al,[32] Northridge et al,[34]
Australia	Carter et al,[14] Clemson et al,[31]
China	Wang et al,[29] Chen et al,[30]
Taiwan	Huang,[21] Lan et al,[22]
Malaysia	Romli et al,[26] Romli et al,[27]

Articles Characteristics

Of the screened records throughout the review, 18 articles were selected for inclusion (Figure 1). Twelve out of eighteen studies applied a cross sectional design, followed by case-control studies (3), cohort studies (2) and qualitative study (1). The frequency of countries reported in the 18 studies varied, with a total of five studies were conducted in the United States of America (USA) followed by two studies each were conducted in Australia, China, Taiwan, and Malaysia. Meanwhile, one study each was performed in Canada, Greece, Japan, United Kingdom, and Sweden. The type of study as well as the country involved were summarised in Table 1 and Table 2. With no time limitation applied as part of the search strategy, out of 18 articles, six articles were published in the last 10 years while the remaining papers were published more than 10 years ago.

Main findings

First research question identified the environmental hazards that existed in the home of the elderly. Studies reported that home environmental hazards were found in 80%-91% of the houses of the elderly with 39% of the homes inspected having more than 5 hazards.[14,33] The average number of home environmental hazards was reported to be varied from as high as 13 hazards to approximately 3 home environmental hazards.[20,22,23] With regard to the location in the home where the environmental hazards were found the most is the bathroom.[14,20,21,33] A study reported that the bathroom was identified as the most hazardous room, with 66% of the bathrooms having at least one hazard.[14] Other common sites in the home for environmental hazards are kitchens, bedrooms, and hallways.[20,21] Various type of environmental hazard exists in the home of the elderly such as dim, slippery floors, out-of-reach storage areas, non-anchored carpeting/rugs or those without anti-skid backing, and loose or non-existent grab bar/handrail.[14,19,20,21,22,26,32,23] Bathroom were mostly included as one of the environmental hazards, as most of them were absence of grab bars and protections against slip as well as flooring encumbered with obstacles.[22,23] This review also managed to yield two studies which investigated the prevalence of specific types of home environmental hazards namely household air pollution (HAP) from solid fuel as well as indoor ventilation frequency and its impact on health and functional status of the elderly.[29,30]

Certain factors may be associated with the presence of home environmental hazards in the house of the elderly. Six out of 18 articles discussed on this issue with all the factors were further divided into a few categories; socio demographic, socioeconomic, living arrangement/house-related

factors and individuals' health-related factors. From socio demographic perspective, age had been found as one of the factors that was associated with the presence of home environmental hazards, supported by three out of four studies.[20,21,26] In addition, gender was also reported as one of the factors associated with having home environmental problems with females being more likely to have home environmental hazards.[20] Another sociodemographic factor found to be associated with the presence of home environmental hazard was race/ethnicity, with a study done in the United States of America found that being a minority race was associated with having home environmental hazards while another study conducted in Malaysia reported that Chinese ethnicity was one of the factors independently associated with home environmental hazards.[20,26]

Income, monthly expenses as well as education level were among socio economic factors associated with home environmental hazards. Participants who had high income or those who left income information blank were less likely to live in a more hazardous home environment.[22] Home hazards also appeared to be associated with lower monthly expenditure.[26] Furthermore, the same study also reported that older people with higher education levels were found to have lower numbers of home hazards.[26] For living arrangement and house-related factors, certain house characteristics or the type of property had been found to be associated with the presence of home environmental hazards. For example, a study conducted in Canada found that older people living in a single-family house had a higher mean number of hazards compared to those living in a private residential facility while another study conducted in Malaysia reported that highest number of home hazards was found in the traditional house with the lowest number of home hazards were found in the apartment.[26,33] The number of occupants in the house were also identified as one of the factors associated with home hazards, with a higher number of home occupants associated with more hazards.[26] Lastly, the location of the house, whether in rural or urban, appeared to be a significant predictor of potential home hazards for the elders. Elderly resided in urban areas had more potential home hazards compared to those who lived in the rural area.[21]

