Journal of Housing and the Built Environment (2019) 34:619–642
https://doi.org/10.1007/s10901-019-09645-3

ARTICLE

Extending the importance–performance analysis (IPA) approach to Turkish elderly people's self-rated home accessibility

Yasemin Afacan[1]

Received: 21 June 2018 / Accepted: 12 January 2019 / Published online: 24 January 2019

Abstract
Designers are still struggling to make good and fair home designs for elderly people. Although there are a lot of studies on accessibility in homes, there are few methodologies to rate the importance of accessible home attributes, or address the relationships between the most important and most satisfactory attributes (in terms of creating a good fit between the elderly and their homes). This study suggests using the importance–performance analysis (IPA) approach to set accessibility priorities and identify the critical performance factors that determine the elderly's satisfaction with accessible homes. A self-assessment questionnaire instrument was developed based on housing accessibility literature and conducted with 342 Turkish elderly people chosen through stratified sampling among neighborhood clusters in Ankara, Turkey. The descriptive results and factor analysis of the study are significant in that they indicate significant differences among dwelling types. There were differences in importance and performance priority levels of home accessibility factors associated with each dwelling type. Moreover, the study found that safety and ease of use are the key indicators of home accessibility. According to the results, the IPA could be an effective tool to overcome the messy character of evaluating home accessibility for the elderly. By extending the accessibility attributes with the IPA analysis, it is possible to identify specific accessibility attributes, establish highest and lower priorities for intervention and decide which attributes should be maintained and/or ignored. Thus, this study contributes to the literature on aging by being the first study to explore the applicability of the IPA technique while eliciting elderly people's accessibility requirements for healthy aging.

Keywords Accessibility · Home · Priority · Importance and performance analysis · Safety · Ease of use

✉ Yasemin Afacan
yasemine@bilkent.edu.tr

[1] Department of Interior Architecture and Environmental Design, Faculty of Art, Design and Architecture, Bilkent University, 06800 Bilkent, Ankara, Turkey

1 Introduction

Home is the most central fixture in a person's life, and is described as an "extension of the self through place" (Fuhrer and Kaiser 1992: 105). This is particularly true for older adults. Empirical studies show that a good fit between the elderly and their home environments has significant effects on healthy aging (Iwarsson 2005). The goal in good design for the elderly is supporting their functional and cognitive abilities (Potter et al. 2018). Satisfaction with housing environments is also an important factor in mental and psychological health (Oswald et al. 2007). Accessibility increases satisfaction level by allowing the elderly to be independent in their daily activities (Rantanen 2013). Homes that will work perfectly for the needs of elderly people inclusively support the activities of their daily lives, and maximize their independence and full participation in all aspects of society. International and national policies and frameworks on aging are organized around these utopian characteristics of the 'inclusive and/or universal home' as ideals for healthy aging (Herssens et al. 2014; Maisel 2011; Young 2011). However, as discussed by Bianchin and Heylinghen (2018), there is a paradox in design approaches which focus on inclusivity and, ultimately, nothing can be designed to meet the needs of everyone. Thus, designers and architects are still struggling to make good and fair designs for the elderly. Although there are a lot of studies on accessibility in homes, there are few methodologies to rate the importance of accessible home attributes, or address the relationships between the most important and most satisfactory attributes (in terms of creating a good fit between the elderly and their homes). According to Keates (2015), "It is often hard to prioritize which issues are the most important to fix and, occasionally, which ones may actually harm the overall usability and accessibility of the product" (p. 398). "While these strategies may help designers in broadening the potential audience their design can accommodate, they offer little assistance in prioritizing issues" (Bianchin and Heylinghen 2018, p.7). To overcome these challenges, this study suggests using the importance–performance analysis (IPA) approach to establish accessibility priorities and identify the critical performance factors that determine the elderly's satisfaction with accessible homes. Different than other priority-based design approaches (Afacan and Demirkan 2010; Raviselvam et al. 2016), the IPA tool analyzes accessibility attributes on two dimensions: performance level (satisfaction) and importance. These dimensions are later combined in a four-quadrant matrix that allows designers to prioritize and identify areas of immediate attention, improvement, elimination and/or maintenance as an advantage. In line with Bianchin and Heylinghen (2018), rather than ordering the accessibility attributes in a naturally shared system of priorities, this study is an initial effort to start an investigation on how to better support designers in designing accessible homes for a population of elderly individuals when their satisfaction and importance needs and interests diverge.

Thus, this study contributes to design literature not only by being a first study to explore the applicability of the IPA technique in design discipline, but also by identifying critical importance and satisfaction dimensions of housing accessibility of Turkish elderly, and determining priority settings for particular improvement opportunities. Specifically, the research explores the following two sub-questions; (1) what are the home accessibility factors of the elderly based on their self-rated importance levels? and (2) how do elderly people perceive the priorities of importance and performance levels of home accessibility factors, using the IPA framework?

The study is presented in the following order. First, the relevant literature on home accessibility is presented. Then, the methodology section details participants, setting,

instrumentation and data collection. Results are elaborated in the findings section and are followed by the discussion section. Finally, the conclusion and implications of the study are presented.

2 Home accessibility

Two very fundamental questions are, 'What is home accessibility?' and, 'How does home accessibility shape home design features while coping with aging in a satisfactory manner?' According to Altman et al. (1984), elderly people who have stayed in their usable and accessible homes have a more favorable experience than elderly people who have had to change their home environment frequently due to inaccessible features (such as stairs, long corridors and unusable bathrooms). There are many definitions of accessibility. 'Accessibility' in general describes the ability to participate in activities, obtain opportunities or interact with others within an environment (Cervero 1996; Hansen 1959; Rooney et al. 2017). Accessibility embraces all environmental arenas in society and is vital for all citizens' societal participation (Iwarsson, Nygren and Slaug 2005). Iwarsson and Stahl (2003) defined accessibility based on two components: the personal component, or a person's functional capacity, and the environmental component, or the barriers in relation to available standards. In the European ENABLE-AGE project (Iwarsson et al. 2007), the fit between these person-environment components are integrated under the perceived aspects of housing with accessibility objectives.

Home accessibility is the extent to which the physical environment of home supports the autonomy of users in their daily activities (Nygren et al. 2007). It is an important prerequisite for the elderly to be able to maintain control and independence in their lives. Although there are some home accessibility standards derived from human considerations, they are indicators, which lack information about qualitative data, (Heylighen et al. 2017) or data, which correlates the satisfaction levels of the elderly. Thus, there are still serious barriers to accessibility in housing environments. Design barriers in homes cause greater social isolation, an elevated risk of injury and reduced life satisfaction (Close et al. 1999; Heywood 2005). Poor accessibility in the home has serious consequences for the elderly, which is defined as a chronological age of 65 years old or older, while those from 65 through 74 years old are referred to as 'early elderly' and those over 75 years old as 'late elderly' (Orimo et al. 2006). Although most elderly people want to age in their current homes for as long as possible, many who experience mobility, visual and cognitive decline are forced to move into nursing homes or other institutions because their homes are not accessible enough for independence and autonomy in their daily activities (Maisel et al. 2008). Thus, elderly market has received increased attention from designers, architects, planners and policy makers to manage elderly people's satisfaction with their homes and their quality of life in these living environments (Engel et al. 2016). These increases have major implications in promoting living arrangements, in which elderly people's autonomy, individuality, community integration and participation supported. Nowadays, how physical and social environment of homes afford accessibility of elderly becomes the extent of healthy aging (Steenwinkel et al. 2017).

