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A qualitative investigation exploring neighbourhood environment, risks and fear of falling, and fall prevention strategies among urban-dwelling older adults in a high-density city

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(Accepted 28 September 2022)

Abstract

Falls in older adulthood can have serious consequences. It is therefore important to identify ways to prevent falls, particularly from the voice of older adults. Bottom-up qualitative exploration of the perspectives of older adults can provide rich insights that can help inform the development of effective fall prevention programmes. However, currently there is a dearth of such empirical data, especially among urban-dwelling older adults in high-density cities where fall rates are high. The current study aimed to examine qualitatively perceptions of neighbourhood physical environment in relation to falls, perceived risks and fear of falling, and strategies and behaviours for fall prevention in a sample of urban-dwelling older adults in the high-density city of Hong Kong. Face-to-face semi-structured in-depth interviews were conducted with 50 community-dwelling older adults. Interviews were transcribed verbatim and analysed using thematic analysis techniques. Five general themes were revealed: risks and circumstances of falls, consequences of falls, fear of falling and its consequences, neighbourhood environment, and strategies and behaviours of fall prevention. While older adults discussed the risks of falling and held a fear of falling, these beliefs were mixed. In addition to fall prevention strategies (e.g. keep balance), current findings highlighted the importance of establishing protective factors (e.g. flat and even walking paths) and reducing risk factors (e.g. neighbourhood clutter) in neighbourhood environments. For urban-dwelling older adults in high-density cities, current findings highlight the importance of focusing efforts at the built environment level in addition to strategies and behaviours of fall prevention at the individual level.

Keywords: built environment; older adults; fall prevention; fear of falling; perceived falling risks

Introduction

Globally, there is a growing population of older adults who are at an increased risk of falls (Khow and Visvanathan, 2017; Zhao *et al.*, 2019). For older adults, falling is associated with poor physical health, greater negative emotions and less physical activity (Ruthig *et al.*, 2007). Falling is also related to decreased functional ability, life-space mobility and quality of life (Li *et al.*, 2003; Ahmed *et al.*, 2021). Furthermore, fall-induced injuries may contribute directly to death in older adults (Kannus *et al.*, 1999). This highlights the need for fall prevention strategies to help older adults avoid the negative consequences of falls.

Outdoor falls are as common as indoor falls, with more than half of all falls occurring in outdoor environments (Li *et al.*, 2006). Preventing outdoor falls should therefore be a key focus to researchers wanting to develop rich insights in this context. Previous research has shown outdoor falls to be associated with environmental factors, such as neighbourhood clutter and uneven floor surfaces (Li *et al.*, 2006; Nyman *et al.*, 2013). To develop effective fall prevention strategies, it seems valuable to explore the fall beliefs held by older adults in relation to neighbourhood physical environment, perceived risks and fear of falling, and fall prevention strategies and behaviours (Chippendale and Boltz, 2015).

The physical neighbourhood often affords open space and active opportunities to deliver fall prevention strategies for older adults in outdoor environments (Chippendale and Boltz, 2015). Notably, outdoor falls often occur in healthy and physically active older adults (Kelsey *et al.*, 2010; Satariano *et al.*, 2017), with many cases experienced during regular physical activity (*e.g.* walking) performed in familiar areas (Li *et al.*, 2006). When performing more vigorous physical activities, the consequences of outdoor falls compared to indoor falls can be quite severe (Kelsey *et al.*, 2012). Yet, it is not recommended nor is it feasible or ethical to restrict outdoor physical activity for fall prevention (Luk *et al.*, 2015), highlighting the need for effective fall prevention programmes in physical neighbourhood environments (Shafizadeh *et al.*, 2020).

In addition to gaining insights into physical environment factors in relation to community-dwelling older adults' fall prevention, it is also important to understand the role of risks and fear of falling (Arfken *et al.*, 1994; Gillespie *et al.*, 2012), which may be related to neighbourhood environments but also to individual factors such as health status (Lee *et al.*, 2018, 2020; Canever *et al.*, 2021). Risk factors of falling among older adults have often included investigations on advancing age, cognitive decline, female gender, history of previous falls, impaired balance and gait, visual impairments and environmental factors (Rubenstein, 2006; Ambrose *et al.*, 2013). Fear of falling has also been investigated in older adults and often described as anxiety experienced towards usual activities of daily living with the persistent perception that a fall will occur (Kumar *et al.*, 2016). Although half of the older adults who fall develop a fear of falling (Legters, 2002), it seems that older adults who have never fallen can also have a fear of falling (Scheffer *et al.*, 2008). Fear of falling is therefore likely to be a key component that prevents older adults from engaging in physical activities, despite physical activity being recommended for fall prevention in older adults (Tiedemann *et al.*, 2011; Grossman *et al.*, 2018). This is because physical exercise has been shown to be associated with fall prevention (Sherrington *et al.*, 2004), and increasing exercise levels among older

adults through programmes that help improve strength, gait and balance constitutes an important public health priority (Gillespie *et al.*, 2012; Arnautovska *et al.*, 2018).

The importance of such strategies and behaviours to fall prevention is highlighted in recommendations and guidelines from various geriatric societies and institutions. For example, the Panel on Prevention of Falls in Older Persons *et al.* (2011) state that older persons with a history of falls should have their gait and balance assessed along with a physical examination, a functional assessment and an environmental assessment. The Panel on Prevention of Falls in Older Persons *et al.* (2011) also recommend that interventions targeting fall prevention in older adults include strategies such as adapting unsafe home environments, addressing foot problems and inadequate footwear, participating in physical activity including balance exercises, and performing strength and gait training. The National Institute on Aging (2017) outlines similar guidelines, including being physically active; having regular eye and hearing tests; getting adequate sleep; limiting alcohol consumption; standing slowly from a sitting or lying position; using assistive devices for walking if needed; being careful when walking on wet or icy surfaces; and wearing non-skid, rubber-soled, low-heeled shoes. These guidelines and strategies are in line with previous research examining older adults' perspectives of their own fall prevention strategies and behaviours (e.g. Nyman *et al.*, 2013; Chippendale and Boltz, 2015; Chippendale and Raveis, 2017; Chippendale, 2019).

