Assessing the safety and quality of the indoor environment of senior housing:

A Swedish case study

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Roya Bamzar

Abstract

The aims of this article are to assess the safety quality of the indoor living environment of senior housing in Hässelgården, Stockholm Municipality (Sweden’s capital), and to suggest improvement strategies. First, the physical indoor environment of older adults is examined via a fieldwork checklist devised in accordance with the principles of universal design (UD). Second, their indoor environment is assessed through a survey that includes subjective questions about seniors’ use of space, experience of falls, and safety perception. Third, the study explores whether the applications of UD in the seniors’ indoor living environment contribute to the understanding of their use of space, experience of falls, and safety perception. Fieldwork inspections and a detailed survey with residents are used as a basis for the empirical analysis. Findings indicate that the living room has the highest UD score compared with those for the kitchen and the bedroom. The elderly spend most of their time in the living room and the kitchen. A low UD score (e.g. kitchen and bedroom) is associated with a higher number of falls but not with low levels of safety perception and use of space. The article concludes with suggestions to improve housing safety of Hässelgården’s senior housing, which may also help prevent falls in the older population elsewhere.

Keywords: housing design, risk of falls in older adults, Stockholm, perceived environmental safety.
1. Introduction

As people age, their tendency to live in the same place increases (Andersson & Abramsson 2012; Sandstedt & Abramsson 2012). This phenomenon is called ‘ageing in place’ (Davey, Nana, de Joux, & Arcus, 2004). This is no surprise given that people’s physical fragility increases with age; they are less mobile than those of young cohorts, spending most of time indoors (Iwarsson et al., 2007). Results from a study conducted by Abramsson and Andersson (2016) on changing preference of housing choice with ageing in Sweden indicate that Swedes tend to change their housing from large to small, and from owner occupation to rental housing as they age. Furthermore, there is a tendency among Swedish older adults to move in more comfortable housings that need less maintenance (Abramsson & Niedomysl, 2008; Abramsson, Elmqvist, & Magnusson Turner, 2014).

This situation makes the ‘older adults’ home an important setting to be studied in relation to how residents perceive and use this environment. Falls are the leading cause of injuries and death among the older population worldwide (World Health Organization [WHO], 2016), and Sweden is no exception. A study by Berleen (2004) found that 80% of all fatal injuries among older Swedes in 1999 were because of falls. The results of two recent studies in Sweden indicate that 57 per cent of all falls in the older population are caused by slipping, tripping, and stubbing; these falls often take place indoors and in the seniors’ immediate environment, with the long winters helping to explain the seniors’ increased tendency to stay indoors (Bamzar & Ceccato, 2015, 2016; Ceccato, 2016). This study builds on the work done by Bamzar and Ceccato (2015, 2016) and Ceccato (2016). Through the use of a case study, this study aims to assess the safety quality of the indoor living environment of senior housing, namely Hässelgården’s senior housing. This study sets out to assess how the physical features of the indoor environment of older adults’ home may influence and be related to their use of space, experience of falls, and safety perception.

Hässelgården is situated in Stockholm, the capital of Sweden, which is located in the centre–south of the country. The study begins with an examination of the physical indoor environment of the older adults living in Hässelgården’s senior housing via a fieldwork
checklist designed in accordance with the principles of universal design (UD). Next, the indoor environment of this older population is assessed through a survey that includes questions about the seniors’ use of space, experience of falls, and safety perception. The study then explores whether adherence/non-adherence to the principles of UD in the seniors’ indoor environment contributes to their use of space, experience of falls, and safety perception. The article concludes with suggestions to improve the housing safety of Hässelgården’s senior housing, which may also guide the prevention of falls in the older population elsewhere.

2. Theoretical background

2.1 Older adults’ homes

Ageing

Conventionally, ageing is defined as a chronological age of 65 years or older, with those from 65 through 74 years referred to as ‘early elderly’ and those 75 years or older as ‘late elderly’, although the origin of this definition is unknown. Scholars suggest that ageing is usually associated with dependency and loss of functionality (Orimo, Ito, Suzuki, Araki, Hosoi, & Sawabe, 2006). Because the healthy life expectancy of seniors has increased, seniors have become more active and independent compared with those living decades ago. However, seniors living in different countries (developed and developing countries) experience different lifespans based on their health and socio-economic status. Therefore, it may be concluded that, realistically, the definition of ageing must be adjusted according to the circumstances of a geographical region in which the population lives.