This study considers fair accessibility in homes. Rather than addressing everyone's accessibility expectations, fair accessibility means how accessibility is distributed across relevant users. Fair accessibility in homes could be achieved by creating conditions to choose where conflicting claims arise about the accessibility priorities.

Differences in home accessibility are acceptable "if overall usability for the worst offs is maximized" (Bianchin and Heylighen 2018, p.162). It explores the importance and satisfaction attributes of fair accessibility under the following three categories: approach to home from the local neighborhood, accessibility within a home, and access to key facilities. This categorization is based on the systematic research review of 37 articles on the role of building design and interiors in ageing actively at home (Ahrentzen and Tural 2015). Referring to some studies included in these reviews (Froyen 2012; Wahl et al. 2009) and citing these reviews (Granbom et al. 2014), most home adaptations focus on three main areas: ease of approach to the home, circulation within the home, and approach to key facilities. Since individuals diverge about which accessibility priorities should be given to each home attribute (Afacan 2008; Afacan and Demirkan 2010; Bianchin and Heylighen 2018; Rooney et al. 2017), it is better to depict these three areas of home accessibility attributes in an analytical matrix.

2.1 Approach to home from the local neighborhood

Approach to home from the local neighborhood is defined as the extent to which people are able to visit, reach, use and access urban facilities, regardless of their abilities (Burton and Mitchell 2006). According to Gabriel and Bowling (2004), one of the central dimensions of quality in later life is offering access to facilities and services in a neighborhood. "An accessible route of travel is the key unifying element that facilitates the safe and independent use of a site and its buildings … connects site arrival points, i.e. parking, bus stops, etc., with all exterior and interior amenities" (New Fair Multi-Family 1996, p. 13). Many housing studies view accessible approach to home as an attribute of land, which is directly related to wayfinding and direction, understanding and legibility of directions in spaces, spatial preferences, sensual stimulation and understanding of the environment (Handy et al. 2002; Türel et al. 2007). According to Harrison (1997), mobility, ease of activity, safety and security outside the home, amenity, community and social connections are key features to consider when designing approach to home from local neighborhoods for the elderly. Niemeier (1997) shows that accessibility preference is connected with social neighborhood characteristics. Oguz et al. (2010) broaden accessibility standards of the elderly by including wayfinding and directional features, understanding and legibility directions in spaces, spatial preferences, sensual stimulation and understanding of the environment. Türel, Yiğit and Altuğ (2007) list the major accessibility problems of the elderly within housing environments as pavement and roads, pollution, safety, insufficiency of maintenance and management, traffic and sociocultural problems. Yung et al. (2016) state that addressing the social needs of the elderly is as significant as physical comfort while planning housing environments. Rooney et al. (2017) provide a useful understanding about how to cope with poor access outside the home, and suggest that using color and tactile surfaces to make homes more accessible can make older adults happy outside the home as well. Yung et al. (2017) define the relationship between urban accessibility and elderly satisfaction based on the following four elements: location, barrier-free, wayfinding and circulation. Access to neighborhood is closely linked with experiences of freedom (Steenwinkel et al. 2017). Thus, accessible approaches to homes could significantly influence accessibility patterns in housing environments, and allow the elderly to stay active and able to perform outdoor activities daily.

2.2 Accessibility within a home

Accessibility within a home, which is a common and important indicator to assess capabilities in daily activities, refers to the compliance of home features with international and national design standards (Pettersson et al. 2017) such as circulation, internal doorways and hallways, ease of use in kitchen/bathroom and adequate space in rooms. Although existing literature documents guidelines, checklists and standards on accessibility inside home environments (Afacan 2008; Carlsson et al. 2009; Afacan and Demirkan 2010; Iwarsson and Slaug 2001; Iwarsson et al. 2012; Smith et al. 2008), the elderly's expectations of housing environments are very different from other age groups (Burby and Rohe 1990). Evaluating built environments and assessing the elderly's potential housing demands are messy activities, which require contextual criteria and specific methodologies. Maisel et al. (2008) redefine accessibility within home under the term 'visitability', which is marked by three core accessibility features: zero step entrances, wide interior doors and half bathrooms on main floors. Froyen (2012) structures accessibility inside home based on activities and patterns of interaction, such as elements for horizontal and vertical circulation, facilities for rest and food and drink. According to Ahrentzen and Tural (2015), spatial layout and dwelling size are key attributes in defining inside accessibility. Pettersson et al. (2017) investigate housing accessibility for the elderly in Sweden and define the following five environmental barriers as having the largest accessibility issues for homes: stairs at entrances, differences in levels between rooms, no grab bars at shower/bath, bathtubs instead of showers and shower stalls with level differences. According to Steenwinkel et al. (Steenwinkel et al. 2017), construction details play a major role in elderly people's experiences of accessibility inside the home.

2.3 Access to key facilities

The term 'access to key facilities' considers the accessibility of fixtures and fittings, such as window handle heights and heights of controls (Rooney et al. 2017). Ease of use in accessories, like cabinet handles and faucets, and provision of safety in the use of controls are home attributes, which significantly affect the elderly's ability to live independently (Afacan and Demirkan 2010). According to Connell et al. (2002), provision of access to key facilities results in the elderly being more engaged in the activities of daily living (for example, moving oral care to a bedside table, providing magnifying mirrors and having high-contrast letters/numbers). Fixtures and controls that maximize accessibility are associated with more positive experiences in aging actively at home (Aminzadeh et al. 2009). Compared to the two previously mentioned home categories, access to key facilities is highly associated with autonomy in relation to daily living (Verbeek et al. 2012). Slaughter and Morgan (2012) discuss adding ambient qualities to fixtures and controls, such as meaningful sounds and visual and tactile simulation. According to Annear et al. (2014), a lack of ergonomically appropriate controls, furnishings and fixtures may result in the elderly spending less time at home and taking more effort to use them. However, assessing the actual demands on these facilities becomes a complicated task. National Research Council (US) Committee (2010) developed 612 criteria to analyze the accessibility of a door handle. Studies show that many dwellings need renovations to create access to key facilities (Kylberg et al. 2013).

3 Methods

3.1 Sample and setting

A total of 342 elderly Turkish participants participated in the study. The participants, all within the same income level, were chosen by stratified sampling among neighborhood clusters in Ankara, Turkey. First, three dwelling type clusters—apartment, detached houses and row houses—were identified in each medium- to high-level income stratum. Then, dwellings and occupants in each cluster were randomly selected. One hundred fourteen participants for each dwelling type were enrolled in this field study, which lasted sixteen-weeks (mid-July 2017 to mid-October 2017). All the participants owned their homes, and the average length of residency was over 20 years.

In Turkey, old age is defined as 65 years and over. According to the Turkish Statistical Institute (2017), the latest projection for the elderly population in Turkey is that it is expected to rise from 7.7% in 2013 to 22.6% in 2060. In 2060, people aged 75–84 years will make up 42.3% of the population. The study ensures that the participants were adults aged 65–90 years (with a mean age of 76.8).

3.2 Instrumentation and data collection

A self-assessment questionnaire instrument was developed based first on housing accessibility literature, and then tested and refined using the Delphi method. The Delphi method is the name given to the technique developed through a series of studies by the RAND Corporation to come up with a technique to reach a consistent agreement between experts (Dalkey and Helmer 1963; Okoli and Pawlowski 2004). An expert panel validated the content of the instrument. The expert panel consisted of 22 academics from all over the world (Australia, Belgium, India, Sweden, United Kingdom (UK), United States (US) and Turkey): eight professors from architecture, five professors from interior architecture, two professors from industrial design, four associate professors from behavioral sciences, two occupational therapists and one doctor of medical science. The experts were selected based on the following four criteria: knowledge of and experience with home accessibility issues regarding the elderly; capacity and willingness; sufficient time to participate in the Delphi Method; and effective communication skills (Adler and Ziglio 1996).