Currently, however, there are limited qualitative studies that have examined the beliefs held by older adults in relation to neighbourhood environment, perceived fall risks and fear of falling, and strategies and behaviours of fall prevention (Curl *et al.*, 2020). Using the phenomenological analysis method (Colaizzi, 1978), one study found that the physical neighbourhood provided a supportive role as well as barriers for physical activity and fall prevention among older adults (Chippendale and Boltz, 2015). Although features of the neighbourhood were found to motivate older adults to be more physically active, they were also found to contribute to risks of falls and fear of falls for some older adults. Furthermore, the data revealed that older adults living in their neighbourhood adopted various personal strategies to increase safety and reduce fall risks. Using the framework approach (Gale *et al.*, 2013), Swancutt *et al.* (2020) identified three key areas of physical and social environment, physical ability and self-efficacy through qualitatively interviewing community-dwelling older people and health-care professionals about older adults getting up from the floor following a fall. Swancutt *et al.* (2020) emphasised the importance of developing effective fall strategies to assist older adults addressing these three priority areas.

The current study

Gaining empirical knowledge to inform the development of effective neighbourhood-based fall prevention programmes for older adults, and particularly healthy and active older adults, living in a high population-density city is an important line of investigation (Chippendale, 2021). Varied geographical and environmental contexts and urban planning policies limit previous evidence providing a broad perspective on the issues facing older adults' fall prevention (Hill *et al.*, 2018). Compared to low-density cities, high-density cities, such as Hong Kong, are often signatored with shorter distances to destinations, preference of walking with

advanced public transport systems, high levels of commercial/service destination density and small urban parks (Cerin *et al.*, 2010; Barnett *et al.*, 2015; Zhang *et al.*, 2021). Therefore, a valuable step forward to improving knowledge gaps is to obtain a rich and bottom-up understanding of the perspectives of older adults living in high-density cities to gain insights into the influence of neighbourhood environments on preventing falls, beliefs around risks and fear of falling, and personal strategies and behaviours for fall prevention (Chippendale and Boltz, 2018).

Hong Kong is a high-density city with high rates of falls among older adults. According to the Centre for Health Protection of Hong Kong (2013), each year one in five community-dwelling older adults aged 65 years and older will fall and, moreover, of the older adults who fall, 75 per cent will sustain a serious injury (e.g. broken bones). Although there have been efforts in the area of fall prevention by local researchers (e.g. Fong *et al.*, 2011; Zhao *et al.*, 2016), a lack of evidence exists on fall prevention within neighbourhood environments among older adults in Hong Kong. This is important given that the functional fitness of Hong Kong older adults (Chung *et al.*, 2016) and their neighbourhood physical environments (Lai *et al.*, 2009; Cerin *et al.*, 2013) are different from Western counterparts. The aim of the current study, therefore, was to explore the fall beliefs of Hong Kong older adults in relation to neighbourhood physical environment, perceived risks and fear of falling, and fall prevention strategies and behaviours.

Methods

Participants

Using the purposeful sampling method (Patton, 1990) to recruit participants who could provide in-depth and detailed information about falling and fall prevention among older adults in their neighbourhoods, we sampled 50 community-dwelling older adults (N = 41 females, N = 9 males; age range = 68–93 years, mean = 78.68, standard deviation (SD) = 7.23) from 14 elderly centres located at different neighbourhoods of the three main regions of Hong Kong: Hong Kong Island, Kowloon and the New Territories. Eligibility criteria included (a) being aged 65 years or older, (b) being a first-language Chinese-speaker, and (c) living in the same neighbourhood in Hong Kong for at least six months. Exclusion criteria included suffering from a disability that impairs movement and memory (e.g. dementia and Parkinson's disease). Participants resided in varied regions and neighbourhoods in Hong Kong and had varied levels of education (N = 12 no formal education, N = 21 primary education, N = 11 middle school education, N = 4 high school education, N = 2 college education). In terms of marital status, the majority of participants were either married (N = 19) or widowed (N = 26), with only a few reporting being divorced (N = 3), separated (N = 1) or single (N = 1) (for the demographics of study participants, see Appendix S1 in the online supplementary material).

Procedure

Before the commencement of data collection, gatekeeper permission was obtained from the directors of elderly centres before approaching the participants. Eligible

older adults were then invited to participate and informed consent was provided. An experienced research assistant with a Master's degree and supervised by the lead author conducted all interviews either in an isolated room provided by the elderly centre or at a location convenient to the participant.

Throughout the interview, participants were invited to share their thoughts and experiences relating to the main interview questions (e.g. neighbourhood physical environment in relation to falls, perceived risks and fear of falling, and strategies and behaviours for fall prevention). Confirming summaries were used to validate participant responses and probing questions were used to clarify responses and elicit further information. All interviews were audio-recorded with the permission of participants. After the interview, participants were provided with a cash coupon of HK \$40 (approximately US \$5.15) as a thank you for their time. The duration of interviews ranged from 30 to 41 minutes (mean = 33.64, SD = 2.84).