The meaning and use of ‘home’ by older adults

A home is a house that can fulfil the needs of its residents (Demirbileka & Demirkan, 2004). The fragility, cognitive impairment, and weaker motor coordination associated with ageing impede older individuals from performing their daily routine safely (Fielo & Warren, 2001; Ritzel, Beasley, Flynn & Liefer, 2001). In addition, long-standing illnesses in this age group restrict the elderly from going out more often (Avis, Gooberman, & Ebrahim, 2003). In their 2004 study, Forlizzi, DiSalvo, and Gemperle focused on how the environment is perceived by
older adults in relation to their domestic lives. They highlighted the importance of the design of physical features of the living environment and of assistive products in either maintaining or decreasing the independency of the elderly. Their findings showed that many aspects of a typical senior’s apartment fail to fulfil the residents’ needs properly. For example, the bathrooms and kitchens had some inadequacies that can limit the daily activities of the elderly. These inadequacies included the storage of unnecessary appliances and food on kitchen countertops and the positioning of cabinets and shelves out of reach for residents. Their findings are corroborated by other studies elsewhere.

**The risk of injuries in older adults’ homes**

Scholars suggest that certain aspects of the environment and the settings to which older people are daily exposed increase their risk of falls (Letts, Moreland, Richardson, Coman, Edwards, Ginis, et al., 2010; Tinetti, Speechley, & Ginter., 1988; Shroyer, 1994; Stevens, Holman, & Bennett, 2001). The results of a retrospective study in Australia indicate that older persons who live in homes with more environmental hazards (e.g. inadequate lighting, slippery and uneven floor surfaces, absence of appropriate grab bars/handrails on stairs) have a 2.8 times greater risk of experiencing at least one injury (Carter, Campbell, Sanson-Fisher, & Gillespie, 2000). The relationship between the presence of environmental hazards and the prevalence of falls has also been highlighted in other studies (Northridge, Nevitt, Kelsey, & Link, 1995; Berg, Alessio, Mills, & Tong, 1997; Connell & Wolf, 1997; Josephson, Fabacher, & Rubenstein, 1991; Fuller, 2000; Gill, Williams, Robison, & Tinetti, 1999). Northridge et al. (1995) described that in the United States, certain home hazards such as clutter and hall rug problems are crucial factors in predicting falls among healthy, active older adults. Carrying heavy or bulky objects, walking on slippery floors, and living with poor lighting may increase the risk of falls (Stevens et al., 2001). Carter et al. (2000) illustrated that the kitchen is the place where most non-fall injuries (31 percent), including burns, knocks, cuts, and bumps, take place, whereas fall-related injuries happen most frequently (20 percent) in the bedroom. Bedrooms were recognized as places with the highest rate of older adults’ indoor falls in other studies as well (Reinsch, MacRae, Lachenbruch, & Tobis, 1993; Connell & Wolf, 1997). The presence of unstable furniture pieces (e.g. unanchored tall shelves), electrical cords, and inappropriately assembled bed frames, as well
as poor lighting at night, may also increase the risk of falls in the bedroom. The implementation of environmental modifications to a living space so that occupants can live safely, despite their physical limitations, has been identified as an appropriate policy to decrease the risk of falls (Fänge & Iwarsson, 2005; van Hoof, Kort, Van Waarde, & Blom, 2010).

**The perceived safety in older adults’ homes**

Studies have revealed that the design and physical features of the living environment as well as the arrangement of furniture influence the safety perception of the elderly (Alcántara, Artacho, Gonzalez, Garcia, 2005; Ishihara, Ishihara, Nagamachi, , & Matsubara, 1997; Jindo & Hirasago, 1997; Nagamachi, 1995; Nakada, 1997). Moreover, Zamora, Alcántara, Artacho, and Cloquell (2008) suggested that despite a higher number of fall incidents in some areas of an apartment, older people feel safer owing to the presence of some physical features that are specially designed for the elderly. Moreover, textures (e.g. shiny floors), dark colours, and surrounding ambience have an important influence on seniors’ perception of the environment as unsafe. However, the mechanisms linking perception and the characteristics of the domestic environment are not clear. What is known is that minor details of an apartment’s design and physical environment can influence the perception of freedom of movement and the risk of falls and other accidents at any age (Yiannakoulas et al., 2003). The results of a Brazilian study indicate that environments that provide higher levels of physical activities are perceived to be safer by older persons (Weber Corseuil, Hallal, Corseuil, Schneider, & d’Orsi, 2012). Leonardi et al. (2009) suggested that the distribution of several types of objects in different areas of the home determine which areas are more frequently used. Moreover, the type of activities related to each area of the home is another determinant factor. According to the results of that study, the living room and the kitchen are the most commonly used areas and that the bedroom is a less frequently used area of a home.