In the study, the Delphi method was conducted through four rounds. In the first round, the experts were emailed the questionnaire separately and they were required to rate the questionnaire items. After the first round, the facilitator collected the experts' scores and feedbacks. The experts received the feedback of all the items from the other experts, including their own, and they changed their views and scores if they wanted to. This process continued until there was a consensus between the experts. Throughout the rating rounds, the experts remained anonymous with each other; this allowed the experts to express and change their thoughts without being influenced previously expressed opinions (Dalkey and Helmer 1963). In the first round, experts were asked to rate 90 accessibility items for appropriateness in the context of the elderly's expectations of housing and active aging, by using a 5-grade scale, from 1 (poor) to 5 (excellent). At the end of these four rounds, accessibility items were reduced to a total of 34 items, which were grouped according to the three categories as they related to 'approach to home' (4 items), 'inside the home' (22 items) and 'approach to key facilities' (8 items).

The final survey instrument was composed of three parts. The first part was concerned with the participants' demographics and their self-assessment of independence or dependence in activities of daily living, such as cooking, bathing, feeding, dressing and going to toilet. The assessment was recorded on a 3-grade scale: independent, partly dependent and dependent. The second part concerned participants' self-rated satisfaction with overall home accessibility and performance. In addition, in this part, the participants were asked about accessibility in their most important room, and their suggestions to designers about home accessibility. The third part was composed of two sets. The first set included 36 accessibility importance questions, which were used to rate participants' importance level of each question item on a 5-grade scale, from 1 (least important) to 5 (most important), and to identify the importance of accessibility items in home environments. The second set was composed of the same 36 questions, but participants were asked to rate their own home's accessibility performance level for each question item on the same 5-grade scale, from 1 (very dissatisfied) to 5 (very satisfied). All the questions were translated into Turkish and checked by two native Turkish proofreaders, followed by the interviewers' training and pilot studies. The four highly skilled interviewers conducted face-to-face interviews. Interviewers collected data during home visits. Moreover, the interviewers took photographs of each home environment for more in-depth analyses.

3.3 Ethics

The study was approved by the Bilkent University Institutional Ethical Review Board, and, later, the Ankara Governorship granted official permission. All the participants were asked to sign the informed consent, which stated the purposes of the study, their involvement, risks and emergency procedures. After they signed, they were enrolled in the study. They were also informed about the confidentiality of the study and their right to terminate their participation at any time.

3.4 Data analysis

To analyze the data, first an exploratory factor analysis was conducted. Later, factor attributes were assessed by the importance–performance analysis (IPA). IPA is one of the most often used methodological tools in tourism literature to set priorities on two dimensions: importance and performance (satisfaction level) (Hansen and Bush 1999). Martilla and James (1977) originally introduced the IPA to provide insights on service attributes in firms in order to achieve customer satisfactions. Data from customer surveys are depicted in a two-dimensional matrix (Matzler et al. 2004). In the matrix, the x-axis depicts attribute importance, and the y-axis depicts attribute performance (satisfaction). The attribute weights are derived from regression weights, structural equation model, correlation weights, etc. These means of importance and performance divide the matrix into four quadrants (Fig. 1). The first quadrant includes attributes with high importance and satisfaction, which refers to key qualities in sustaining competitive advantage. In the second quadrant, there are attributes with high importance but low satisfaction, which signify that they need immediate attention (Martilla and James 1977). Quadrant three includes attributes of low importance and satisfaction; it is therefore not necessary to put in additional effort with these attributes. Quadrant four is rated as low importance but high satisfaction, which implies that resources for these attributes could be used elsewhere.

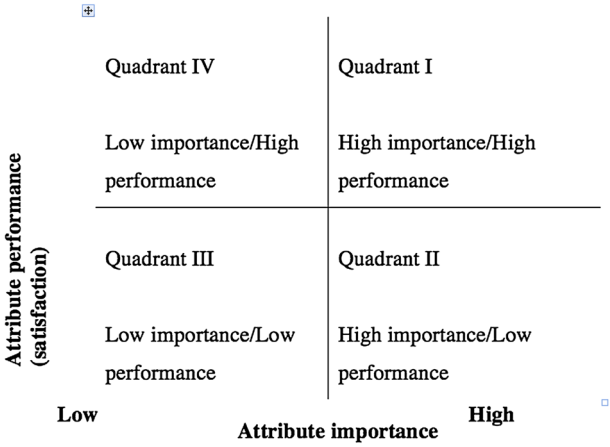

Fig. 1 Importance–performance analysis (IPA) matrix with four quadrants

According to Sampson and Showalter (1999), IPA has been used for years in a variety of settings, especially in hospitality and tourism research (Evans and Chon 1989; Go and Zhang 1997), leisure (Guadagnolo 1985), smart phone application (Chen et al. 2016), education (Alberty and Mihalik 1989) and healthcare (Abalo et al. 2007), banking (Yeo 2003) and information technologies (Skok et al. 2001). Insch (2010) used IPA in the context of urban design, where IPA was suggested as a tool for identifying gaps in residents' perceptions of the importance and their satisfaction with aspects of city life in Dunedin, New Zealand. However, as far as the study examined, no one has used IPA in the context of interior architecture. This would be a multi-parameter task, and would require identifying a set of priorities to satisfy changing user needs, demands and expectations in buildings. The study suggests that IPA is an effective tool in deciding how to best meet housing accessibility requirements for the elderly in order to maximize home satisfaction, which is closely and directly linked to healthy aging.

4 Findings

4.1 Descriptive statistics

A total of 342 Turkish elderly persons participated in the study. The average age of the participants is 76.8 years old; 41% of the participants are male, and 59% are female (as shown in Table 1). 74.1% of the participants do not have any physical health problems, whereas 9% pointed out eye problems, such as low vision, cataracts, etc. 16.9% reported mild movement problems, such as rheumatism, etc. 6.4% of the participants were dependent in all activities. More than half of the participants (63.8%) were independent in all daily living activities, whereas slightly less than one tenth (9%) were dependent. Proportions of dependence in each activity are illustrated in Table 2. There is a statistically significant relationship between participants' dependence and their self-rated satisfaction with overall home accessibility ($p=0.000$). 20 among 33 participants, who were very satisfied with their overall home accessibility, were independent in all activities. There was also a statistically significant relationship between gender and self-rated satisfaction with overall home accessibility ($p=0.000$). Most of the female participants (161 of 202) were satisfied with

Table 1 Socio-demographic characteristics of the participants

Socio-demographic characteristics	Total sample 100% (N = 342)
Age	
65–74	49% (168)
75–84	43.8% (150)
85–90	7.2% (24)
Gender	
Male	41% (140)
Female	59% (202)
Marital status	
Not married	9% (30)
Married	71% (243)
Widow/widower	20% (69)
Living arrangement	
Alone	18% (62)
With someone	82% (280)
Self-rated satisfaction with overall home accessibility	
Very satisfied	9.6% (33)
Satisfied	51% (175)
Average satisfied	22% (75)
Dissatisfied	11% (37)
Very dissatisfied	6.4% (22)
Self-rated satisfaction with overall home performance	
Excellent	11% (38)
Average	47% (161)
Poor	42% (143)
Physical functioning limitations	
No limitations	74.1% (253)
Some limitations	25.9% (89)