Data collection continued until no further themes were generated from the data (Braun and Clarke, 2021). It is believed that the sample size of the current study was sufficient based on previous guidelines on thematic saturation. For example, Ando *et al.* (2014) recommend 12 interviews are sufficient for thematic analysis while Namey *et al.* (2016) report eight interviews can reach 80 per cent thematic saturation and 16 interviews can reach 90 per cent thematic saturation. More recently, Hennink and Kaiser (2021) conducted a systematic review on empirical studies that assessed data saturation in qualitative research and found that 9–17 interviews can reach data saturation. However, it should be noted that Braun and Clarke (2021) have criticised the concept of data saturation for thematic analysis as information redundancy and suggest the need for care and reflexivity in describing and doing thematic analysis.

Interview guide

Prior to data collection, a semi-structured interview guide using open-ended questions was developed to stimulate older adults' discussion on their experiences and beliefs towards neighbourhood environments, risks and fear of falling, and fall prevention strategies and behaviour (for the detailed interview guide, see Appendix S2 in the online supplementary material). The interview guide consisted of two main sections. The first section focused on older adults' experience and beliefs of falling risks, fear of falling, and fall prevention behaviours. The second section focused on older adults' perceived influence of the neighbourhood environment on fall risks, fear of falling and fall prevention. This was done to capture the perceived risk of falls when accessing recreational facilities and parks, access to transit points, pedestrian infrastructure and access to a variety of destinations (Cerin *et al.*, 2010). At the beginning of the second section, participants were provided with a definition of neighbourhood, *i.e.* the area within a perceived 15 minutes' walking distance from home (Cerin *et al.*, 2010).

Data analysis

Audio files of the 50 interviews were transcribed verbatim, and any identifying data were removed and replaced with code names. The text was then imported into

NVivo 12 qualitative analysis software to facilitate coding. We adopted the inductive and deductive approach for thematic analysis (Braun and Clarke, 2006, 2013) to analyse the data. The coder (CQZ) first read and re-read the transcribed data to ensure familiarity. At the inductive stage, all extracts within the dataset were coded into tags (*i.e.* meaning units), in which tags were then resorted and collated according to potential themes capturing salient patterns in the data. Using an iterative process, the themes, with reference to the original interview transcripts, were reviewed to ensure they were an accurate representation of their original content. The terms from the data were used to assign the names of the themes where possible. Using the interview topics as a guide, a deductive approach was adopted when the higher-order themes were formed into the five general dimensions. To ensure trustworthiness of the analysis, another coder (RZ) checked and refined the coding to ensure stability of coding on tags and themes, and any inconsistencies in coding assignment were resolved in discussions between the two coders (CQZ and RZ). It should be noted that only the themes and quotes cited in the article were translated into English, whereas the data analysis was conducted using the transcripts in Chinese.

Results

Findings were coalesced into five general dimensions: risks and circumstances of falls, consequences of falls, fear of falling and its consequences, neighbourhood environment, and strategies and behaviours of fall prevention. Under each of these five general dimensions, further main themes and sub-themes were revealed (*see* Tables 1–5 for the sampled codes and themes of each general dimension). Based on sequential ordering of interviews, the codes E1 to E50 were used to represent participants, and following each quote was a code for gender (F = female and M = male) and age (in years).

Risks and circumstances of falls

Two main themes were revealed under the general dimension of risks and circumstances of falls: (a) risks of falls, *i.e.* older adults' perception of their falling risks; and (b) circumstances of falls, namely older adults' beliefs on why and in what situations they might fall (for sampled quotations, main and sub-themes of risks, and circumstances of falls, *see* Table 1).

Risks of falls

When older adults estimated their risks of falls, their perceptions were not unanimous but a *mixed estimation of the risks of falls*. While some older adults believed that their risk of falling was high, others believed their risk was low, with being more careful, doing more physical exercise and having good physical condition provided as reasons for low fall risk. A key factor discussed for high fall risk was *ageing-related physical degeneration*. Older adults described different types of degeneration including degradation of knees and feet, lack of power, difficulty maintaining balance, and lack of vision and hearing. These age-related factors were believed to place older adults at increased risk of falls, which could also potentially lead to serious consequences if one did fall.

Table 1. Themes, sub-themes and selected quotes supporting the general dimension of risks and circumstances of falls

Main themes and sub-themes	Examples of quotations from participants
Risks of falls:	
Mixed estimation of the risks of falls	<i>Perceived high risks.</i> 'The risk is high. Well, I am getting older, in my seventies' (E29, female (F), age 74) <i>Perceived low risks.</i> 'The risks should not be high, I am more careful now' (E18, male (M), 84); 'It should not be very high. Because I do physical exercises regularly, I think the risks for me should not be high' (E7, F, 70); 'My physical condition is fine, so no problem at all' (E24, F, 81)
Ageing-related physical degeneration	<i>Degradation of knees.</i> 'I have seen doctors many times and they told me that my knees were degenerated. They said that ageing leads to the degeneration, and I have to accept that' (E36, F, 82) <i>Degradation of feet.</i> 'My feet are not strong enough, they are degenerated' (E11, F, 86) <i>Lack of power.</i> 'These are my own physical problems. Image that you are physically unhealthy, your feet lack power, you may have degenerated joints or weakened muscles' (E6, F, 88) <i>Cannot maintain balance.</i> 'Stand not steady and walk not steady, I might fall. In these two to three years, my physical condition gets worse' (E33, F, 90) <i>Cannot see clearly and hear well.</i> 'But I feel a little deaf, degenerated. My eyes are not that sharp anymore' (E25)
Circumstances of falls:	
Fall for no reason	'Be careful with yourself. But sometimes it is not your turn to be careful, you fall for no reason' (E16, F, 83)
Rush to fall	'Sometimes it is just rushing to walk' (E20, M, 70)
Fall due to misstep	'Sometimes I missed the steps myself, then I fell down' (E2, M, 75)
Tripped to fall	'I took my grandson to see the doctor. The root of the tree was on the road, but I did not notice it. I fell down after kicking it' (E46, F, 82)
Fall due to bus suddenly accelerating or braking	'Last time I got on the bus fine, but I did not hold the handrail and stand stable yet when the driver suddenly accelerated and I fell down in the bus' (E12, M, 76)