**2.2 UD principles and older adults’ homes**

A home and its surrounding environment should be designed in a way that can be adapted to a wide range of people with different needs. The concept of UD, often referred to as
‘inclusive design’ in Europe (Persson, Åhman, Yngling, & Gulliksen, 2015), helps to provide an environment that is fit for all. According to Mace, Hardie, and Plaice (1991:156), UD is ‘an approach to creating environments and products that are usable by all people to the greatest extent possible’ and is composed of seven principles, namely: equitable use, flexibility in use, intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use. The aim of UD specified for the ageing population is to provide a safe environment so as to enable older people to perform and conduct their daily activities independently (Crews & Zavotka, 2006). It stems from barrier-free and accessible design approaches. However, a barrier-free environment for one person can be a barrier for someone else (Mace, Hardie, & Place, 1996). Therefore, the solution involves not only removing the barrier but also giving the designer the opportunity to address the issue from a broader perspective (Persson et al., 2015). Accessible design approaches also focus on how the design is simplified with regard to distance and time to allow individuals to perform activities in society (Pirie, 1979). Within the concept of accessibility, the interaction between the environment and the person’s functional capacity is often disregarded (Preiser & Ostroff, 2001). Although applying features of barrier-free and accessible design approaches to the physical environment could help to provide better accessibility and usability, these features are visible enough to create a sense of segregation in the environment among users (Deardorff & Birdsong, 2003).

UD is more about democracy, design for all, and social inclusion (Iwarsson & Ståhl, 2003). It means that people with limited mobility or a disability should not be excluded and segregated by design. According to this philosophy, the solution suggested by the designer of a building to help provide better accessibility for those with disabilities should also work for everybody. In other words, the design of a building should be based on the needs of every stage of human life.

There are several guidelines for designing a home for the elderly based on the principles of UD. In general, accessibility is the most essential element that needs to be taken into account when designing for the elderly. Fewer doors, hallways and rooms make a home more accessible for people with limited mobility (Baldrica, 2003). For instance, the kitchen is usually designed in such a way that the stove, refrigerator, and sink are three vertices of a triangle. The bathroom should be also located within the shortest distance possible to the
bedroom and should have certain features such as grab bars near the toilet, a non-slip mat on the shower floor, various lighting options such as a dimmer (to adjust the rate of illumination), and ambience for those with limited mobility (Baldrica, 2003).

Like other design standards, UD also has a number of limitations. Iwarsson and Ståhl (2003) suggested that applying the principles of UD into practice is still an awkward process because there is a lack of adequate education among the involved stakeholders (e.g. planners, engineers, and architects). Furthermore, there is a discrepancy in reporting the cost of implementation of the principles of UD between researchers and professionals. The construction costs of a building will increase if at least some of the principles of UD are applied, for example, a larger bathroom and its accessories (Commission for Architecture and the Built Environment, 2008). Finally, a lack of communication and participation involving the end users of UD in the related guidelines and codes is another challenge associated with UD (Carr, Weir, Azar, & Azar, 2013). Newell and Gregor (2000) also argued that designing a product that is usable for a group of people with a certain type of disability can make the use of the product more difficult for people with no disability or with other different types of disability. Yet, in Sweden, the goal is achieving an accessible society rather than simply applying the principles of UD (A Nordic Region for All, 2016).

3. The conceptual framework

The physical layout and design features of older adults’ homes influence the way in which they use and perceive them (Zamora et al., 2008; Yiannakoulas et al., 2003; Leonardi et al., 2009). In addition, physical attributes of older adults’ homes (e.g. slippery floors, insufficient illumination) have long been associated with injuries among the elderly (Letts et al., 2010; Tinetti et al., 1988; Shroyer, 1994; Stevens et al., 2001); therefore, it could be expected that some environments are riskier than others for older adults.

The principles of UD are expected to work as a reference for promoting environments that are adapted for all and are suited to meet the needs of the elderly. In this study, UD principles are used as a reference for comparison with what is found in Hässelgården’s senior housing in Stockholm, Sweden. Therefore, it could be expected that the more these environments share UD qualities, the more adapted they are to meet the needs of older adults. Based on these assumptions, Hässelgården’s senior housing is expected to have the following features:
1. The areas of an apartment with higher UD scores (e.g. the living room) are used more frequently by residents (Zamora et al., 2008; Yiannakoulas et al., 2003; Leonardi et al., 2009).