Table 2 Proportions of dependence in each activity of daily living

	Dependent		Partly dependent		Independent	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Eating–drinking	22	6.4	34	9.9	286	83.7
Personal hygiene	42	12.3	53	15.5	247	72.2
Going to the toilet	25	7.3	37	10.8	280	81.9
Circulating between rooms	27	7.9	31	9.1	284	83
Dressing	28	8.2	45	13.2	269	78.6
Using below cabinets	44	12.9	78	22.8	220	64.3
Using above cabinets	45	13.1	32	9.4	265	77.5
Cooking	90	26.3	34	9.9	218	63.8
Ascending and descending the stairs	56	16.4	33	9.7	261	73.9

overall home accessibility, whereas more than half of the male participants (90 of 140 participants) were averagely satisfied or dissatisfied. There was not a statistically significant relationship between living duration and their overall accessibility performance ($p=0.34$). The highest mean score was obtained for the attribute 'a legible unobstructed route to the main entrance' (4.48) regardless of the type of dwelling. However, regarding the gender difference, the highest mean score was obtained for the attribute 'sufficient counter space' (4.51) by the female participants, whereas the attribute 'ease of reach to all electrical outlets' had the highest mean score of 4.68 among male participants. Regardless of gender and dwelling type, 205 of 342 participants stated that 'adequate space and size of rooms' was the most important accessibility attribute.

4.2 Factor analysis: Development of home accessibility factors

The internal consistency of the instrument was good (Cronbach's alpha = 0.96). The confirmatory factor analysis revealed a good model fit of the survey instrument (RMSEA = 0.041, CFI = 0.98, IFI = 0.98, NNFI = 0.98 and NFI = 0.96). Before carrying out the exploratory factor analysis, the survey instrument was first checked to see whether there were any items at the extreme ends (floor and/or ceiling effects). Since the used scale in the study is 5, items below 1.5 and above 4.5 are regarded as extreme ends. There were no items at the extreme ends. Pearson product-moment correlations of the response scores were calculated and a correlation matrix was constructed. Items with a correlation score lower than 0.30 are not preferred for the study; for a useful statistical approach, a correlation coefficient of 1.00 indicates a perfect association between two variables (Argyrous 2005). However, in the study all correlations between item response scores are greater than 0.30. The study defines factor loadings in excess of 0.55 as suitable, and excludes factors with factor loading values below 0.55 (Argyrous 2005). Total variance of factors was calculated. In this respect, factor analysis results in a four-factor solution that accounts for 60.175% of the total variance; 36 items had 60.175% variances in common, so they correlated highly with four common themes. Each theme was considered to be a factor scale (Tables 3, 4).

Factor 1, 'ease of approach', deals with the provision of adequate size and space at the entrances and inside the rooms. Having a floor-level shower is as critical as being able to enter the shower without having to use steps. Any changes in levels can create barriers for ease of approach and should be avoided or replaced by gentle slopes, particularly where they approach the home. Bathroom design is a significant consideration in achieving accessibility and autonomy requirements for the elderly in their daily living activities (Afacan 2008). All components of bath services should be designed with comfortable frontal and side approach zones (see "Appendix" for exemplary bathroom photos taken from participants' homes by the Interviewers). Moreover, ease of operation in door handles and an outward opening bathroom door can maximize independence for the elderly, and these features contribute to home accessibility by corresponding to the physical demands of older

Table 3 Total variance explained

Factor	Scale	Eigenvalue	Variance	Cumulative
1	Ease of approach	9.041	23.382	19.043
2	Safety and comfort inside rooms	4.692	11.862	28.930
3	Safe approach to facilities	1.972	6.379	45.888
4	Ease of use in kitchen	1.647	5.112	60.175

Table 4 The attributes of the factors along with their loadings

Factors	Loadings
Factor 1: Ease of approach (EA)	
EA1. Appropriate size and space at the entrance of house.	.780
EA2. Ease of operation in door/window handles/controls	.742
EA3. Entering without steps.	.703
EA4. Provision of a comfortable approach zone for each sanitary ware	.665
EA5. Curb-free shower/bathroom unit	.607
EA6. An outward opening bathroom door	.564
Cronbach's Alpha	.908
Factor 2: Safety and comfort inside rooms (SCR)	
SCR1. Convenient movement between rooms (bedroom and bathroom in close proximity)	.693
SCR2. Adequate illumination in rooms without glare	.681
SCR3. Room entrances without steps	.659
SCR4. Adequate space and size of rooms	.638
SCR5. Non-slippery floor material in rooms	.631
SCR6. Provision of tonal contrasts in rooms	.566
Cronbach's Alpha	.836
Factor 3: Safe approach to facilities (SAF)	
SAF1. Ease of reach to all electrical outlets	.705
SAF2. Effective clear width of hallway/stairs	.676
SAF3. A safe route from entrance to rooms	.590
SAF4. An adequate area to enable of a (seated) stair lift	.563
Cronbach's Alpha	.722
Factor 4: Ease of use in kitchen (EUK)	
EUK1. Sufficient counter space	.833
EUK2. Ease of reach to below cabinets	.690
EUK3. Ease of reach to above cabinets	.648
Cronbach's Alpha	.756

people. Factor 2, 'safety and comfort inside rooms', is defined as 'requiring low physical effort while promoting safety'. One can achieve comfort in home environments with adequate lighting, non-slippery floor surfaces and design that allows convenient movement between rooms (see "Appendix" for exemplary room photos taken from participants' homes by the Interviewers). Legible rooms with tonal contrasts, daylight and tactile surfaces are easy to navigate. The visually impaired elderly, whose orientation and wayfinding abilities decrease with age, prefer well-connected spaces with clear daylight views. Thus, adequate illumination improves elderly people's performance, health and wellness in their home environments as they carry out their daily living activities. Concerning aspects of comfortable floor space, the physical aspects of home environments, particularly the size of rooms as well as the numbers of rooms, are closely related to the spatial layout of home interiors and furniture. A calm, welcoming, user-friendly atmosphere in homes is required for healthy aging.

Factor 3, 'safe approach to facilities', deals with the design of electrical outlets as well as circulation elements (such as effective clear widths, safe routes and adequate area for stair lifts, see "Appendix" for exemplary corridor photos taken from participants' homes

by the Interviewers). Easy-to-reach electrical outlets should be part of home design for inhabitants of any age, but especially for the elderly. Factor 4, 'ease of use in kitchen', is defined as the usability of the main kitchen elements (such as counters and cabinets). 'Person-environment fit' has a unique meaning in housing for the elderly. 'Usability' highly affects the elderly's performance with respect to particular tasks or activities, especially kitchen tasks. In Turkey, unlike other countries, women are the primary users of kitchens, so main kitchen features, such as counters, cabinets etc. Thus, Factor 4 is closely related to having sufficient counter space. Moreover, 'ease of reach' below and above cabinets are also attributes of this factor (see "Appendix" for exemplary kitchen photos taken from participants' homes by the Interviewers). All kitchen cabinet components should provide comfortable and equitable use, with low physical effort, for any user, whether they are seated or standing. The uncorrelated analysis of variance only shows significant differences for Factor 2. Scheffe's range test found that elderly participants living in detached homes differed significantly from the participants living in apartments and row houses ($p = 0.000$). Convenient movement between rooms and adequately sized rooms were very important features for participants living in homes with stairs. The detached-home user group differed significantly from the other participants as they rated non-slippery flooring material in rooms and on stairs as highly significant.