Home environmental hazards were also associated with certain individual health-related factors. Certain factors such as having pain, having poor gait, poor balance, poor vision, and greater physical disability were associated with more home environmental hazards.[20,21,26] In addition, poor awareness of one's health status was identified as a significant predictor of potential home hazards for elderly.[21] Moreover, contact with healthcare service providers appeared to be a protective factor of the home hazard level in older people's homes. A study conducted in Australia reported that elderly who were never visited by service providers were twice as likely to have more than 5 hazards as those who were visited weekly or more frequently.[14]

This review also examined the impact of home environmental hazards on the elderly ageing in place with twelve out of eighteen studies discussed on this issue. Of all the impacts studied, fall appeared to be the most popular impact of home environmental hazards on the elderly ageing in place, examined with eight studies discussed on this topic.[23,24,25,27,31,32,33,34] A few studies included in this review looking at the association of home environmental hazards and fall, produced mixed results. A study conducted in Canada concluded that the presence of hazards was significantly associated with all falls and fall-related medical consultations.[33] However, another studies examined the same relationship found no significant association between environmental home hazards and fall.[31,32,34] A study conducted in Australia found that homes of fallers were no more hazardous than the homes of non-fallers.[31] Meanwhile, two other studies done in the United States of America reported that most of the environmental hazards found in home were not associated with an increased risk of fall injury events among most older persons with the increasing numbers of tripping hazards, or total hazards in the dwelling unit, did not affect the risk of fall injury events.[32,34] These studies also included other factors that may affect the home environmental hazards towards the fall events. For instance, a study reported that the presence of indoor environmental hazards was significantly associated with falls in women only but not in men with the odds of having falls were 1.37 times higher for older women who lived in areas with the presence of any indoor environmental hazards.[23] Environmental causes of falls also predominated in women fallers below age 75 years old.[25] The role of health and functional status in home environmental hazard and fall events in the elderly were also examined. It was found that vigorous older persons living with more home hazards were more likely to fall, though the increased risk for falls among vigorous elderly was limited to falls where home hazards were present.[34] On the other hand, elderly living with more home hazards was not associated with increased likelihood of falls among frail older persons.

Apart from the fall events, certain studies looked at the other impact of home environmental hazards on the elderly ageing in place. For example, a study conducted in China examined the effect of home environmental hazards such as the household air pollution from the use of solid fuels towards the elderly's sleep quality.[30] Meanwhile, another study conducted in China investigated the effect of frequent ventilations on the cognitive function among community-dwelling older adults.[29] Other impacts of home environment hazards toward the

elderly ageing in place were life satisfaction, self-rated health and home rehabilitation, which were examined in a few studies with various results.[28,35]

DISCUSSION

Studies included in this review reported high prevalence of environmental hazards in the home of the elderly and bathrooms had been identified as the most home environmental hazards. Generally, bathrooms can be a dangerous place for seniors due to multiple factors such as the slippery floor and wet surfaces. In addition, the bathroom spaces are likely to be small and the equipment and accessories are hard, which will cause potential injuries to the elderly. The environmental hazards range from hazards that can affect elderly's vision, such as poor and dim lighting, hazards that can affect elderly's gait and stability, such as slippery floors, non-anchored carpeting/rugs or those without anti-skid backing, as well as those that give elderly lack of support during fall event, such as absence of/loose grab/handrails. Two other home environmental hazards found in this review were household air pollution (HAP) from solid fuel as well as indoor ventilation frequency, with specific impact on health and functional status of the elderly were being measured in these studies.

Age had been found as one of the associated factors with the presence of home environmental hazards, though the findings were inconsistent. The younger age group might have home environmental hazards due to less contact with formal organisations, thus less access to information about the home environmental hazards.[20] Meanwhile, the older age group might have poor functional status and suffer from disability, thus having difficulties to modify and eliminate home environmental hazards. Females are more likely to have home environmental hazards compared to male, and a possible explanation for these associations is that females had limited resources.[20] Similar reasons might be applicable in the case of a minority race that was associated with more home environmental problems. High income and high monthly expenses are associated with less home environmental hazards, and this might be due to more funds available that can be used to finance home modifications, thus reducing or eliminating home environmental hazards.[27] People with high education levels were found to have lower numbers of home hazards and this might be explained by higher access to information regarding to the home environmental hazards.