2. A higher number of falls take place in the areas of an apartment with lower levels of adoption of the principles of UD (e.g. the kitchen; Letts et al., 2010; Tinetti et al., 1988; Shroyer, 1994; Stevens et al., 2001).

3. The areas of an apartment that are perceived safer by residents are those with better levels of adoption of the principles of UD (e.g. the living room). Residents have a greater tendency to spend more time and feel safe in those areas of an apartment (Zamora et al., 2008; Yiannakoulas et al., 2003; Leonardi et al., 2009).

4. The case study

This case study focuses on Hässelgården’s senior housing, which is located in Hässelby district, on the outskirts of Stockholm Municipality. Hässelgården’s senior housing comprises 119 apartments (36 studio apartments [42 m² each] and 83 two-room apartments [52–57 m² each]), which were built in 1973. These apartments are situated in four different blocks of a five-storey building. The owner of the housing is Micasa Fastigheter, which also manages the City of Stockholm’s care homes. The housing is a subsidiary of Stockholm Stadshus AB and is owned by the City of Stockholm. There is another block in Hässelgården (not included in this study) that offers round-the-clock home care to its residents and conducts individualized care and nursing for residents with dementia. These apartments have one of the lowest rental costs among Micasa’s senior housing because they offer few adaptations for their elderly occupants and they are located a long distance from Stockholm’s city centre, (15 km, about 40 minutes by train). The district of Hässelby has a high proportion of children and middle-aged people, but young adults are not as well represented there as in the rest of Stockholm. The average annual income is SEK 249 000, which is slightly lower compared with Stockholm as a whole, where the average annual mean income is SEK 269 300 (1 SEK = 0.11 EUR) (Stockholm Municipality, 2009). Hässelgården senior housing was selected as a case study because it could typify present situation of elderly living areas in Stockholm in terms of physical environment. Moreover, the apartments with the least adoption may expose
older adults to hazards, and consequently influence the likelihood of fall, use of space, and safety perception.

5. Data and methods

All the data used in this study are primary data and, and we collected them by conducting a survey and performing fieldwork in Hässelgården’s senior housing. The data were processed with descriptive statistics, a tool for visualizing data (graph and chart) in collected empirical material so as to have a better handle on the data (Befring, 1994).

The methodology of the analysis is divided into three parts. First, the physical features of each area of the apartments is analysed and scored based on fieldwork (checklist) results. To do so, a checklist was designed in accordance with the seven principles of UD for the inspection of seniors’ apartments. The design of the check list was based on studying housing checklist manuals related to UD principles as well as fall prevention measures (Universal Design & Green Home survey checklist, 2009; A home fall prevention checklist for older adults, 2005; Home Modification, 2008). The checklist includes 61 questions about physical features and potential risk factors for falls that are present in different areas of an apartment such as the kitchen, bedroom, living room, and bathroom. However, these questions are not only related to the layout, and design of the apartments, but also they touch upon the residents’ placement of furniture and arrangement. Each question on the checklist is an indicator for UD principles. Ten inspection visits of the senior citizens’ apartments were carried out. Analysing these data involved relating each question on the checklist with one to three principles of UD. If the presence of that condition asked in the question is confirmed, each related principle to that question is graded one, otherwise it is graded zero. Finally, the sum of all obtained grades for each principle is divided by the total number of questions related to that principle in each area of the apartments. For instance, if the question is about the presence of walking space around the bed, this is related to the seventh principle: size and space for approach and use. If the answer is yes, the number one is assigned to this question. The same rule is applied for other questions related to size and space in the bedroom. Let’s consider there are five questions about size and space on the bedroom checklist, of which the answer for two of the questions is yes. Then the bedroom score regarding size and space is 40
of 100. The score for the 10 visited bedrooms with regard to size and space for approach and use is the average of the scores for each apartment bedroom in terms of size and space for approach and use.