4.3 Importance–performance analysis

To answer the second research question, 'How do the elderly perceive the priorities of importance and performance levels of home accessibility factors, using the IPA framework?', the importance and performance ratings of each factor item were calculated and presented in Table 5 and Fig. 2. In Fig. 2, a positive gap indicates that importance level is higher than performance level considering Factor 1 and Factor 4, signifying room for improvement. However, importance and performance levels fluctuate in Factor 2 and 3. As recommended in the IPA literature, comparing ratings of importance and performance would elaborate more significant differences among ratings. According to the p-values presented in Table 5, there are significant differences among all the items of Factor 2, whereas there is not a statistically significant difference in Factor 4. Nine items among 19 in home accessibility factors show significant differences regarding importance and performance ratings. Moreover, the importance level ratings of apartment users are higher than performance level ratings of both detached home and row house users, considering all items of home accessibility. Scheffe's range test found that, considering all the factors ($p = 0.000$), participants living in apartments differed significantly from participants living in detached homes and row houses. According to elderly people living in apartments, the least important accessibility items are 'SAF2. Effective clear width of hallway/stairs' and 'SCR2. Adequate illumination in rooms without glare'.

IPA quadrants were constructed based on the two-dimensional grid of importance and performance ratings. Importance and performance ratings were used because IPA was chosen as the methodological tool, which set priorities on two dimensions of importance and performance. The means of overall importance and performance were the cut-off points between IPA quadrants (Chen et al. 2016). An IPA graph, shown Fig. 3, was drawn based on comparing the importance and performance mean ratings of every factor item to the overall means of importance rating (4.13) and performance rating (3.76). The four items, calculated in the first quadrant and evaluated as high in both importance and performance, are: appropriate size and space at the entrance of house (EA1), ease of operation in door/

Table 5 Importance and performance ratings, IPA quadrants and "T" tests

Accessibility factors	Importance Mean	Performance Mean	P value	IPA Quadrant
Ease of approach				
EA1. Appropriate size and space at the entrance of house.	4.48	4.38	0.00*	2
EA2. Ease of operation in door/window handles/controls	4.34	4.42	0.37	2
EA3. Entering without steps.	4.37	3.38	0.00*	4
EA4. Provision of a comfortable approach zone for each sanitary ware	4.44	4.40	0.51	2
EA5. Curb-free shower/bathroom unit	4.37	3.36	0.22	4
EA6. An outward opening bathroom door	4.36	3.39	0.94	4
Safety and comfort inside rooms (SCR)				
SCR1. Convenient movement between rooms (bedroom and bathroom in close proximity)	3.43	4.40	0.00*	1
SCR2. Adequate illumination in rooms without glare	3.42	4.41	0.00*	1
SCR3. Room entrances without steps	4.36	4.39	0.00*	2
SCR4. Adequate space and size of rooms	4.54	2.49	0.00*	4
SCR5. Non-slippery floor material in rooms	3.38	3.47	0.67*	3
SCR6. Provision of tonal contrasts in rooms	4.31	3.38	0.00*	4
Safe approach to facilities (SAF)				
SAF1. Ease of reach to all electrical outlets	4.34	2.38	0.77	4
SAF2. Effective clear width of hallway/stairs	3.27	4.36	0.00*	1
SAF3. A safe route from entrance to rooms	3.51	4.35	0.00*	1
SAF4. An adequate area to enable of a (seated) stair lift	4.44	3.37	0.44	4
Ease of use in kitchen (EUK)				
EUK1. Sufficient counter space	4.42	3.51	0.35	4
EUK2. Ease of reach to below cabinets	4.28	3.13	0.71	4
EUK3. Ease of reach to above cabinets	4.37	2.82	0.13	4

*$p < .01$

window handles/controls (EA2), provision of a comfortable approach zone for each sanitary ware (EA4), and room entrances without steps (SCR3). The first quadrant, which is called 'Keep up the good work', means that these four items have a good match between importance and performance. It is interesting that most of the items (10 among 19) fell into the second quadrant. Quadrant two indicates low performance on important items. These items are as follows: entrances without steps (EA3), curb-free shower/bathroom units (EA5), outward-opening bathroom doors (EA6), adequate space and size of rooms (SCR4), provision of tonal contrasts in rooms (SCR6), ease of reach to all electrical outlets (SAF1), adequate area to enable a (seated) stair lift (SAF4), sufficient counter space (EUK1), ease of reach to below cabinets (EUK2), and ease of reach to above cabinets (EUK3). To enhance the accessibility satisfaction of elderly people, designers should concentrate on these items. Ignoring these items could result in the failure of home accessibility. The *t* test results of these items do not show any statistical difference between importance and performance. There is only one item in the third quadrant: non-slippery floor material in rooms (SCR5). This item has low priority, and a t-test result also indicates that there is not a statistically significant difference between its importance and performance ratings. In

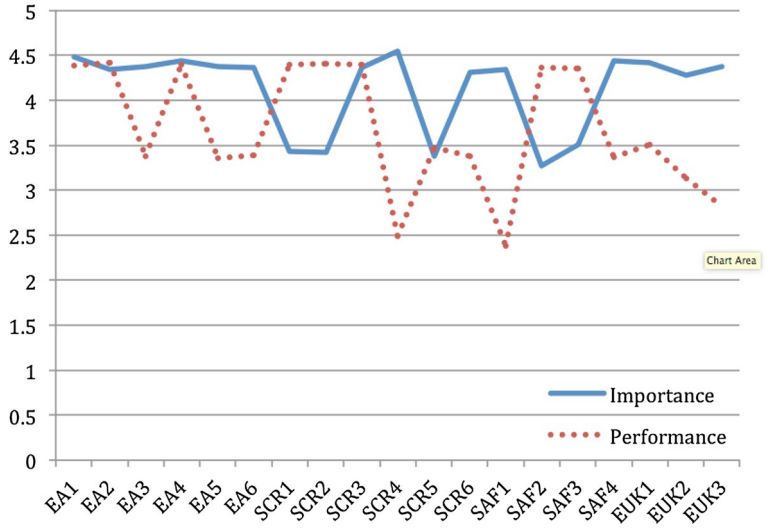

Fig. 2 Importance and performance ratings of home accessibility factor items by 342 older people

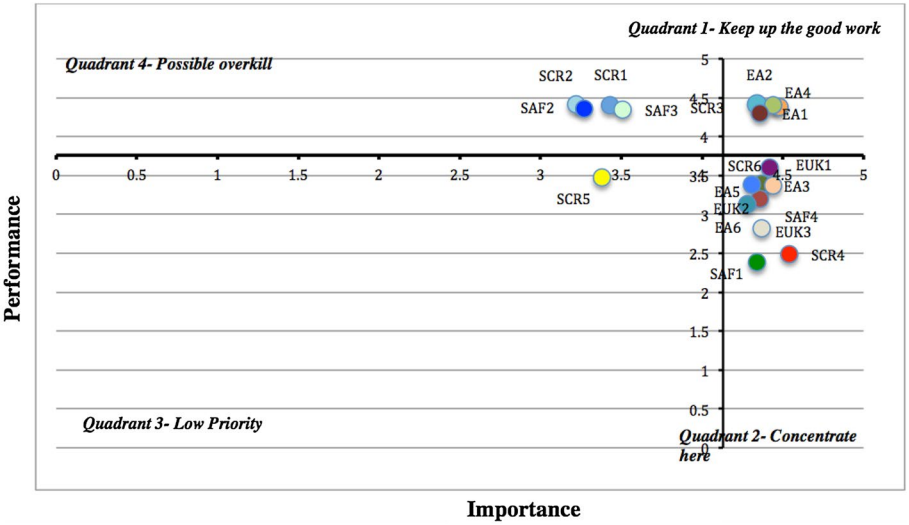

Fig. 3 The IPA Graph with four quadrants

the fourth quadrant, four items rate high in performance but low in importance: convenient movement between rooms (bedroom and bathroom in close proximity) (SCR1), adequate illumination in rooms without glare (SCR2), effective clear width of hallway/stairs (SAF2), and a safe route from entrance to rooms (SAF3). The t-test results of these four items show significant differences between importance and performance ratings. It means that resources committed to these items would be better employed on other items.