Circumstances of falls

Regarding the circumstances of falls, *fall for no reason* was a belief held by many older adults. This reflects a perception that falls may be difficult to prevent as older adults can suddenly find themselves falling for no obvious reason or identifiable cause. It does not necessarily reflect a lack of awareness on the risk factors related to falls or with less fall prevention strategies. In contrast, older adults' perceived that falls are something that can just happen due to the ageing process and

associated degenerated physical conditions. In addition, *rush to fall* was another belief held as a reason for older adults falling. For example, experiencing a fall at the bus stop because of rushing to catch the bus: 'I saw the bus coming. I walked faster as I do not want to wait for the next bus. I fell down again with my whole body falling down' (E22, F, 89). Other circumstances of falls for older adults included *fall due to misstep* and *tripped to fall*. Further, given bus transportation is common for older adults in Hong Kong, the likelihood of older adults to *fall due to bus suddenly accelerating or braking* was also discussed.

Consequences of falls

For older adults, falling was discussed as having various consequences including both physical and psychological. For physical consequences, some were discussed as being serious whereas others were discussed as being less serious, with different effects as a result on older adults (for sampled quotations, main and sub-themes of the consequences of falls, see [Table 2](#)).

Physical consequences of falls

In terms of the physical consequences of falls, some older adults believed that the *seriousness of fall depends on the consequences*. A theme to this thread was that some older adults believed that they will be *fine after fall*. On the other hand, the seriousness of falls was also discussed, with sustaining *bone fracture after fall* described as one of the more serious physical consequences. Indeed, bones become more fragile with ageing and bone fracture is highly probably after a fall (e.g. hands, feet, legs or even the pelvis), a fact salient to most of the older adults. Further, some older adults mentioned that falls can be as serious as *lost self-care ability after fall*, with the potential for activities of daily living to be negatively compromised, including assistance with walking, confinement to a wheelchair and admission to a nursing home. In the most extreme of cases, a few participants discussed circumstances where older adults within their social network *passed away after fall*.

Psychological consequences of falls

In terms of the psychological consequences of falls, some older adults mentioned that they *start to have a fear of falling after falling*. The fear was discussed as developing out of a fear of the physical consequences of falls, as mentioned above: fracture, lost self-care ability or even death. However, some participants discussed a positive aspect from falling experience in that they *start to be more careful after falling* when they walk and do other things.

Fear of falling and its consequences

With regards to the general dimension of fear of falling, some older adults described how they are afraid of falling, mostly out of a fear of the potential negative consequences (as discussed in the theme above). Others, however, mentioned that they are not afraid of falling, holding the belief, which may be based more on optimism bias, that they will be fine after falling (for sampled quotations, main and sub-themes of fear of falling and its consequences, see [Table 3](#)).

Table 2. Themes, sub-themes and selected quotes supporting the general dimension of the consequences of falls

Main themes and sub-themes	Examples of quotations from participants
Physical consequences of falls:	
Seriousness of fall depends on the consequences	'These are hard to determine, depending on whether your fall is serious or not' (E28, male (M), age 72)
Fine after fall	'At that time, someone tried to drag me up. I said no thank you and I slowly helped myself up' (E11, female (F), 86)
Bone fracture after fall	'The bone fractured because it is brittle. You feel the pain, but you cannot move, right? So, I think falling is quite serious' (E35, F, 69)
Lost self-care ability after fall	'There is also the loss of self-care ability. After fall, someone needs to take care of you. If it is more serious, you will not be able to walk. Then, you will in big trouble, don't you?' (E1, F, 68)
Passed away after fall	'I have a friend who is a little bit clumsy. I do not know what happened. She climbed to bed from the ground and fell. She passed the second day, doctor could not save her' (E8, F, 91)
Psychological consequences of falls:	
Start to fear falling after falling	'It has been a long time, at least three years. I started to fear after the fall' (E3, M, 85)
Start to be more careful after falling	'After these few times, I started to be more careful, like walking carefully' (E18, M, 84)

Fear of falling

For many older adults, the fear of falling stemmed from being *worried about falling* when considering the serious consequences of falling and their high risks of falling. In addition, older adults expressed their *fear of being bumped into fall* by other people, particularly by running children and people cycling.

Fear of the consequences of falling

Some older adults *worried about the medical costs after fall*. Although the costs of public health care are government supported for older adults in Hong Kong, unless the medical condition is considered urgent, many older adults are put on long waiting lists to receive treatment, and private hospital care, although timely, is often expensive. In addition, older adults discussed a *fear of not being cared for after fall*, which fed into their fear of falling especially if they did not have children or close relatives to care for them if they were to lose their self-care ability after a fall. Also, and linked to the traditional Chinese concept of filial piety, is that older adults had a *fear of becoming a burden to children and family after falls*.

No fear of falling

Although many older adults expressed a fear of falling, there were some who mentioned that they are not worried about falling, characterised by the theme *not worried about falling – let nature take its course*. These older adults choose to accept

Table 3. Themes, sub-themes and selected quotes supporting the general dimension of the fear of falling and its consequences

Main themes and sub-themes	Examples of quotations from participants
Fear of falling:	
Worried about falling	'It is terrible for older adults to fall. I really worried about it' (E45, female (F), age 80)
Fear of being bumped into fall by other people	'Especially those kids when they go to school or after schools. They run. Let alone our older adults, normal people can be knocked down by them with the momentum of running' (E4, F, 83)
Fear of the consequences of falling:	
Worried about the medical costs after fall	'If you fall, you go to the public hospitals. Unless it is an emergency, you must wait at least nine months. Not everyone can afford the costs of a private doctor' (E12, male (M), 76)
Fear of not being cared for after fall	'I am old with many physical conditions. It is a big thing if I fall, with many problems arising. What should I do if no one can look after me after I fall?' (E48, F, 77)
Fear of becoming a burden to children and family after fall	'I am so grateful. I often tell myself that I must take good care of myself to be filial to my children. I will not become a burden to them. Do you know? You must not fall down and become a burden to your children. We used to say that taking care of yourself is filial piety to the parents. Now it becomes I take care of myself and be filial piety to those young people. Isn't it?' (E40, F, 75)
No fear of falling:	
Not worried about falling – let nature take its course	'I do not worry about it. There is nothing to worry about, just take things as they come. Isn't it? Worry is useless. If it comes, it will come, and it is okay' (E39, F, 79)
No fear of falling – protected by their faith	'Yes, a lot of people have to use crutches. I do not have to use crutches, which is good. Fortunately, God bless. I only stayed in the hospital for one week' (E29, F, 74)
No fear of falling – in luck	'I fell several times, but I am totally fine. I was in luck' (E43, F, 84)

any of consequences, regardless of severity, that may occur from falling and, therefore, expressed having no fear of falling. In addition, some older adults mentioned that they have no fear of falling because they believe that they are *protected by their faith*. Furthermore, some older adults perpetuated their belief in having no fear by mentioning that they are fine after fall because they are *in luck*.

Neighbourhood environment

In discussion about the neighbourhood environment, two major features were revealed that impacted on the falls of older adults: (a) factors that could increase older adults' risks of falls, and (b) protective factors to reduce the risks of falls for older adults (for sampled quotations, main and sub-themes of neighbourhood environment, see Table 4).

Neighbourhood risk factors

Regarding the risk factors of the neighbourhood environment, *neighbourhood clutter* was a salient factor believed to cause older adults to fall, such as sprawling garbage, messy construction sites and randomly parked cars. *Stairs and stone steps* were also discussed as contributing to risks of falls for older adults. One prominent risk factor within the neighbourhood environment mentioned by many of the older adults was *uneven floors* in the streets and at bus stations (e.g. bricks protrude, floor rotten, potholes). *Narrow sidewalks* were also discussed and led older adults to think they could be easily bumped into fall, as was *slippery grounds* which included at public toilets, bathrooms and street markets, and after rain. Another risk factor included *short signal timing at pedestrian crossings*, in which short signal timing of traffic lights could prevent older adults from crossing the road carefully and safely. Instead, older adults are forced to stop at the halfway waiting point. Other risk factors were *poor light at night* and, although less observed, *electric wheelchairs and trolleys* where some older adults talked about their experiences of being knocked down by the wheelchairs and trolleys.

Neighbourhood protective factors

Older adults, however, also emphasised protective environmental factors in their neighbourhoods. One salient protective factor mentioned by many of the older adults was having *flyovers with lifts* for them to cross the roads. *Ramps and railings* were also mentioned to help prevent falls as was having *flat roads*. Further, older adults affirmed the importance of *warning notices of slippery and uneven surfaces* to prevent them falling. In addition, having *roadside benches for older adults to take a rest* was talked about as important, especially when older adults feel tired after a long walk. In recreational facilities in urban parks or playgrounds, having *non-slip materials on the ground around leisure facilities* was thought of as useful in preventing falls in older adults, as was having *clean/non-slip grounds of markets and public toilets* in their neighbourhoods.

Strategies and behaviours of fall prevention

Older adults also discussed a range of fall prevention strategies and behaviours to help them to avoid falling in their neighbourhoods (for sampled quotations, main and sub-themes of strategies and behaviours of fall prevention, see Table 5).

Strategies of fall prevention

One of the more salient fall prevention strategies mentioned by older adults was to *keep vigilant and be careful*, especially when walking outside. *Slow down and not rush* was also a common theme in relation to walking. The importance of *keeping balance* was also emphasised with specific ways to help older adults to keep balance which included using crutches, not carrying heavy things, sitting down to put on clothing (e.g. trousers, socks) and bathing, and holding handrails when going up and down stairs and climbing on and off buses. Further, *avoid crowds* was another key strategy mentioned that potentially helps fall prevention in older adults. This consisted of two aspects: avoid going to crowded places and avoid going out at times likely to be crowded. Also, older adults discussed how they prevent

Table 4. Themes, sub-themes and selected quotes supporting the general dimension of the neighbourhood environment