Second, a survey consisting of 43 questions was conducted in about half of the two-room apartments. The residents’ survey responses were assessed based on the survey results. The questions on the survey focused on older adults’ use of space, safety perception, and experience of falls in different areas of an apartment. Each area of an apartment is identified by the number of respondents declaring that area as the safest/least safe, the most/least used, and the riskiest place for falls. A graph is used to represent the results of the analysis of these data. The choice of a two-room apartment is explained by the fact that in a one-room apartment, the residents do not have many choices in the use of their space, but there is a clearer picture of the older population’s use of space, routine path, and daily activity environment in a two-room apartment. Overall, 56 questionnaires were distributed, of which 27 were collected (10 were face-to-face interviews, and the rest were sent via post). Third, the presence of any relationship between the UD score of each area of the apartments and the related percentage of frequency of use, number of falls, and perceived safety is investigated separately. The aim of using qualitative methods in research design is to obtain a better understanding of the experiences and attitudes of the participants (Bricki & Green, 2016). Creswell (2013) suggested the following steps for carrying out qualitative research analysis: organize the data; describe, classify, and interpret the data into codes and themes; and represent and visualize the data. We also made use of narrative approach to capture the emotion and perception of story tellers at the time of her/his experience. Narrative approach is a collection of stories from individuals about individuals’ experience that is documented by the interviewer (Creswell, 2013). Table 1 shows the characteristics of the elderly sample in Hässelgården senior housing.
Table 1 – The characteristics of the elderly sample in Hässelgården senior housing.

<table>
<thead>
<tr>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Gender</td>
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<td>10</td>
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<tr>
<td>Age</td>
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<tr>
<td>70-74</td>
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<td>75-79</td>
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<td>85+</td>
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<tr>
<td>Between 1 and 5 years</td>
<td>14</td>
</tr>
<tr>
<td>More than 5 years</td>
<td>5</td>
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</tbody>
</table>

Source: Fieldwork in Hässelgården 2014.

6. Results

6.1 UD principles and older adults’ apartments in Hässelgården

In this section, we report the scores of the UD principles attributed to different indoor environments of older adults’ apartments in Hässelgården. Figure 1(a) presents the layout of an apartment. Figure 1(b) shows the UD scores for all areas of the inspected apartments. The findings show that the living room has the highest score for UD principles, followed by the bathroom and the kitchen, whereas the bedroom has the lowest. The living room is the space between the kitchen and the bedroom and has an entry to the balcony.

The living room is large enough to accommodate several types of furniture, such as sofas and tables, which are often used by older adults for support when walking or standing up. The kitchen and the living room are usually where functional objects, such as the stove, other appliances (kitchen), the TV, the sofa and the computer (living room), needed for daily routine activities are located. Other objects, such as photographs, paintings and knick-knacks,
are regarded as mementos and are found in the living room. Moreover, multiple activities are
carried out in the kitchen and the living room. In the kitchen, many important activities such
as cooking, eating, taking medication and washing dishes are conducted in the course of a
routine day. The living room is associated with activities related to relaxation, realization and
self-expression (e.g. listening to music, reading a book, and watching TV). Moreover, light
switches and electrical outlets were well placed within easy reach for older users. These
living-room characteristics contribute to flexibility in use and simple and intuitive use.
However, many of the inspected living rooms had loose electrical cords on the floors (instead
of being placed along walls and away from high traffic areas), which constituted a clear
hazard and a risk for tripping and falling. The presence of extra furniture in the living room
also represented a hazard for it affects the ability of older adults to move easily. There were
also cases in which residents used more than one or two carpets to cover the floor, the
presence of which potentially contributing to fall-related injuries.
Each bathroom was installed with a single lever mixing faucet. This type of faucet handle is
easy to grasp, making it simple and intuitive to use. Although grab bars were installed on the
wall by the shower area and the toilet in most cases, there were no non-skid mats or strips on
the shower floor in any of the visited bathrooms.

Figure 1(a) – The layout of an apartment in Hässelgården’s senior housing. Source: Fieldwork, 2014.
The toilet and sink are made of porcelain, but these surfaces are not soft enough from a safety perspective. The presence of this type of feature may increase the likelihood of falls and indicate a lower level of tolerance in error in bathrooms.

According to the UD score, the bedroom is the worst area of an apartment. The lack of walking space around the bed, the lack of light to brighten the way to the bathroom at night and the lack of wall-to-wall carpeting contribute to lower levels of flexibility in use and tolerance in error. However, most bedrooms are equipped with a lamp or a flashlight kept within reach of the bed and a sturdy chair with arms where one can sit to dress; these features promote equitability in use and low physical effort.

Some deficiencies were also detected in other areas such as the kitchen and the balcony. For instance, the stoves did not have exhaust hoods; nor did they have alarm or automatic shut-off systems. In addition, many kitchen countertops and work areas were cluttered with unnecessary objects. Some balconies were adorned with unsteady objects and had thresholds that had not been bevelled. These balcony features may increase the risk of falls for residents. However, the balcony is the area of an apartment that is generally used only in summertime.
6.2 The daily use of older adults’ apartments

The results of the survey revealed that the living room was the most frequently used area of an apartment, with residents spending almost twice as much time in the living room than in the second most frequently used area, the kitchen. However, many residents suggested that if the kitchen were large enough, they would prefer to spend their time in the kitchen rather than any other area in their apartments. One resident noted, ‘The kitchen is too small to be there. If it had been big enough to put a comfortable sofa/chair or my laptop there, I would not have to go to the kitchen for coffee or food’. Moreover, a few respondents argued that they would spend more time in the kitchen if there were a proper ventilation system. One resident described the situation as follows:

When I am cooking, I have to open the window, even in winter. The exhaust hood in my kitchen does not work properly. I often forget that I’ve put something in the oven. Being in the kitchen helped me not to forget about it.