5 Discussion

An important result of this study is that it is not the number of achieved accessibility factors but rather the match between importance and performance ratings by elderly users that relates to a good fit between elderly people and their physical home environments. In line with the literature on accessibility, the proposed IPA framework in the study shows that customizing accessibility factors and focusing on matching the importance and performance criteria of elderly people could overcome a lack of accessibility in elderly people's homes. Designers and users have budget and time constraints, as well as other limitations. So, rather than wasting time and money trying to achieve all the accessibility requirements, through the use of IPA methodology it is possible to concentrate on the critical factors that are evaluated as having high importance and satisfaction. When examined in detail, the study supports the study by Pettersson et al. (2017), which suggests that differences of floor levels in entrances and bathrooms have the greatest effect on home accessibility. This study evaluates that items related to floor level differences are high priority items which designers should concentrate on in order to achieve a good fit. As highlighted by Bianchin and Heylinghen (2018), the IPA four-quadrant matrix does not only provide conditions of home accessibility, but has the advantage of identifying areas of immediate attention, improvement, elimination and/or maintenance. Concerning spatial layout and dwelling size as key attributes in defining indoor accessibility (Ahrentzen and Tural 2015), the IPA results are in accordance with prior findings. The item 'adequate space and size of the rooms' (SCR4), has the highest mean of overall importance rating, and is allocated in quadrant 2, which requires concentration.

The second important finding is that the descriptive results and factor analysis of the study are significant in that they indicate significant differences among dwelling types. There are differing importance and performance priority levels of home accessibility factors associated with each dwelling type. For the elderly living in detached homes with stairs, convenient movement between rooms is very important. Participants living in apartments differ significantly from participants living in detached homes and row houses, considering all four factors. In Turkey, apartments lack not only accessibility features, but social and physical design qualities to reflect the needs of the elderly (Afacan 2008). The design of these buildings neglects to consider the importance of independence in daily living activities (Imamoglu and Imamoglu 1992). Therefore, because of the negative impacts of these poorly planned living environments, the importance level ratings of apartment users are higher than their performance level ratings considering all accessibility items; this also impacts the priorities. So, adding to previous studies, this study highlights the significance of dwelling type and its fit to both design qualities and user needs simultaneously, not only in supporting high levels of access in homes, but also in reallocating limited resources to promote independence and health in old age.

A third important finding is that safety and ease of use are key indicators of home accessibility. Comfort is closely related to ease of use in indoor environments, as well as the ability to use spaces without physical or mental discomposure (Burton and Mitchell 2006). According to Imrie (2012), comfort in a built environment is associated with a calm and welcoming feeling. Michael, Green and Farquhar (2006) highlight the importance of comfort in a built environment for active aging and elderly people's decision to live in a particular neighborhood. Safety is referred to the extent to which elderly people use the environment without fear of falling, being attacked or run-over (Afacan 2013). If an indoor environment is familiar, legible and distinctive, then it is obvious that the environment

is safe and there will be no fear of falling. Therefore, referring to the specific definition of accessibility used in the literature (Iwarsson et al. 2012; Smith et al. 2008), this study addressed the crucial links between safety and ease of use to support accessibility along with independence in daily living activities.

These main findings of the study are different compared to the previous studies in the way that this study does not rest on whether each elderly user approaches to home accessibility in the same way. On the contrary, some home attributes get high importance but low performance while some get high satisfaction but low importance. This seems to provide a fair design solutions to home accessibility in which critical factors are gained more significance based on importance and performance analysis. An important design and managerial implication of this analysis is that it helps clarifying the contradictory relationships between priority rankings of home attributes to be considered for inclusion in new home developments.

The proposed IPA approach tries to overcome the messy character of evaluating home accessibility for elderly people. By extending the accessibility attributes with the IPA analysis, it is possible to identify specific accessibility attributes, highest and lower priorities for intervention, and then decide which attributes should be maintained and/or ignored. Interestingly, different accessibility outcomes could be achieved with different accessibility attributes.

6 Conclusion

This study presents an initial attempt to develop an IPA analytical tool that addresses the paradox of accessibility and creates better support for designers whose elderly audience diverges in how they rate satisfaction of, and the importance of, their needs and expectations. Although most studies report a possible link between housing accessibility and independence in daily activities of the elderly, there is still a lack of information about the critical set of housing accessibility attributes and their comparison regarding importance and performance of these same attributes. Finally, this study defined 'housing accessibility' as a design response for sustainable performance and increased home satisfaction, resulting in healthy aging.

The design and managerial implications of the study are summarized as follows:

1. *Housing satisfaction*: Since 1960, housing satisfaction has been defined as the classic measurement of the perceived quality of the home (Hidalgo and Hernandez 2001). However, as highlighted in this study, home satisfaction in later life is a complex and multi-parameter issue, which needs to be prioritized based on an importance ranking by elderly people. It is mostly based on the cognitive assessment of elderly people on the person-environment fit of their own home environment. Thus, poor physical housing conditions and/or inaccessible homes could be reported as creating high levels of housing dissatisfaction.
2. *Accessibility at home*: Accessibility and usability in home environments refer to functionality and the capacity of the physical environment to allow residents to perform necessary activities. Through the IPA, this study explores the idea that although an attribute is essential for accessibility, it could be ranked as being of 'low' importance, such as adequate illumination while approaching, or a safe route from entrance to rooms. Thus, it should be questioned by designers, architects and policy makers whether they should solely trust the well-known accessibility standards to meet elderly people's expectations of healthy aging in their home environments.

3. *Operation and management of home accessibility:* Reliable operation and management services are crucial to extend the domain of accessibility to the realm of design practice. Homes without good management services should be questioned in terms of importance and performance rankings of home accessibility. Thus, it is inevitable to provide exceptional maintenance in order to tackle with high importance and high performance home attributes of accessibility. In this respect, IPA is useful in developing marketing plans for current and future homes ensuring fair accessibility not only for elderly but also for everyone.

The findings of this study are subject to limitations. First, the generalization of the findings is critical in terms of common age-related importance–performance attributes of home environments. Furthermore, the study is based on a Turkish sample, so a cross-cultural study is needed. Moreover, the study is only focused on physical aspects of accessibility; in the future, cognitive and emotional aspects of accessibility should also be considered.

Acknowledgements Preparation of this article was supported by the grant of Science Academy's Young Scientist Awards Program 2017 (BAGEP), Turkey.

Appendix: Exemplary photos of accessibility problems taken from the participants' homes

See Figs. 4, 5, 6, 7, 8, 9, 10 and 11.

Fig. 4 Exemplary bathroom photo taken from one of the participants' homes by the Interviewers

Fig. 5 Exemplary bathroom photo taken from one of the participants' homes by the Interviewers

Fig. 6 Exemplary room photo taken from one of the participants' homes by the Interviewers

Fig. 7 Exemplary room photo taken from one of the participants' homes by the Interviewers

Fig. 8 Exemplary corridor photo taken from one of the participants' homes by the Interviewers

Fig. 9 Exemplary corridor photo taken from one of the participants' homes by the Interviewers

Fig. 10 Exemplary kitchen photo taken from one of the participants' homes by the Interviewers

Fig. 11 Exemplary kitchen photo taken from one of the participants' homes by the Interviewers

References

Abalo, J., Varela, J., & Manzano, V. (2007). Importance values for importance–performance analysis: A formula for spreading out values derived from preference rankings. *Journal of Business Research, 60,* 115–121.

Adler, M., & Ziglio, E. (1996). *Gazing into the Oracle*. Bristol, PA: Jessica Kingsley Publishers.

Afacan, Y. (2008). Designing for an aging population: Residential preferences of the Turkish older people to age in place. In P. Langdon, P. J. Clarkson, & P. Robinson (Eds.), *Designing inclusive futures* (pp. 237–248). London: Springer.

Afacan, Y. (2013). Elderly–friendly inclusive urban environments: Learning from Ankara. *Open House International, 38*(1), 52–62.

Afacan, Y., & Demirkan, H. (2010). A priority-based approach for satisfying the diverse users' needs, capabilities and expectations: A universal kitchen design case. *Journal of Engineering Design, 21*(2–3), 315–343.

Ahrentzen, S., & Tural, E. (2015). The role of building design and interiors in ageing actively at home. *Build Research and Information, 43,* 582–601.

Alberty, S., & Mihalik, B. (1989). The use of importance–performance analysis as an evaluative technique in adult education. *Evaluation Review, 13*(1), 33–44.

Altman, I., Lawton, M. P., & Wohlwill, J. F. (1984). *Elderly people and the environment*. New York: Plenum Press.

Aminzadeh, F., Dalziel, W. B., Molnar, F. J., & Garcia, L. J. (2009). Symbolic meaning of relocation to a residential care facility for persons with dementia. *Aging and Mental Health, 13,* 487–496.

Annear, M., Keeling, S., Wilkinson, T., Cushman, G., Gidlow, B., & Hopkins, H. (2014). Environmental influences on healthy and active ageing: A systematic review. *Ageing & Society, 34,* 590–622.

Argyrous, G. (2005). *Statistics for research*. London: Sage.

Bianchin, M., & Heylinghen, A. (2018). Just design. *Design Studies, 54,* 1–22.

Burby, R. J., & Rohe, W. M. (1990). Providing for the housing needs of the elderly. *Joumal of the American Planning Association, 56,* 324–340.

Burton, E., & Mitchell, L. (2006). *Inclusive urban design: streets for life*. Oxford: Elsevier.

Carlsson, G., Schilling, O., Slaug, B., Fange, A., Stahl, A., Nygren, C., et al. (2009). Towards a screening tool for housing accessibility problems: A reduced version of the housing enabler. *Journal of Applied Gerontology, 28*(1), 59–80.

Cervero, R. (1996). *Paradigm shift: From automobility to accessibility planning* (Working Paper No. 677, Institute of Urban and Regional Development). Berkeley, CA: University of California.

Chen, M., Murphy, H. C., & Knecht, S. (2016). An importance performance analysis of smartphone applications for hotel chains. *Journal of Hospitality and Tourism Management, 29,* 69–79.

Close, J., Ellis, M., Hooper, R., Glucksman, E., Jackson, S., & Swift, C. (1999). Prevention of falls in the elderly trial (PROFET): A randomized controlled trial. *The Lancet, 353,* 93–97.

Connell, B. R., McConnell, E. S., & Francis, T. G. (2002). Tailoring the environment of oral health care to the needs and abilities of nursing home residents with dementia. *Alzheimer's Care Quarterly, 3*(1), 19–25.

Dalkey, N., & Helmer, O. (1963). An experimental application of the DELPHI method to the use of experts. *Management Science, 9*(3), 458–467.

Engel, L., Chudyk, A. M., Ashe, M. C., McKay, H. A., Whitehurst, D. G., & Bryan, S. (2016). Older adults' quality of life—Exploring the role of the built environment and social cohesion in community-dwelling seniors on low income. *Social Science and Medicine, 164,* 1–11.

Evans, M. R., & Chon, K. S. (1989). Formulating and evaluating tourism policy using importance–performance analysis. *Hospitality Education and Research Journal, 13,* 203–213.

Froyen, H. (2012). *Universal design: a methodological approach*. Boston: IHCD Books.

Fuhrer, U., & Kaiser, F. G. (1992). Bindung an das Zuhause: Die emotionalen Ursachen [Attachment to the home place: The emotional bases]. *Zeitschrift für Sozialpsychologie, 23*(2), 105–118.

Gabriel, Z., & Bowling, A. (2004). Quality of life from the perspectives of older people. *Ageing & Society, 24*(5), 675–691.

Go, F., & Zhang, W. (1997). Applying importance–performance analysis to Beijing as an international meeting destination. *Journal of Travel Research, 35,* 42–49.

Granbom, M., Himmelsbach, I., Haak, M., Löfqvist, C., Oswald, F., & Iwarsson, S. (2014). Residential normalcy and environmental experience in very old age. Changes in residential reasoning over time. *Journal of Aging Studies, 29,* 9–19.

Guadagnolo, F. (1985). The importance–performance analysis: An evaluation and marketing tool. *Journal of Park and Recreation Administration, 3*(2), 13–22.

Handy, S. L., Boarnet, M. G., Ewing, R., & Killingsworth, R. E. (2002). How the built environment affects physical activity views from urban planning. *American Journal of Preventive Medicine, 23*(1), 64–73.

Hansen, W. G. (1959). How accessibility shapes land use. *Journal of the American Institute of Planners, 25*(2), 73–76.

Hansen, E., & Bush, R. J. (1999). Understanding customer quality requirements: Model and application. *Industrial Marketing Management, 28,* 119–130.

Harrison, J. (1997). Housing for the ageing population of Singapore. *Ageing International, 23*(3/4), 32–48.

Herssens, J., Nijs, M., & Froyen H. (2014). Inclusive Housing (Lab) for all: A home for research, demonstration and information on Universal Design (UD). *Assistive technology research series*, *Vol. 35: Universal design 2014: Three days of creativity and diversity* (pp. 185–194).

Heylighen, A., Linden, V. V., & Steenwinkel, I. V. (2017). Ten questions concerning inclusive design of the built environment. *Building and Environment, 114,* 507–517.

Heywood, F. (2005). Adaptation: Altering the house to restore the home. *Housing Studies, 20,* 531–547.

Hidalgo, M. C., & Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. *Journal of Environmental Psychology, 21,* 273–281.

New Fair Multi-Family Housing. (1996). *A design primer to assist in understanding the accessibility guidelines of the fair housing act*. North Carolina: North Carolina State University Press.

Imamoğlu, O. E., & Imamoğlu, V. (1992). Housing and living environments of the Turkish elderly. *Journal of Environmental Pscychology, 12,* 35–43.

Imrie, R. (2012). Universalism, universal design and equitable access to the built environment. *Disability and Rehabilitation, 34*(10), 873–882.

Insch, A. (2010). Managing residents' satisfaction with city life: Application of importance–satisfaction analysis. *Journal of Town and City Management, 1*(2), 164–174.

Iwarsson, S. (2005). A long-term perspective on person–environment fit and ADL dependence among older Swedish adults. *The Gerontologist, 45,* 327–336.

Iwarsson, S., Nygren, C., & Slaug, B. (2005). Cross-national and multi-professional inter–rater reliability of the housing enabler. *Scandinavian Journal Occupational Therapy, 12,* 29–39.

Iwarsson, S., & Slaug, B. (2001). *Housing enabler: an instrument for assessing and analysing accessibility problems in housing*. Nävlinge and Staffanstorp, Sweden: Veten & Skapen HB and Slaug Data Management.

Iwarsson, S., Slaug, B., & Malmgren Fänge, A. (2012). The housing enabler screening tool: Feasibility and interrater agreement in a real estate company practice context. *Journal of Applied Gerontology, 31*(5), 641–660.

Iwarsson, S., & Stahl, A. (2003). Accessibility, usability, and universal design. Positioning and definition of concepts describing person–environment relationships. *Disability and Rehabilitation, 25,* 57–66.

Iwarsson, S., Wahl, H.-W., Nygren, C., Oswald, F., Sixsmith, A., Sixsmith, J., et al. (2007). Importance of the home environment for healthy aging: Conceptual and methodological background of the European ENABLE-AGE Project. *The Gerontologist, 47,* 85–95.

Keates, S. (2015). Design for the value of inclusiveness. In J. Van den Hoven, P. E. Vermaas, & I. van der Poel (Eds.), *Handbook of ethics, values and technological design* (pp. 383–402). Dordrecht: Springer.

Kylberg, M., Lofqvist, C., & Horstmann, V. (2013). The use of assistive devices and change in use during the ageing process among very old Swedish people. *Disability and Rehabilitation: Assistive Technology, 8,* 58–66.

Maisel, J. (2011). The evolution of universal design in housing in the United States: Toward visitability and pattern books. In W. F. E. Preiser & K. H. Smith (Eds.), *Universal design handbook* (pp. 25.1–25.8). New York: McGraw Hill.

Maisel, J. L., Smith, E. A., & Steinfeld, E. (2008). *Increasing home access: Designing for visitability, Research Report 2008–2014*. Washington DC: AARP Public Policy Institute.

Martilla, J., & James, J. (1977). Importance–performance analysis. *Journal of Marketing, 41,* 77–79.

Matzler, K., Bailom, F., Hinterhuber, H. H., Renzl, B., & Pichler, J. (2004). The asymmetric relationship between attribute level performance and overall customer satisfaction: A reconsideration of the importance–performance analyses. *Industrial Marketing Management, 33*(4), 271–277.

Michael, Y. L., Green, M. K., & Farquhar, S. A. (2006). Neighborhood design and active aging. *Health and Place, 12,* 734–740.

National Research Council (US) Committee. (2010). The physical environment and home health care. *The role of human factors in home health care* (pp. 211–245). Washington, DC: National Research Council.

Niemeier, D. (1997). Accessibility: An evaluation using consumer welfare. *Transportation, 24*(4), 377–396.

Nygren, C., Oswald, F., Iwarsson, S., Fange, A., Sixsmith, J., & Schilling, O. (2007). Relationships between objective and percieved housing in very old age. *The Gerontologist, 47*(1), 85–95.

Oguz, D., Cakci, I., Sevimli, G., & Ozgur, S. (2010). Outdoor space design in elderly nursing homes. *Elderly Issues Research Journal, 1*(1), 23–33.

Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: An example, design considerations and applications. *Information & Management, 42*(1), 15–29.

Orimo, H., Ito, H., Suzuki, T., Araki, A., Hosoi, T., & Sawabe, M. (2006). Reviewing the definition of "elderly". *Geriatrics and Gerontology International, 6,* 149–158.

Pettersson, C., Slaug, B., Granbom, M., Kylberg, M., & Iwarsson, S. (2017). Housing accessibility for senior citizens in Sweden: Estimation of the effects of targeted elimination of environmental barriers. *Scandinavian Journal of Occupational Therapy*. https://doi.org/10.1080/11038128.2017.1280078.

Potter, R., Sheehan, B., Cain, R., Griffin, J., & Jennings, P. A. (2018). The impact of the physical environment on depressive symptoms of older residents living in care homes: A mixed methods study. *The Gerontologist, 58*(3), 438–447.

Rantanen, T. (2013). Promoting mobility in older people. *Journal Preventine Medicine and Public Health, 46,* 50–54.

Raviselvam, S., Wood, L. K., Holtta-Otto, K., Tam, V., & Nagarajan, K. (2016). A lead user approach to universal design-involving older adults in the design process. *Studies in Health Technology and Informatics, 229,* 5–6. https://doi.org/10.3233/978-1-61499-684-2-131.

Rooney, C., Hadjri, K., Mcallister, K., Rooney, M., Faith, V., & Craig, C. (2017). Experiencing visual impairment in a lifetime home: An interpretative phenomenological inquiry. *Journal of Housing and the Built Environment, 33*(1), 1–23.

Sampson, S. E., & Showalter, M. J. (1999). The performance–importance response function: Observations and implications. *The Service Industries Journal, 19,* 1–26.

Oswald, F., Wahl, H. W., Schilling, O., & Iwarsson, S. (2007). Housing-related control beliefs and independence in activities of daily living in very old age. *Scandinavian Journal of Occupational Therapy, 14,* 33–43.

Skok, W., Kophamel, A., & Richardson, I. (2001). Diagnosing information systems success: Importance–performance maps in the health club industry. *Information & Management, 38,* 409–419.

Slaughter, S. E., & Morgan, D. G. (2012). Functional outcomes of nursing home residents in relation to features of the environment: Validity of the professional environmental assessment protocol. *Journal of the American Medical Directors Association, 13*(5), 487.e1–487.e7.

Smith, S. K., Rayer, S., & Smith, E. A. (2008). Aging and disability: Implications for the housing industry and housing policy in the United States. *Journal of the American Planning Association, 74*(3), 289–306.

Steenwinkel, I. V., Casterle, B. D., & Heylighen, A. (2017). How architectural design affords experiences of freedom in residential care for older people. *Journal of Aging Studies, 41,* 84–92.

Türel, H. S., Yiğit, M. E., & Altuğ, I. (2007). Evaluation of elderly people's requirements in public open spaces: A case study in Bornova District (Izmir, Turkey). *Building and Environment, 42,* 2035–2045.

Turkish Statistical Institute. (2017). *Statistical reports*. http://www.tuik.gov.tr/UstMenu.do?metod=kategorist.

Verbeek, H., Zwakhalen, S. M. G., van Rossum, E., Kempen, G. I. J. M., & Hamers, J. P. H. (2012). Small-scale, homelike facilities in dementia care: A process evaluation into the experiences of family caregivers and nursing staff. *International Journal of Nursing Studies, 49*(1), 21–29.

Wahl, H.-W., Fänge, A., Oswald, F., Gitlin, L. N., & Iwarsson, S. (2009). The home environment and disability-related outcomes in aging individuals: What is the empirical evidence? *The Gerontologist, 49*(3), 355–367.

Yeo, A. Y. C. (2003). Examining a Singapore bank's competitive superiority using importance–performance analysis. *Journal of American Academy of Business, 3*(1/2), 155–161.

Young, L. C. (2011). Universal housing: A critical component of a sustainable community. In W. F. E. Preiser & K. H. Smith (Eds.), *Universal design handbook* (pp. 241–2413). New York: McGraw Hill.

Yung, E., Conejos, S., & Chan, E. (2016). Social needs of the elderly and active aging in public open spaces in urban renewal. *Cities, 52,* 114–122.

Yung, E. H. K., Winky, K. O. H., & Chan, H. E. W. (2017). Elderly satisfaction with planning and design of public parks in high density old districts: An ordered logit model. *Landscape and Urban Planning, 165,* 39–53.