Traditional houses have more hazards, and this might be due to the basic structures usually found in these houses. Traditional houses are often built with basic materials, and the flooring is usually uneven, which can pose environmental hazards. In addition, the toilets are usually built at the back or outside of the houses through the kitchen and squatting toilets are common.[27] The number of occupants in the house were also identified as one of the factors associated with home hazards, with a higher number of home occupants associated with more hazards. More home occupants' activities might increase the possibility of environmental hazards such as obstacles that are being left on the floors. Some individual health-related factors such as having pain, having poor gait, poor balance, poor vision, and greater physical disability are associated with more home environmental hazards. This might be explained due to poor functional status experienced by the elderly as a result of these health conditions thus limiting the modifications and interventions that can be done. Furthermore, those with more contact with healthcare service providers appeared to have less home environmental hazards and this is possibly due to more access to information regarding this topic.

One of the most common impacts of home environmental hazards on the elderly were fall. The contribution of home environmental hazards on the risk of falling remained uncertain. There were mixed findings regarding the association between home environmental hazards and the occurrence and risk of fall. Falls among older adults are a result of complicated factors, involving individual and environmental circumstances.[36,37] Sociodemographic factors, health, and behavioural characteristics are some of the individual factors for risk of falling. For instance, older adults with functional limitations, muscle weakness, comorbidities, anxiety, and lack of physical activity tend to be exposed to the risk of falling.[38] Meanwhile, environmental factors refer to all extrinsic factors such as dim lighting, slippery or uneven surface, obstacles, stairs, abrupt vertical transitions, and weather conditions.[39] Study reported that these individual and environmental factors are known to be independently associated with the occurrence of falls.[40]

Fall is one of the most common causes of injuries among the elderly.[41] Minor injuries happened in about 30%–50% of these falls, with another 10% sustained major injuries. About 1% of all falls in the elderly result in hip fractures, which pose a significant risk for post-fall morbidity and mortality, such as deterioration in quality of life, with significant decline in functional capacity for both the basic and instrumental activities of daily living.[42,43] Falls were also the leading cause of traumatic brain injury-related deaths in persons aged 65 or older.[44] In the USA, the economic cost of falls among elderly people is estimated from $31.3 billion dollars to $49.5 billion dollars.[41,45] Fall injuries among older adults ranked fifth among the 155 health conditions in personal healthcare spending in 2013.[46] Falls among the elderly also associated with a substantial proportion of hospitalisation and this may have a potential impact

on the healthcare system. A study conducted in the Netherlands found that the total number of fall-related hospital bed–days in 2008 is 388 650 days, though the number is decreasing due to the lower average length of stay amid the increase in the absolute numbers and the incidences of fall-related hospital admissions in older people.[47]

Though there is mixed evidence regarding the influence of home environmental hazards towards fall among the elderly, interventions aimed at reducing or eliminating home environmental hazards remains one of the common strategies practiced to reduce the occurrence of fall among the elderly. Some interventions such as health advice and education are relatively inexpensive, while home modifications are costlier. An interventional study conducted in Australia has been found to be effective to reduce some home environmental hazards.[48] In this study, three interventions were utilised; home environmental hazards assessment, advice and general education on fall hazards, as well as an invitation to have safety devices installed for free. The studies on the cost effectiveness of the interventions are scarce. A study conducted examining the cost effectiveness of the interventions found that over a one-year period, the incremental cost of introducing the intervention was $172 per person, resulting in an incremental cost per fall prevented of $1,721 and cost per injury prevented of $17,208.[49] However, these data are based on a model and more updated research is required before conclusions and recommendations may be made.

Several limitations arose throughout the course of the scoping review. Results obtained from this review could have been skewed given the frequency of certain countries reported in the studies. Furthermore, the inclusion of articles available in the English language further limited the number of potential studies. Additional analyses with information from other sources can help to overcome these limitations and to establish more complete interpretations.

CONCLUSIONS

There is a high prevalence of environmental hazards in elderly people's homes with certain factors appeared to be associated with these observations. Though there is mixed evidence on how these home environmental hazards can have negative impacts on the elderly, such as fall, some interventions are necessary for high-risk elderly people. Health care workers also need to be more active in understanding and identifying elderly's needs, involving their families, and locating the necessary resources to reduce or eliminate home environmental hazards. Further studies should be carried out to develop individualised home environmental assessments and modifications. In addition, studies should also be done to identify potential interventions based on known risk factors to reduce the presence and risk of home environmental hazards, so that the health, safety, and welfare of the elderly can be protected.

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