Figure 2 presents two photos of a typical kitchen in Hässelgården’s senior housing.

Figure 2 – Hässelgården’s senior housing – a typical kitchen. Photos: Bamzar (2014).

Not surprisingly, the participants’ use of the balcony depends on the season and the number of sunny days. Many of the participants spend some of their time on the balcony instead of the living room during the summer. The bedroom is not used very much during the day, with
the participants generally waiting until bedtime to go there. Some participants mentioned that they would like a proper ventilation system to be installed so as to improve the air quality in the bedroom. In addition, some pointed out that the lack of walking space around the bed impeded their ability to move properly in the bedroom. One participant remarked, ‘My bedroom is cramped, and the walking space around my bed is very limited. I experience difficulties when making my bed or adjusting the sheet and pillow’.

6.3 Older adults’ apartments and the areas where falls occur

One fourth of the respondents experienced falls in their apartments, of which half of them experienced multiple falls. Figure 3(a) shows the environmental features that may cause falls and injuries, and Figure 3(b) shows a number of apartment features that promote safety in Hässelgården’s senior housing.

Figure 3(a) – Hässelgården’s senior housing – environmental features such as electrical cords, boxes and tables that promote accidents. Photos: Bamzar (2014).
The kitchen and the bedroom are the most common areas for falls, followed by the bathroom and the living room. One participant described her multiple falls in the bathroom as follows:

I fell when I was taking a shower in the bathroom. I slipped on a rug and fell down. Stone floors there. I woke up on the floor the next morning, and, fortunately, everything went fine. Another time in the early morning in my previous apartment, I fell from the toilet chair. I had taken very strong medicine. My head was close to being injured from [hitting] the hard toilet.

Another fall incident occurred in the bedroom:

At midnight, I woke up to go to the toilet. I didn’t turn on the light. There was something in my way, and I fell badly. I was found by my grandchild the next morning. My head had been injured.

Although the number of falls is not high in bathrooms, there are some triggers that increase the likelihood of falls for the elderly. For instance, the toilet is made of porcelain, a hard material that when struck can turn a seemingly simple fall into a serious head injury.

6.4 Older adults’ apartments and residents perceived safety

The survey respondents regarded the living room as the safest area of their apartments, followed by the bedroom and then the kitchen. Although around 40 per cent of the
interviewees thought that all areas of their apartments are safe, there were a few individuals who indicated that they felt partially safe or even totally unsafe in all areas of their apartments. Moreover, one ninth of the participants felt totally unsafe even in the living room. One participant described this feeling as follows:

Nowhere I feel safe here; I am not able to use my walking aid inside my apartment as it [the apartment] is too small. I have a visual impairment. I am always fearful of walking since there is no handrail or support for me to [help me] walk. I always feel unsafe.

Furthermore, some respondents commented that residents living on the first floor of an apartment building need extra protection. In Hässelgården, one of ten interviewees had been victims of burglary. According to police records, residential burglary is the most common type of crime in Hässelby (Stockholm Municipality, 2009).

The elderly residents declared the bathroom to be the least safe area of their apartments. Figure 4 shows the different areas of senior housing apartments and the percentages of participants who fall, feel safe, and spend more of their time in each of these areas.

![Figure 4](image.png)

Figure 4 – Frequency of use, place of fall, and perceived safety (%) in different areas of senior housing apartments (N = 27 elderly respondents). Source: Fieldwork in Hässelgården, 2014.
7. Discussion of the results

Compared with the kitchen and the bedroom, the living room received the highest UD score. The survey findings also show that it is in the living room where seniors spend most of their time. Some studies (e.g. Leonardi et al., 2009) have emphasized the importance of the distribution of objects in different areas of an apartment so as to achieve higher usability. However, our results show that this is not the case. Although older residents of Hässelgården would prefer to spend more time in the kitchen (because of the distribution of objects), the lack of proper physical adaptations to meet the needs of seniors in the kitchen prevents them from doing so. In Hässelgården’s senior housing, the living room is adjacent to the kitchen. Therefore, the amount of walking required to perform daily routine activities between these two areas is also minimized (enhanced accessibility), which is a great benefit for someone with limited mobility and stamina.