Main themes and sub-themes	Examples of quotations from participants
Neighbourhood risk factors:	
Neighbourhood clutter	'Earlier, typhoon Mangkhut caused neighbourhood clutter. Now, it is much better, things improved' (E17, female (F), age 73)
Stairs and stone steps	'Most of the falls happen when [I] walked down the stairs of the park, did not pay attention and miss a step, twisted the ankle position' (E15, male (M), 70)
Uneven floors	'I think the floors of roads within this neighbourhood are uneven. Sometimes, one place is a little higher, but you did not know that. Alternatively, there might only be a little bit uneven. Young people do not think it is an issue, but older adults might fall when tripped' (E26, F, 73)
Narrow sidewalks	'The sidewalk is narrow because the road is narrow. Sidewalks are not roads, which are flat. The pedestrian sidewalk next to the road is narrow. It is difficult to avoid people who pull a trolley' (E32, F, 93)
Slippery grounds	'Needless to say, the [street] market is very slippery' (E23, F, 84) 'Not enough; I can only walk a little more than halfway. If the crossing the road needs 10 minutes, the lights will turn at 7 minutes' (E13, F, 78)
Short signal timing at pedestrian crossing	'For those of us who walked slowly, we sometimes stopped halfway at the middle' (E11, F, 86)
Poor light at night	'Yes, it's dark at night and it's easy to fall' (E47, F, 85)
Electric wheelchairs and trolleys	'I was knocked down by the trolley in the market, it took me a long time to recover' (E48, F, 77)
Neighbourhood protective factors:	
Flyovers with lifts	'It is convenient to walk on the flyovers since it is equipped with lifts now. Very convenient' (E18, M, 84)
Ramp and railing	'For the time being, I think everything is okay. It is not that easy to fall. For example, it is convenient for older adults to go in and out of the ramp. In the past, you might be afraid of the stone steps, but now it is convenient for older adults to walk, not so easy to fall. It is much better to have a railing on the ramp' (E47, F, 85)
Flat roads	'The roads are easy to walk, very flat' (E28, M, 72)
Warning notices of slippery and uneven surfaces	'Working staff normally find railings to surround the uneven places and then post notices to warn that the ground is uneven' (E20, M, 70)
Roadside bench for older adults to take a rest	'Now, there are stone benches along the road to the dining places. Previously, there were only benches in the park. Now, there are benches everywhere, all the way along the roads even to the hospital' (E32, F, 93)

(Continued)

Table 4. (Continued.)

Main themes and sub-themes	Examples of quotations from participants
Non-slip materials on the ground around leisure facilities	'I do not dare to say that it is not easy to fall. If looking at the recreational facilities, there are non-slip materials around them, feel like the automobile tyre fabric' (E15, M, 70)
Clean/non-slip grounds of markets and public toilets	'The public toilets are okay, which are non-slippery' (E35, F, 69); 'The markets are all good, which are not slippery. They are all dry. Even the places for selling fish and other aquatic products, there are no risks' (E2, M, 75)

Table 5. Themes, sub-themes and selected quotes supporting the general dimension of the strategies and behaviours of fall prevention

Main themes and sub-themes	Examples of quotations from participants
Strategies of fall prevention:	
Keep vigilant and be careful	'I have to keep vigilant myself. My children are busy working. I have to be 120 per cent vigilant' (E9, female (F), age 85); 'See [the road] clearly before I walk. I worry about uneven road leads to falling' (E13, F, 78)
Slow down and no rush	'You [older adults] do not have to go to work now and you don't have to be in a hurry. Take it slowly. Before my last fall, I was always in a rush crossing the road before traffic lights change the colour. Now, no matter how urgent the situation is, I do not care. I need to wait [traffic lights]' (E4, F, 83)
Keep balance	'Sometimes when I go out and walk, I try to keep balance, not swing on both sides' (E46, F, 82)
Avoid crowds	<i>Avoid going to crowded places.</i> 'What I worried most is going to crowded places. In the crowded places, people push each other' (E34, F, 81) <i>Avoid going out when crowded.</i> 'In the afternoon, I usually stay away from the street and avoid that after-school time of the two middle schools. Because there are so many people crowd near those two schools' (E41, F, 84)
Go out less	<i>Go out less when raining.</i> 'I stopped going out when it was raining, and the road was slippery. I stopped walking around' (E8, F, 91) <i>Go out less during nighttime.</i> 'I rarely go out at night. I went home before dark. Not sure whether the lights at night are bright enough, I went home early' (E3, male (M), 85)
Avoid putting things in a high place	'Don't put things for use too high. You cannot reach it. If you use a stool, you cannot stand still and may fall at any time' (E12, M, 76)
Behaviours of fall prevention:	
Wear non-slip shoes	'I always choose the non-slippery shoes to wear' (E10, F, 70)
Exercise to prevent falls	'Do more exercise, it's less likely to fall when walking' (E7, F, 70); 'We do exercise mainly to make our feet have more power' (E36, F, 82); 'How much help does it [physical exercise] give me when I feel better? I feel better and my balance is better' (E28, M, 72); 'All is to do exercise, our hands and feet become a bit more flexible' (E38, F, 78)

experiencing falls by trying to *go out less*, especially when it is raining or dark outside. To prevent serious consequences as a result of falling, older adults mentioned that they *avoid putting things in a high place*.

Behaviours of fall prevention

To reduce the chances of falling due to slipping, older adults discussed the importance of *wearing non-slip shoes*. In addition, engaging in *exercise to prevent falls* was also emphasised. In particular, the benefits of doing exercise were highlighted by older adults and included having more power, better body balance and improved flexibility.

Discussion

The current study aimed to examine qualitatively perceptions of neighbourhood physical environment in relation to falls, perceived risks and fear of falling, and strategies and behaviours for fall prevention in a sample of urban-dwelling older adults in the high-density city of Hong Kong. Findings revealed that neighbourhood environments provide both risk and protective factors for falls in older adults. Across the various discussions on reasons for falls, it was revealed that there are mixed perceptions on fall risks, with some older adults perceiving risks while others perceiving no risks. Likewise, some older adults expressed a fear of falling while others did not believe that they had any risk of falling. Finally, key fall prevention strategies and behaviours were shared by older adults including keeping vigilant, not rushing, maintaining balance and engaging in exercise.

Older adults held mixed beliefs on their risks of falls; a finding consistent with previous research (Stevens *et al.*, 2010). Profiling older adults on their risk perceptions may therefore be important to consider when designing fall prevention programmes, especially as risk perceptions are shown to be associated with individuals' behavioural motivations (Brewer *et al.*, 2004; Ferrer and Klein, 2015; Kasten *et al.*, 2019). Also, in line with previous studies (Bergland *et al.*, 2003; Scheffer *et al.*, 2008; Chippendale and Lee, 2018) was the belief that older adults' ageing-related physical degeneration could lead to a high risk of falling. These included degradation of knees and feet, lack of power, difficulty maintaining balance, and lack of vision and hearing. Decline in physical function is a common feature of older age (Stevens *et al.*, 2010) and has important outcomes in terms of fall prevention. A focus therefore on improving older adults' physical function through strength and balance training is important to consider to combat fall incidence (Zhao *et al.*, 2016).

The circumstances of falls described in the current study were similar to those presented in previous research including rushing, falling due to missteps and tripped to fall (Li *et al.*, 2006; Lai *et al.*, 2009; Nyman *et al.*, 2013). It seems that most circumstances of falls are attention related, thus improving older adults' abilities to be mindful of their steps might be useful (Hoang *et al.*, 2020). Other circumstances related more to specific contexts, such as falling due to a bus suddenly accelerating or braking. Given older adults frequently use the bus as a means of public transportation in Hong Kong, finding feasible and safe ways of preventing falls in such contexts is warranted, such as allocating more seats to older adults

or installing better handrails. There was, however, the belief held of falling for no reason, where falling was perceived as potentially difficult to prevent as one can suddenly fall for no obvious reason or identifiable cause (Nyman *et al.*, 2013). Although not obvious, there is usually an underlying cause of a fall and education programmes aimed at preventing falls could highlight these causes, as identified in this study, so they are more salient to older adults.

Older adults' views on the physical consequences of falls were also mixed. As has been identified in other qualitative research (Nyman *et al.*, 2013), national-level statistics on fall-induced injuries and deaths among older adults (Kannus *et al.*, 1999) and multi-year retrospective summary of fall deaths in older adults (Deprey *et al.*, 2017), in general the serious physical consequences of falling included bone fracture, loss of self-care ability and even death. For some older adults, however, the fall experience resulted in no injury, as noted in previous studies (Nyman *et al.*, 2013; Swancutt *et al.*, 2020), which may perpetuate a false belief that they will be fine if they fall. Unpacking these misperceptions and contrary beliefs about fall consequences might be a useful line of further investigation, using quantitative (Chippendale and Lee, 2018) and qualitative (Nyman *et al.*, 2013) methods to triangulate data.

For older adults, falls were not only discussed in relation to physical consequences but also in relation to psychological outcomes. One common view was that older adults might start to fear falling after experiencing a fall. This is supported by previous research which has shown older adults' prior fall experiences are associated with a fear of falling (Bergland *et al.*, 2003; Scheffer *et al.*, 2008; Denkinger *et al.*, 2015; Chippendale and Lee, 2018). Therefore, developing programmes through older adults' stories of falls and the fear experience could be used to enhance more careful attention to daily activities and potential fall risks. This could also provide insights for future interventions introducing young older adults who have had limited or no fall experience to imagine, potentially through mental imagery techniques (Hamel and Lajoie, 2005), the processes and outcomes relating to falls and fall prevention.

In addition to developing a fear of falling because of experiencing a fall, older adults held a general overall fear of falling. Indeed, fear of falling is common among older adults (Lee *et al.*, 2018). Specifically, older adults worried about the financial burden (*i.e.* medical costs) if the consequences of the fall would be serious, such as being hospitalised or requiring surgery. Furthermore, there was an overwhelming fear of not having access to adequate care after falling, especially for those who lived alone (Kong *et al.*, 2002). Also, some older adults expressed a fear of becoming a burden to children and family after falling, a belief embedded in Chinese culture (Kong *et al.*, 2002). It would be therefore useful for future research to explore further the role that traditional Chinese culture has on the formation of beliefs and thinking styles of older adults in relation to falls and fall prevention behaviours.

Of note was that some older adults expressed no fear of falling, embedded in the themes of letting nature take its course, protected by their faith and luck. The beliefs of letting nature take its course is perhaps reflected in an attitude of experiential acceptance as proposed in the contextual approach of acceptance and commitment therapy (Hayes *et al.*, 2006). In addition, older adults might attribute the reasons that they are fine after falls because they are 'in luck' or that they are

protected by their religious belief or a higher power. Future research could therefore consider examining older adults' attribution styles on their falls. Developing church-based fall prevention programmes for older adults could also be considered (e.g. DiGuseppi *et al.*, 2014).

The current study also highlighted the importance of neighbourhood environments on older adults' fall beliefs, which were perceived to provide both risk and protective factors. In line with previous research (Li *et al.*, 2006; Lai *et al.*, 2009; Nyman *et al.*, 2013; Chippendale and Boltz, 2015, 2018; Chippendale and Raveis, 2017; Lee *et al.*, 2018, 2020; Janakiraman *et al.*, 2019), older adults in this study identified risk factors of the neighbourhood physical environment to include neighbourhood clutter, stairs and stone steps, uneven floors, narrow sidewalks, slippery ground, short signal timing and pedestrian crossing, and poor light at night. Perhaps a unique feature of the socio-human geography of Hong Kong is that older adults identified the risk of electric wheelchairs and trolleys knocking individuals and therefore causing a fall, a finding consistent with a previous quantitative study conducted in Hong Kong (Lai *et al.*, 2009). It is therefore important that the regulations governing electric wheelchair use ensures the safety and protection of older adults in their neighbourhoods.

Despite the potential neighbourhood risks, there were many protective factors identified within the neighbourhood environments to help prevent falls of older adults, possibly the result of the age-friendliness policy in Hong Kong (Chui *et al.*, 2019). For example, flyovers equipped with lifts were installed across populous areas in Hong Kong to assist road crossing and stair climbing for older adults. Other protective factors discussed included ramps and railings, flat roads, and non-slip surfaces at markets and public toilets. Older adults also discussed the usefulness of notices warning of slippery and uneven surfaces to cue them to be extra careful and vigilant when walking on such surfaces. Having regularly spaced roadside benches to facilitate taking a rest from walking was identified as another important protective factor for fall prevention (Lee *et al.*, 2020). Given the importance of participating in physical activity at recreational facilities in neighbourhood playgrounds and parks for fall prevention (Shafizadeh *et al.*, 2020), having non-slip materials on the ground around leisure facilities was also described as helping to prevent falling in older adults. It is therefore recommended that policy makers responsible for urban design in cities with high population density develop ageing-friendly neighbourhoods by improving built environment-related protective factors and reducing neighbourhood risk factors. Such designs could include the range of neighbourhood factors described by older adults in this study, e.g. using non-slip materials in leisure parks and high-traffic public areas, installing flyovers equipped with lifts, building and maintaining flat and even-surfaced walking paths, and placing sitting benches for resting at regular intervals. The improvement of neighbourhoods to ensure safe walking environments for older adults is an important component for fall prevention (Li *et al.*, 2014; Nicklett *et al.*, 2017; Curl *et al.*, 2020).

Implementation of strategies and behaviours of fall prevention is also an important consideration for preventing falls in older adults. Current findings were in line with previous research (Chippendale and Boltz, 2015; Chippendale and Raveis, 2017; Chippendale, 2019), e.g. keeping vigilant and being careful (Chippendale and Raveis, 2017). Practising mindful walking could therefore be a way to help

cultivate extra care when walking (Shi *et al.*, 2019). In addition, slowing down and not rushing was discussed as an effective fall prevention strategy to overcome the risk of rushing leading to falls (Chippendale and Raveis, 2017; Chippendale, 2019). Consistent with previous studies (Chippendale and Raveis, 2017; Chippendale, 2019), keeping balance was identified as important to fall prevention, which is in line with evidence showing loss of balance as a major cause of falls in older adults (Ambrose *et al.*, 2013; Cuevas-Trisan, 2019). Further, and also consistent with previous research (Nyman *et al.*, 2013; Chippendale and Boltz, 2018; Chippendale, 2019), older adults discussed decisions to avoid crowds, go out less and wear non-slip shoes to prevent falling. Given the benefits of exercise on fall prevention, including improving strength, balance and flexibility, participation in regular exercise to prevent falls should be a key recommendation (Stevens *et al.*, 2010).

Study limitations and future directions

Limitations of the current study should be acknowledged. The majority of participants were female (N = 41, 82%) and thus representativeness of male older adults is lacking. This is possibly because participants were recruited from elderly centres which have greater numbers of female members than male members. Although this is a common issue for studies of older adults in Hong Kong (Zhang *et al.*, 2019; Hu *et al.*, 2020) and female older adults have higher fall-related injuries than other age groups (Talbot *et al.*, 2005) and show more fear of falling as compared to male older adults (Denkinger *et al.*, 2015; Chippendale and Lee, 2018), future studies should consider recruiting a gender-balanced sample. We recruited older adults aged 65 years and older and, therefore, beliefs of 'young' older adults, such as those aged 55–65 years, is limited. Age group differences may exist in perceptions of detrimental effects of falling and falling risks among older adults across different age groups (Ruthig *et al.*, 2007; Sakurai *et al.*, 2013), and future research should consider recruiting a more age-balanced group of older adults representing both young older adults and old older adults. When reflecting on falling experiences, the majority of participants (N = 43, 86%) discussed falling experiences that were not recent. Thus, recall bias may have influenced participants' thoughts and perceptions on falls, in particular fear of falling. Future studies could therefore consider conducting qualitative investigations on older adults with recent fall experiences (*e.g.* Swancutt *et al.*, 2020). Also, due to study pragmatics such as budget and time constraints, only one member of the research team coded the data, although another independent team member checked and refined the coding to ensure the trustworthiness of the results. Furthermore, we did not conduct other investigations, such as interviewing elderly centre staff or health-care professionals, to enable data triangulation (Nowell *et al.*, 2017). Finally, the current sample may not represent the broader elderly population in Hong Kong. This is because elderly centres in Hong Kong are like social clubs where members participate in group activities and, therefore, these clubs attract a certain 'type' of older adult who is interested in participating and able to engage in social and group-based activities. Nonetheless, current findings could still generalise somewhat to the broader Hong Kong older population, given that participants of the current study resided in varied neighbourhoods in Hong Kong.

Conclusion

Findings from the current study demonstrate that neighbourhood environments have both risk and protective factors of falls for older adults, although it is noted that some older adults perceive no falling risks or fear of falling. Fall prevention strategies and behaviours are, in general, shared by older adults, such as keep vigilant and be careful, slow down and do not rush, maintain balance and exercise to prevent falls. This knowledge can be used to inform and develop interventions aimed at reducing falls in urban-dwelling older adults in large cities with high-population densities.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/S0144686X22001209>.

Author contributions. CQZ, MSH and KH secured the grant and planned the study. CQZ and RZ analysed the data, reviewed the literature and drafted the manuscript. JSB, MSH and KH contributed to revising the manuscript. All authors approved the final manuscript as submitted.

Financial support. This work was supported by Hong Kong Baptist University (grant number FRG1/17-18/021).

Conflict of interest. The authors declare no conflicts of interest.

Ethical standards. Ethical approval to conduct the study was obtained from the Research Ethics Committee of Hong Kong Baptist University.

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Cite this article: Zhang C-Q, Zhang R, Baker JS, Hagger MS, Hamilton K (2024). A qualitative investigation exploring neighbourhood environment, risks and fear of falling, and fall prevention strategies among urban-dwelling older adults in a high-density city. *Ageing & Society* **44**, 2155–2176. <https://doi.org/10.1017/S0144686X22001209>