As expected, low scores with regard to UD principles (particularly tolerance of error) contribute to higher numbers of falls (e.g. kitchen and bedroom). This result is confirmed by several studies. The presence of hazards in the environmental setting (not adapted for the elderly) increases the risk of falls for the elderly (Letts et al., 2010; Tinetti et al., 1988; Shroyer, 1994; Stevens et al., 2001, Northridge et al., 1995; Berg et al., 1997). Obviously, spending more time in one place may result in a greater number of falls there. Hence, more falls would be expected to occur in the living room and the kitchen, the most commonly used areas. However, the highest number of falls occurred in the bedroom, although the bedroom is used mostly at night and is associated with few activities. The results also show that there has been at least one fall incident in all areas of an apartment in Hässelgården’s senior housing – even in the balcony and the bathroom, despite the shorter amount of time spent there by the residents. This finding may underscore the importance of making physical adaptations to senior housing so as to meet the needs of elderly residents.

As expected, the older residents perceived the living room, with the highest score based on UD principles, as the safest area of their apartments. The physical features of the living room and the limited number of activities performed there contribute to this safety perception (Alcántara et al., 2005; Weber Corseuil et al., 2012). Overall, the results of this study indicate that a higher score based on UD principles for an area may predict greater use of that area,
lower number of falls, and higher perceived safety. A lower score based on UD principles for an area in this study may predict only a higher number of falls and not necessarily lower levels of safety perception and frequency of use. Therefore, our results highlight the effectiveness of the application of UD to the living environment of residents for its fall-related injury reduction but not for other dimensions of well-being considered in this study (use of space, safety perception). For instance, the participants in this study regarded the bathroom to be the least safe area of their apartments; however, in actuality, the bedroom had the lowest UD score and was the site of the highest number of falls. The participants’ perception of the bathroom as the least safe area of their apartments could be related to the presence of environmental hazards and the lack of certain assistive products (Zamora et al., 2008), as well as other factors, such as performing relevant challenging activities. The bathroom is the area of an apartment that is associated with necessary routine activities for personal care and hygiene that could be perceived with some degree of concern by older adults. Moreover, the furniture and texture of the floor and walls of the bathroom may promote the residents’ perceived lack of safety.

8. Implications and looking ahead

This study sets out to assess how the physical features of the indoor environment of older adults’ homes may influence and be related to their use of space, experience of falls, and safety perception. The findings indicate that adapting the physical features of the indoor environment to meet the needs of seniors may reduce the number of falls among seniors, promote seniors’ perception of safety, and more frequent use of space – but not vice versa. Different areas of a senior housing apartment exhibit different potential risk factors for use of space, falls, and safety. Furthermore, some parts of the apartments show clear difference between the quantity of use (time spent), and quality of use, that is what kind of activities are performed. For instance, bathrooms are characterized as low in frequency of use, but the activities that are performed there are challenging like undressing, and showering, sitting down

The potential causes of falls are related to the apartment layout and the lack of required modifications (especially in the bathroom) to meet the needs of seniors. However, having a
safe environment to live is not only related to proper design and layout. The ways in which the furniture is organized (apartments are often ‘over-furnished’) and the apartment is decorated also play a role. Not surprisingly, older adults tend to hold on to their belongings because these objects represent their memories. However, doing so creates problems for older adults living in senior housing (an apartment with a floor area of 53 m²).

Many interviewees suggested changing the windows because they are not easy to open. Moreover, the presence of thresholds in the floor in some areas, especially the balcony, makes walking difficult, and it is where one can trip and fall. Installing a proper ventilation system in the kitchen may also make it a more pleasant place for seniors to spend time there. Making a list of safety improvements for residents is not a simple task. Table 2 summarizes the problems that exist in different areas of Hässelgården’s senior housing and presents several suggestions that may reduce seniors’ falls, improve use of space and elevate seniors’ safety perception. Micasa, working together with renovation companies, can install a proper night light system (preferably amber/red light) in the walls, floors, and ceiling to help seniors navigate the space from the bedroom to the bathroom and the kitchen. Stockholm Municipality and Micasa can also encourage residents to use fitted carpet that covers a floor entirely (instead of mats) to prevent fall-related injuries. In addition, Micasa and renovation companies can work together to make various other improvements such as placing non-skid mat/strips on the shower floor and constructing a safety glass or plastic wall to separate the shower area from the bathroom. Moreover, porcelain toilets can be covered with soft damping material as a simple way in which to reduce the risk of injuries. Installing handrails and grab bars in some parts of the living room or bedroom will also make walking easier and less risky for residents.
<table>
<thead>
<tr>
<th>Average UD score</th>
<th>Use</th>
<th>Falls</th>
<th>Perception</th>
<th>Diagnostic</th>
<th>Action</th>
<th>Actor</th>
<th>Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Living room</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
<td>A relatively high UD score; the living room is the most commonly used area, with average levels of safety perception and number of falls.</td>
<td>Keep electrical, appliance and telephone cords out of walkways. Install wall-to-wall carpeting. Downsize items (e.g. sofa) and excess belongings (e.g. clothes, paintings, knick-knacks).</td>
<td>Municipality</td>
<td>Inform the elderly about how they can organize their homes safely. Conduct regular inspections of apartments to improve conditions (applicable for all areas of an apartment).</td>
</tr>
<tr>
<td><strong>Bedroom</strong></td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
<td>A low UD score. Although the bedroom is the least commonly used area, the highest number of falls take place there.</td>
<td>Provide permanent night lighting along hallways near bedrooms and bathrooms. Choose linear LED lighting for this type of lighting. Downsize items around the bed. Use wall-to-wall carpeting.</td>
<td>Municipality</td>
</tr>
<tr>
<td><strong>Bathroom</strong></td>
<td>Medium</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
<td>Despite a medium UD score and a low level of number of falls, a low level of safety perception is associated with the bathroom.</td>
<td>Avoid use of bath mats on the floor. Place non-skid mats on standing areas. Use softer materials. Place towels and bathing supplies near the bath or shower. Place storage for make-up and medicine near the vanity/sink area.</td>
<td>Municipality</td>
</tr>
<tr>
<td><strong>Kitchen</strong></td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Despite a good UD score, the kitchen is the worst area in the apartment (3+ falls) and is perceived as risky.</td>
<td>Install countertops, sinks, cooktops and cabinets that can be raised or lowered. Install more and better lighting. Install lighting that is adjustable. Use shelving and rack systems that can be installed in existing cupboards.</td>
<td>Municipality</td>
</tr>
</tbody>
</table>

Table 2 – Indoor apartment environment: universal design (UD) scores, quality diagnostics, required actions to reduce elderly falls and relevant stakeholders.
Senior housing residents should be informed about the possible risk factors in their immediate environment so as to ensure their safe indoor and outdoor mobility. Some of the residents’ interview responses indicate that they lack adequate information about environmental risk factors – for instance, how easily a fall could happen. Holding informative meetings/programmes about the potential risk factors associated with injuries may promote safety.

The performance of regular inspections of apartments by social care, for instance, could potentially decrease the risk of tripping (e.g. electrical cords, rugs, paintings or other objects that can lead to injury) among elderly residents. However, of perhaps greater importance is providing residents with safety information, as well as the results of these inspections. (These inspection reports are usually produced for internal circulation among municipal officials and politicians.) The housing company could also be directly involved in helping residents to plan the placement of furniture when moving from a larger apartment to Hässelgården’s senior housing.

If safety is an individual right, then the municipality of Stockholm is obliged to implement a systematic assessment of housing standards in all seniors’ apartments. This process would benefit from an open discussion with housing companies and service providers (private sector). When this framework is in place, the next relevant issue is where to begin making modifications: bathrooms or kitchens? Certainly, the elderly who live in these apartments are the ones who know best where to start. Hence, they should be the first ones to be consulted regarding the prioritization of adaptations to these apartments.

Although many private companies in Sweden are involved in delivering services to seniors’ homes, the municipalities are ultimately responsible for making sure that these services are delivered. The municipalities also need to supervise the quality of these services. At the regional level, the National Board of Health and Welfare has a web page (Äldreguiden) that allows older adults to compare the services delivered by different companies, thus providing them with the knowledge necessary to make informed decisions about which senior housing to choose that best meets their needs and priorities. The information on the web page is obtained from surveys answered by Swedish senior citizens. Municipalities may also use this information as a tool to assess the quality of each service company and to aid decisions regarding the extension of contracts.
These suggestions are specific to Hässelgården, and although they may be relevant to other elderly residential areas in Stockholm, these suggestions may not prove useful for preventing elderly falls in home environments in other contexts. This study contributes knowledge of how senior citizens use their apartments and perceive their home environment. More studies are needed to investigate whether current housing standards meet the needs of the elderly.

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9. References:


