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ARTICLE

An investigation into the relationship between quality of life of the elderly in relation to physical spaces in order to select an ideal residence

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Abstract
The purpose of this research is first to discover and study the design factors associated with increasing quality of life of the elderly in the physical residential spaces and, then, to assess and select the best housing option meeting the needs of the elderly (nursing home, private home, elderly village) in Iran. This study is an applied survey. A researcher-made questionnaire was distributed among 150 elderly to determine quality of life indicators in relation to physical spaces. Then, the relative importance of each indicator in relation to elderly housing options was determined using AHP technique and distribution of the questionnaire among experts. The statistical population in the second stage of research was 35 experts in the field of architecture, rehabilitation, medicine, and nursing which were selected in a non-random purposive manner. In this research, the five main factors of educational and encouraging spaces, environmental desirability and comfort, personal peace and quiet, perception of ownership, and home likeness were identified in relation to the design of physical spaces to increase quality of life of the elderly. The results of the ranking of options based on these five factors indicated that the nursing home ranked first in increasing quality of life of the elderly based on its final weight.

Keywords Design · Elderly housing · Quality of life · Physical environment

1 Introduction

According to the official predictions of international organizations, as a developing country, Iran is also approaching population aging (Kiani and Bayanzadeh 2010). It is anticipated that there will be a blast in the elderly population from 6.6% in 1995 to 25.1% in

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2061 in Iran (Sigaroudi et al. 2013). Therefore, preemptive measures are required to be taken to overcome this phenomenon. However, nowadays, the main concern of researchers is not just to increase longevity. In other words, if the main challenge of health system in the twentieth century was only "survival", its challenge in the new century is "living a better-quality life" (Ahangari et al. 2008).

According to Iranian culture, providing care to seniors is a sacred duty, thus, most Iranians are willing to provide care to the elderly family members (Cheraghi et al. 2005). In the past, Iranian family members provided care to seniors when the average number of children per family was more than 6.5 making it possible to provide care in rotating shifts. According to the state welfare organization, although children were responsible for supporting older people, the population of seniors without children or those having only one child is growing (Pouryousef 2014). This trend sits beside the transition from a traditional to a developed society, women's employment, and limited family living spaces, making it necessary for the healthcare system to develop more supportive programs (MOHME 2012). Such problems caused changes in traditional attitudes and cultural values in recent years which negatively affected quality of life (QOL) of Iranian seniors (Heydari et al. 2012). Therefore, due to the issues such as deterioration of seniors' health (McLennon et al. 2010), lack of physical space in homes, and disruption of the normal life pattern, family members had no choice, but to put seniors in nursing homes (Peyrovi et al. 2012). These have contributed to the growth of various institutions such as nursing home as an alternative to the family structure (Masoudi et al. 2010). Therefore, although the culture of placing seniors in nursing homes is not present in Iran (Sam Aram and Amin Aghai 2007), the development of elderly care institutions seems to become a necessity in the future (Momeni and Karimi 2010).

Unfortunately, elderly care centers in Iran, public and private, which are governed by the State Welfare Organization, are limited (Nayeri et al. 2018; Rejeh et al. 2011) and such centers do not meet the required standards (Goharinezhad et al. 2016). For instance, in Tehran, with a population of more than 12 million, there are 64 rehabilitation and nursing homes; one comprehensive rehabilitation center, and 4 day care centers (SWOI 2012). In traditional models of nursing homes in Iran seniors not only are not involved in social activities, but living in these centers is quite routine and the care plans are not designed to match the conditions of each elderly (Goharinezhad et al. 2016). Therefore, more researches should be conducted from the point of view of the elderly about their housing needs (Bigonnesse et al. 2014). The inability of nursing homes to meet the needs of Iranian seniors (Nayeri et al. 2018) has led to negative attitudes among seniors of Iran. Therefore, Iranian seniors prefer aging in-place (Haghnia 2018). Based on the observations, traditional model of nursing homes in Iran does not provide elderly people a good QOL (Haghnia 2018). Therefore, many studies indicated that the Iranian seniors living in their own homes have higher QOL than those living in nursing homes (Heydari et al. 2016). However, feeling of loneliness at home is one of the main predictors of seniors living in the elderly home (Sigaroudi et al. 2013). Studies in Iran showed that seniors living alone were more likely than others to report low levels of QOL (Heravi-Karimooi et al. 2010). The important reasons of declining QOL of seniors living alone are the lack of financial and social support, companionship, and care from family members (de Jong Gierveld 2003). Therefore, the choice that is left could be non-family protection, which could be available only in the nursing homes (Smetcoren et al. 2017). Moreover, seniors are starting to recognize nursing homes as a social fact (Sheykhi 2004). Studies indicated that the senior residents in a long-term care facility exhibited a better QOL than expected (González-Salvador et al. 2000). Therefore, in order to enhance seniors' attitudes towards nursing homes, care

home buildings need to be changed to enable the experience of a better QOL (Abdollahi and Mohammadpour 2013). Enhancing the quality of nursing homes and matching them with the future expectations of the elderly are therefore crucial at this stage (Vincent et al. 2006).

It should be noted that moving into nursing homes will bring about changes in seniors' experiences with the environment and affects their participation in outdoor activities. In nursing homes, these activities are limited (Gonzalez and Kirkevold 2015). Old age creates many constraints in different areas, including social, cultural, and economic aspects (Park and Kim 2016). Therefore, nursing home environments should give them the opportunity to be successful in most of physical and psychological challenges (Haghnia 2018).

The aim of this article is to find architectural design and physical factors in order to provide strategies to increase QOL of the elderly. First, a researcher-made questionnaire was distributed among 150 elderly to determine QOL indicators in relation to physical spaces. Then, the relative importance of each indicator and the most suitable housing option was selected using AHP method, to meet QOL needs in residents.

2 Research background

In developing countries such as Iran, population ages faster than developed countries. Therefore, these countries lack the necessary preparation to deal with the challenges of old age (Karimi et al. 2013) in terms of immediate care. In Iran, nursing homes have two types of private and public which have different circumstances for admission (Sheykhi 2004). However, both types of nursing homes lack the acceptable quality in terms of physical planning. According to studies, in terms of nursing homes in Iran, not much is spent on the housing and health sectors of the elderly at present (Sheykhi 2004) which has caused quality and quantity problems (Haghnia 2018). In such aging researches in order to investigate the conditions of nursing homes in Iran, QOL has been used as an umbrella term to describe a number of outcomes which is believed to be important in the lives of seniors (Afsharkohan and Koolivand 2015; Mokhtari and Ghasemi 2011). For instance, some studies investigated solutions to increase quality of senior's life through physical exercises (Torghabeh et al. 2011), social support (Abedi et al. 2011) and trainings (Afkari et al. 2011) in nursing home residents of Iran. Several studies have pointed out factors affecting QOL (Fig. 1). However, it is rare for academic curricula to directly investigate the needs of Iranian seniors of nursing homes in architecture and design context.

One of the factors contributing to enhancing QOL which can be related to the physical environment is senior's experience of place in later life (Rowles and Chaudhury 2005). Since relocation occurs for seniors living in care home buildings, negative aspects of the location (push factors) which encourage one to leave that place, and the positive aspects of the new destination (pull factors) should be considered (Smetcoren et al. 2017). Seniors might move to a new place due to the influence of push factors which negatively affects their life quality (Oztop and Akkurt 2016). Therefore, the push–pull factors can help planners to shed light on the pull factors and to modify the environment. At this stage, the meaning of home plays an important role in the process of relocation. Studies concerning relocation have highlighted different reasons why seniors decide to move which can be seen through Fig. 2.

Unfortunately, housing stock in Iran has not been designed or constructed to accommodate the needs of lonely older people in terms of their needs, e.g. accessibility, independence, and

Previous studies	Factors affecting QOL (conceptualization of QOL)
(OECD, 2010)	Health status, social connections, subjective well-being, environmental quality
(Whoqol, 1998)	Physical health, psychological wellbeing, social relationships and the physical environment
(People, 2010), (Joseph, 2006)	Physical environment of nursing homes can enable seniors to be active, with a view to favor better QOL, since the environment influences participation in physical activity among seniors.
(Kaldi, 2004)	In a research conducted in Tehran, it was concluded that the seniors encounter many issues such as life dissatisfaction, mental and emotional problems
(Aliasquarpoor M & Eybpoosh S, 2012; Hasani, Kamali, Akbarfahimi, & Davatgaran, 2011; Hesamzadeh, Maddah, Mohammadi, Fallahi Khoshknab, & Rahgozar, 2010; J. Heydari et al., 2012; Jadidi, Farahaninia, Janmohammadi, & Haghani, 2015; Masoudi et al., 2010; Nayeri et al., 2018; Zarghami & Olfat, 2015, 2017)	The poor QOL of seniors in Iranian nursing homes should be enhanced to induce a sense of positive QOL through the enhancement of environments.
(Sh.Salarvand & H.Abedi, 2007), (Barnes & the, 2002)	-Majority of seniors mentioned their sense of loneliness and depression for environmental reasons. -QOL of residents not only is related to the quality of the care provided, but can be also related to the physical environment
(Alessi et al., 2005; Matlabi, Hamedi Behtash, & Shafiei, 2016; Joseph, 2006; (Reimer, Slaughter, Donaldson, Currie, & Eliasziw, 2004))	-Design of physical environment impacts resident and staff outcomes in long-term care settings and contributes to a better QOL. -Different aspects of the physical environment have an effect on reducing disruptive behavior, increasing social interactions and satisfaction among seniors in long-term care settings. -A purposively designed physical and social environment has a positive effect on seniors' QOL

Fig. 1 Factors affecting QOL of seniors based on previous studies

Previous studies	Crucial role of design features in seniors' decision to move.
(Baeumker et al., 2012; Tyvimaa & Kemp, 2011; Weeks, Keefe, & Macdonald, 2012).	The meaning of home plays an important role in the process of relocation which van be addressed through physical environment..
(Oztop & Akkurt, 2016)	The suitability of the living environment helps seniors to adapt to that environment, feel themselves as a part of it, and find it comfortable and safe.
(Hansen & Gottschalk, 2006)	There are several push and pull reasons of relocation which can be ascribed to environmental triggers, e.g. aspects of the dwelling
(Hillcoat-Nalletamby & Ogg, 2014)	This study indicated the influence of the home environment on moving behavior, such as concerns about structural design features, location and maintenance.
(Hwang, Cummings, Sixsmith, & Sixsmith, 2011; Fänge & Iwarsson, 2005; Tanner, Tilse, & de Jonge, 2008; Connell, Sanford, Long, Archea, & Turner, 1993; Smetcoren et al., 2017)	Home modifications is one of the solutions by enhancing accessibility and usability of environments, strengthened personal and social meaning of home through comfortable and aesthetic spaces for seniors, lessened dependence in performing daily activities and a more attractive environments. This could help care home buildings to make seniors feel familiar with such environments
(Hawkins & Stewart, 2002; Golant, 2014))	The experience of home can be diminished when the physical aspects of accessibility and functionality are emphasized and the personal and social meanings of home are neglected. In such cases, seniors' participation and control over modifications should be considered as well
(Rowles & Chaudhury, 2005)	They developed a heuristic framework on domains of meaning of home in old age which included physical, personal and social aspects. From physical environment perspective, they recommended architects to consider new patterns of the meaning of home: to foster positive bonding with home and to reduce dysfunctional attachment whenever it may appear.

Fig. 2 Studies concerning design features in seniors' decision to move

etc. While a few studies regarding the design of care home buildings have been conducted, it still remains underdeveloped (Barnes and The Design in Caring Environments Study Group 2002) and Iranian public and private care home buildings, still confront significant barriers regarding design features.

3 Methodology

3.1 The literature review search process

The literature review of the relevant studies was conducted on the challenges associated with Iranian and worldwide care home buildings, physical environment, and its effect on seniors' QOL. The literature review search process can be seen through Fig. 3. Based on the findings of previous researches, 41 questions were arranged into a researcher-made questionnaire to identify the categorized factors and their significance using exploratory factor analysis.

3.2 Quality of life definition and test

In order to define and test QOL based on Iranian seniors' preferences, an appropriate questionnaire should be developed in terms of relevant indicators which could have a significant relationship with QOL of Iranian seniors. The measurement of QOL is usually undertaken using objective (physical settings) and subjective indicators (the psychological state) regarding life satisfaction (Sahin et al. 2007).

In this research, the QOL defined based on the researches in which the relationship between QOL of elders and the preferred physical environment was highlighted. After the emergence of QOL in medical field and political science, it received growing interest among the researches in the field of social sciences, built environment and etc. (Mohit 2013; Zarghami et al. 2017). These researches defined QOL based on the living environment's success in increasing positive feelings and decreasing negative feelings of elders (Andersson 2011; Bowling et al. 2013; Lee et al. 2013; Fig. 4) in accordance to their subjective and objective needs (Mohit 2013). It should be noted that the questions to be designed from the subjective indicators were asked in a way that the indicators be related to the physical environment. For instance, to relate exercise to the environment, the existence of an open space for exercising were asked.

The World health organization demonstrated that the assessment of QOL should be developed in accordance with the individual's perception in the context of their culture and value system and their expectations, standards, and concerns in terms of physical and functional conditions (Zarghami et al. 2018). Therefore, the analysis of settings of both built environment and the social environment through objective indicators,

Fig. 3 Literature review search process

Fig. 4 QOL indicators of previous researches based on the living environment

physical features and the attractiveness of the place of the care home built environment were carried out to determine the level of QOL in seniors' living environment.

The first attempt was to collect information from previous researches in which the indicators had a statistically significant relationship to seniors' QOL through the physical environment.

Previous studies had identified different domains when assessing care buildings for the enhancement of the QOL, including availability of space, safety features and orientation cues (Bowie et al. 1992; Sloane et al. 2002). Moreover, four domains of physical, social, and care environment were identified having relationship with QOL of seniors in a way that addressing such domains could enhance seniors' QOL (Andersson 2011; Parker et al. 2004). After the selection of the indicators based on the mentioned studies, 41 questions were arranged into a researcher-made questionnaire. The development process of a valid questionnaire and the test were indicated in Fig. 5.

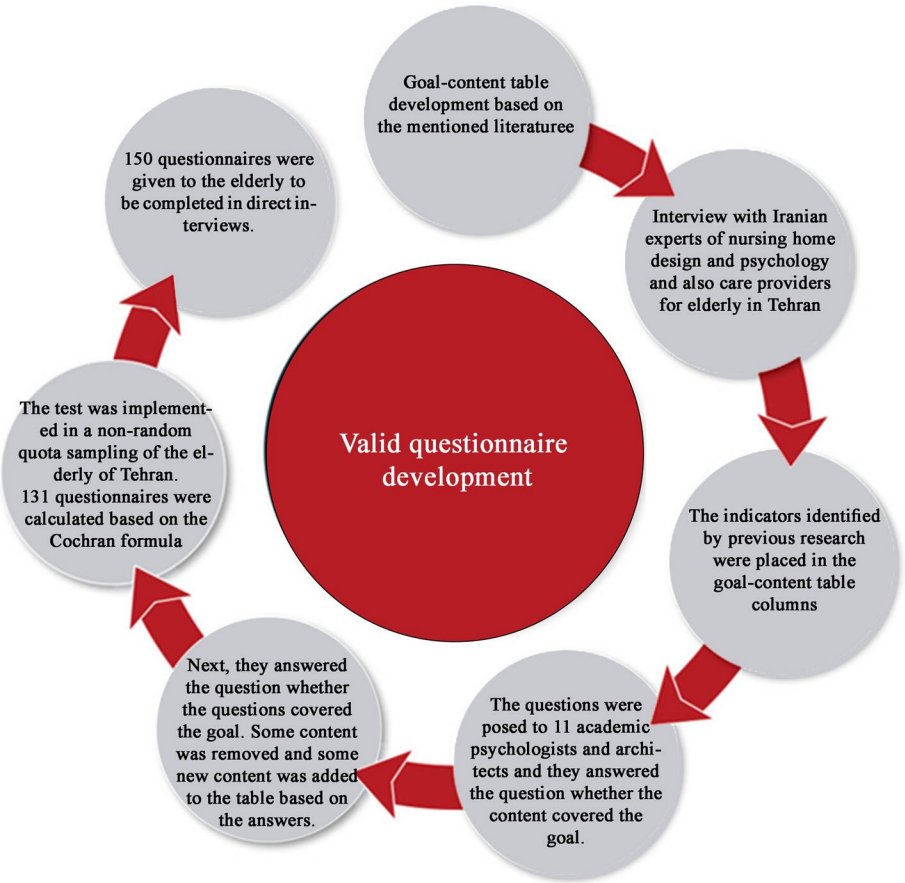

Fig. 5 The process of developing a valid questionnaire

3.3 Recruitment of the samples

Of the 64 care homes in the study area, 43 were approached before the desired number was recruited. Some sample stratification was used to ensure a mix by gender, cognitive status, and length of stay. Seven of those approached had too few long-stay residents. Of the remainder, ten of those declined to take part or failed to provide the necessary information, which included architectural plans of the building. The non-participants identified to be in the small or private residential group. The recruited sample comprised 26 homes, of which 6 were small, 9 medium and 11 large. There were 740 seniors with long-stay residents in these homes. Demographic characteristics of subjects (age, gender, diseases background, and education) were collected through face-to-face interview. Subjects of both genders as inclusion criteria defined as: able to communicate verbally, have at least 6 months experience of living in the elderly home, and aged above 60 years were defined. Exclusion criteria were individuals with Alzheimer disease and other cognitive disorders who had no ability to answer the questions and took part in the interview. The physical health of the elderly in the use of rehabilitation equipment was not included as a criterion. On the other hand,

based on the Cochran formula, questionnaires were given to 150 non-randomly-selected elderlies.

In order to discover seniors' attitudes towards significant factors affecting their QOL, the questionnaires were created based on a five point Likert scale based on their level of importance for the elders, e.g. "very important, important, fairy important, slightly important, not important". For instance, to determine the importance of exercise in terms of physical environment, the question of "How important is it for your living environment to have yard or open space for playing or exercising?". After collecting the questionnaires from Iranian seniors, experts named the factors based on their related indicators (questions) and their related criteria based on the categorized factors implemented by exploratory factor analysis of SPSS 21.

On the other hand, for the second stage of the research, the AHP questionnaires were distributed among 35 experts in the fields of architecture, rehabilitation, medicine, and nursing which were selected in a non-random purposive manner. The highly informed experts were selected based on their experience towards elderly home design for architects and elderly care experience of the experts in the fields of rehabilitation, medicine, and nursing. The inclusion criteria for the purposive selection was their education from local universities, their role and influence on the way to enhance the QOL of elders, their professional experience in such fields, and their willingness to participate.

The data was analysed in two stages:

First stage The data collected by questionnaires was analysed through SPSS 21 and the reliability of the research tool was measured through the use of components' internal compatibility method and Cronbach's alpha. In order to define categorized factors and their significance in terms of the enhancement of the QOL, exploratory factor analysis was utilized. The steps of this method are indicated in Fig. 6.

Second stage In previous stage, based on the indicators extracted from the literature review, the questions for seniors were devised and the main factors were identified and named by the experts. In this stage, AHP method used for pairwise comparisons (Saaty 2001). The second stage of the research were indicated in Fig. 7.

4 Results and discussion

4.1 Description of the samples (seniors and experts)

Participants in this research were classified into three age groups of 60–75, 76–85, and +86 years, which correspond to the early stages of ageing, mid-ageing, and the end of ageing, respectively. Also, their education level was classified as illiterate, high school diploma, bachelors, masters, and doctoral degrees. Demographic characteristics of elderly participants are shown in Table 1.

A total of 150 elderly were selected from 26 elderly care homes in Tehran, Iran, including 51% female and 49% male. Majority (58%) were 76–85 years old and the frequency of the ages 60–75 and +86 years were 38% and 4%, respectively. Totally, 47% were illiterate or below high school diploma, the frequency of 56% had diploma and a total of 47% had university education. 99 elders (66%) were married and 51 (34%) were single or divorced.

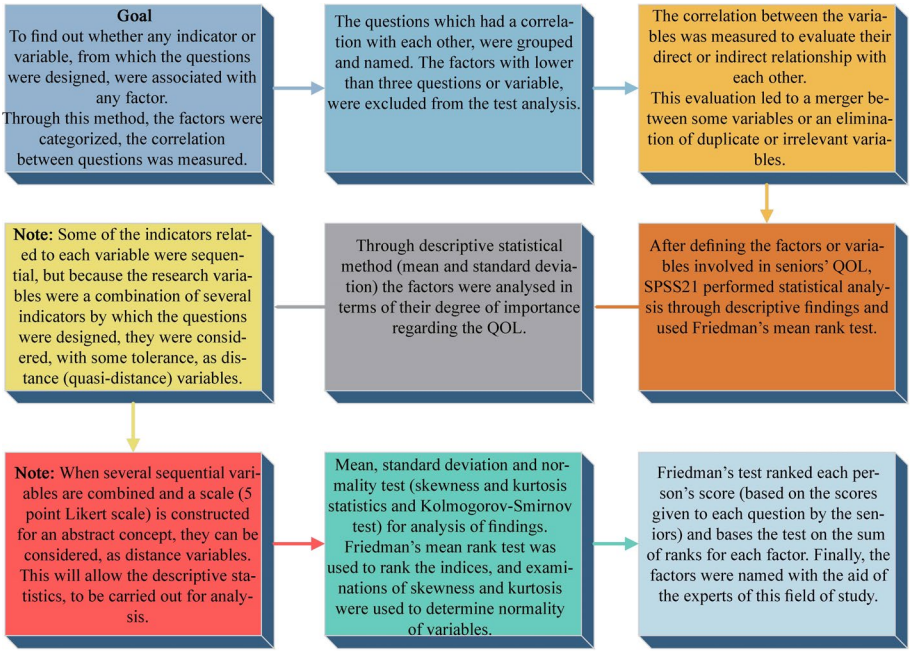

Fig. 6 First stage of the research methodology

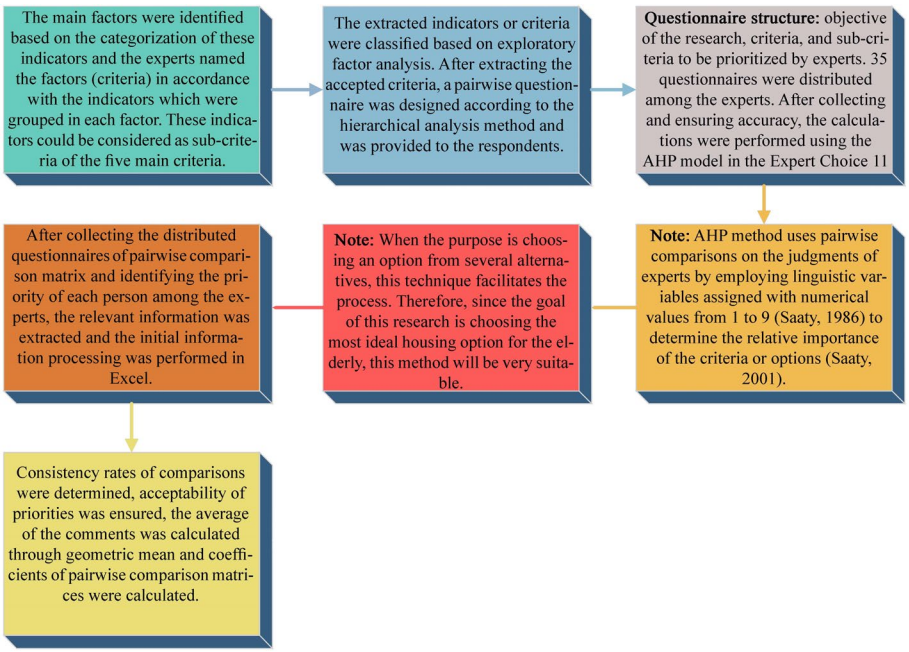

Fig. 7 Second stage of the research methodology

Table 1 Demographic characteristics of the elderly sample (N = 150)

Characteristics	Frequency	Frequency percentage
Education		
Illiterate or below high school diploma	47	31.33
High school diploma	56	37.33
Bachelor	43	28.66
Master's degree	2	0.01
PhD	2	0.01
Age		
60–75 years	57	38
76–85 years	87	58
86 years and above	6	4

On the other hand, Table 2 presents the demographic variables (education, age, and work experience) of the experts. Most respondents (51%) have master's degrees, 40% have PhDs and 9% have bachelor's degrees. In terms of age, 45% of the subjects are 30 years and younger and 55% of them are older than 30 years. In terms of work experience, the highest level of work experience (37%) is for the less than 5 years group, 26% for the 6–10 years, and 23% for the 11–15 years.

4.2 Defined factors and their impact on seniors' QOL

The exploratory factor analysis identified 14 factors which were categorized by SPSS21. After the evaluation of the correlations between the questions and factors through SPSS, five main factors were defined with the aid of the experts based on their related questions

Table 2 Demographic characteristics of the sample (N = 35)

Characteristics	Frequency	Frequency percentage
Education		
Bachelor	3	9
Master's degree	18	51
PhD	14	40
Age		
26–30 years	16	45
31–35 years	9	26
More than 35 years	10	29
Work experience		
0–5 years	13	37
6–10 years	9	26
11–15 years	8	23
16–20 years	3	8
More than 20 years	2	6

Table 3 Mean and standard deviation of main variables

Variable	Mean	Standard deviation
Educational and encouraging spaces	3.47	0.81
Environmental desirability and comfort	4.17	0.63
Personal peace and quiet	3.94	0.72
Perception of ownership	3.33	0.80
Similarity to home space	4.21	0.65

Table 4 Skewness and kurtosis values and Kolmogorov–Smirnov test to assess the normality of the main variables

Variable	Kolmogorov–Smirnov test		Skewness	Kurtosis
	Z statistic	Significance level		
Educational and encouraging spaces	0.129	0.067	−0.193	−0.325
Environmental desirability and comfort	0.105	0.095	0.066	−0.811
Personal peace and quiet	0.096	0.117	−0.122	−0.779
Perception of ownership	0.146	0.043	0.298	−0.481
Similarity to home space	0.094	0.121	0.099	−0.460

which are named as follows: educational and encouraging spaces, environmental desirability and comfort, personal peace and quiet, perception of ownership and similarity to home space. In order to determine whether the correlation between variables and QOL is significant from the seniors' point of view, significance level of the correlation was calculated for each variable using mean and standard deviation (Table 3). The average range of all scores is from 1 (very low) to 5 (very high) in which the average score is 3 and is defined as the mean.

Table 3 showed that the average score of all variables is higher than the mean, all of which are greater than 3. This means that all components have a more than average impact on the QOL in the elderly. The lowest mean is that of ownership perception with a value of 3.33, and the highest mean is related to similarity with home space with a value of 4.21. The mean of educational and encouraging spaces is 3.47, that of personal peace and quiet is 3.94 and that of environmental desirability and comfort is 4.17. In other words, according to elderly respondents, all these variables can enhance the seniors' QOL.

4.3 Measuring the normality of variables

The importance of measuring data distribution normality is that some statistical methods such as Pearson correlation, t-tests and ANOVA test are based on the assumption of the normal distribution of data (in the population). Also, population parameter estimation is based on the normal distribution of variables in the population (Karimi 2015: 125). The Kolmogorov–Smirnov test and skewness and kurtosis indices were used to determine the distribution of data (normality). Results are reported in Table 4.

Table 4 shows that all research variables (other than perception of ownership) have a normal distribution. The significance level of the Kolmogorov–Smirnov test for all research

Table 5 Friedman test results to investigate the difference in the rank of research variables

Statistical indices	Statistic value
Sample size	150
Chi square value	188.69
Degree of freedom	4
Significance level	0.001 >

Table 6 Friedman test result for ranking variables

Rank	Dimensions	Average rank
1	Environmental desirability and comfort	3.80
2	Similarity to home space	3.77
3	Personal peace and quiet	3.28
4	Educational and encouraging spaces	2.21
5	Perception of ownership	1.93

variables (other than perception of ownership) was greater than 0.05 ($P > 0.05$), indicating the normality of all variables. Examination of the skewness and kurtosis values shows that, as these values for all variables are in the range of +1 to −1, all variables have a normal or near to normal distribution. When the distribution of all variables is considered normal, parametric tests can be used to test the hypotheses. As the significance level for the perception of ownership is 0.043 which is close to the standard value of 0.05, and as the skewness and kurtosis values of this variable are suitable, we can also consider the distribution of this variable to be approximately normal.

4.4 Ranking the factors that increase QOL of the elderly

Friedman test, which is suitable for intergroup designs (dependent samples), was used to prioritize (rank) the factors affecting the increase in QOL in the elderly.

The results of Friedman test are presented in Tables 5 and 6. Based on the findings, it can be stated that according to the Chi square value of 188.69 ($df = 4$) which is significant at an error rate of less than 0.01 ($P < 0.01$), there is a significant difference between the five studied factors.

The order of prioritization of the elderlies is shown in Table 6. It shows that the highest average rank is for the environmental desirability and comfort factor (3.80), which means that this factor is more effective in increasing QOL of the elderly than any other factor. Similarity with home space with the average rating of 3.77 and personal peace and quiet with an average rating of 3.28 get the next ranks. The lowest average rating (1.93) was attributed to the perception of ownership, indicating its minimal role in increasing QOL of the elderly.

4.5 Second stage of research (distribution of questionnaires among experts)

This research has five main criteria, 18 sub-criteria and three final options. In this stage, the hierarchical model was developed as the following figure (Fig. 8). The main criteria were

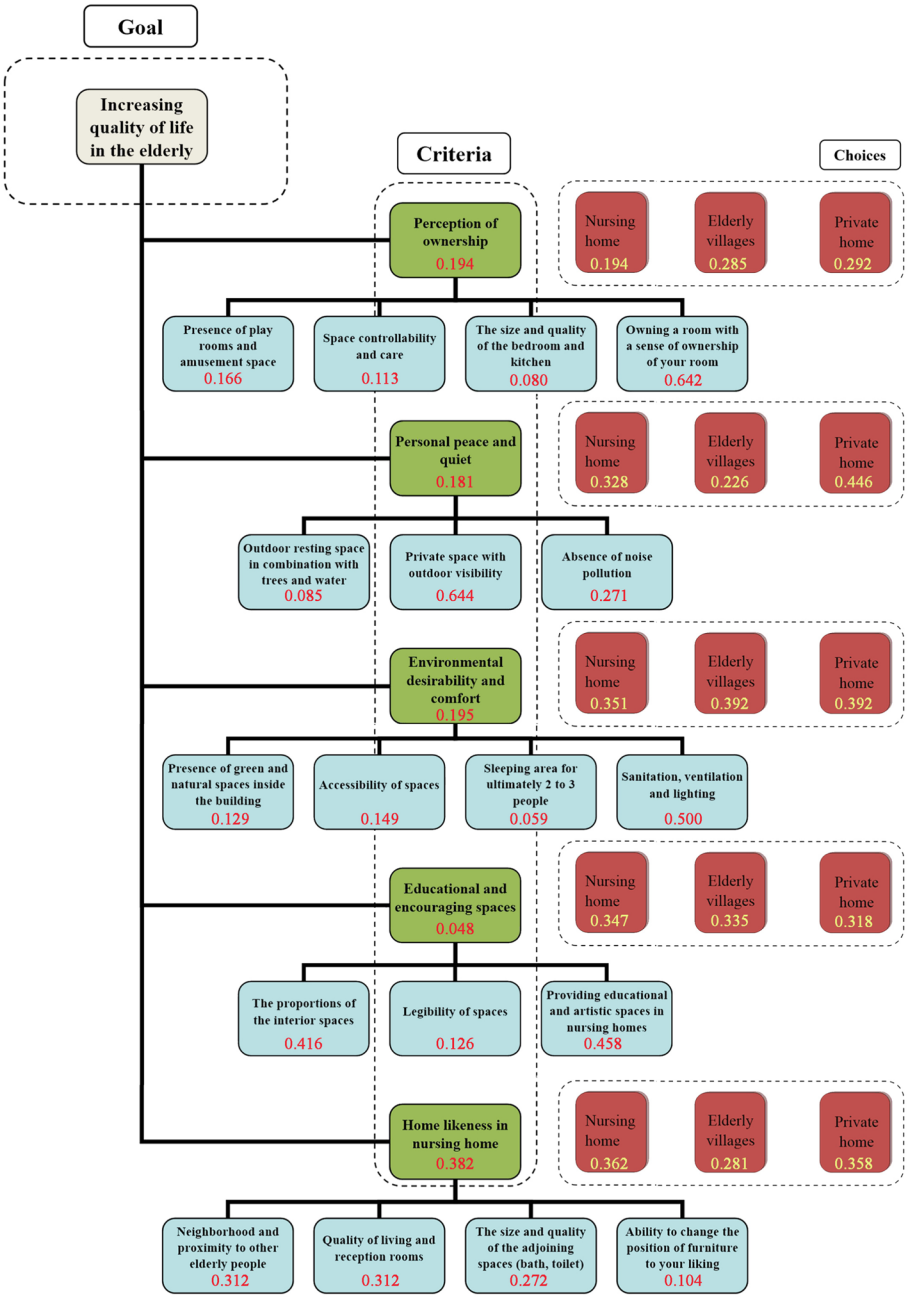

Fig. 8 The hierarchical structure of QOL criteria, sub-criteria and options and their weight vectors

named based on the sub-criteria extracted from the literature review. In other words, the experts endeavored to give a relevant name to a group of sub-criteria which were grouped by factor analysis (Fig. 9).

1 Definition base (sub-criteria group)	2 New Definition	3 Relevant name
Play rooms and amusement space, Space controllability and care, Size and quality, and Owning a room	The way in which a place is regarded as a person's own place with his/her full control of it through the physical or functional features and characteristics provided by the place.	Perception of ownership
Outdoor resting space with trees and water, Private space with outdoor visibility, and Absence of noise pollution	Peace and quiet feelings in a space can be reached through a non-cluttered place (Absence of noise) with a nearby garden (trees and water) which is considered as a private place for resting by the occupant. Experts indicated that in order for people to go to a place for peace and quiet, such characteristics can be identified as an important place characteristics.	Personal peace and quiet
Presence of green spaces inside buildings, Accessibility of spaces, Sleeping area for 20-3 people, Sanitation, ventilarion and lighting	It is mainly related to indoor spaces. The most important characteristic in an indoor space for elderlies is to provide mental and thermal comfort and accessibility, the 'comfort' term was selected. The experts believed that other than considering natural and resting places for the outdoors, a place is needed where a senior could rest and never get tired of being there through the natural environment (Presence of green and natural spaces).	Environmental desirability and comfort
The proportions of the interior spaces fitted to the needs of the elderly, Legibility of spaces, educational and artistic spaces	For the enhancement of the QOL, elderlies might need to be encouraged to have educational spaces. Moreover, the scale of the educational spaces should be proportioned to such activities and the space itself should provide ease with which people understand the layout of a place.	Educational and encouraging spaces
Proximity to other seniors, Quality of living and reception room, The size and quality of adjoining spaces, Ability to change the position of furniture	Mainly related to interior spaces and the elderlies' sense of home is mainly active in the interior architectural space.the criteria should describe the communal indoor space in which elders get the opportunity to get familiar with each other and feel like being with their own family. This feeling could only be induced in the familiar space (Faulkner, 2001).	Home likeness

Fig. 9 Finding relevant criteria for the groups of sub-criteria

For the selection of options to be investigated in terms of the extracted criteria and sub-criteria, the places in which Iranian seniors live should be generally investigated to realize the best and the worst accommodation type regarding the enhancement of seniors' QOL in Iran. Such accommodation types should be investigated whether they fit these identified criteria in an architectural manner, since the identified criteria are considered as architectural solutions. In Iran, there are 3 types of living area for seniors namely, nursing homes, private homes and elderly villages and the experts selected the ones which were located in Tehran. It should be noted that for the elderly village, experts evaluated the one and only village located in the south of Tehran. Since the experts of the study were highly informed about the existing situation regarding the physical built environment of the seniors' living area, it was decided to rank these 3 types of accommodation. Depending on the extent of meeting the identified criteria by these accommodations, the experts selected the option which has addressed a relevant criteria and also the option which has not addressed that criterion. This will not only ascertains the best type of accommodation which addresses the identified criteria in Iran, but will detect the criteria to be addressed in other accommodation types to be improved through the physical built environment.

The results related to criteria and options' consistency showed that inconsistency level in all cases was less than 0.10. An inconsistency rate of at least 0.01 was obtained for educational and encouraging spaces and a maximum value of 0.07 was obtained for the whole criteria. As a result, the scores of pairwise comparison matrices are acceptable, responses are consistent and allocated coefficients are reliable.

After reviewing the inconsistency of judgments, criteria weights were examined. The final weights of the criteria effective on choosing the best type of residence fitting the factors that increase QOL in the elderly are presented in Fig. 8. The final weights of pairwise comparison matrices were determined and the relative weights were obtained by normalizing the columns of the matrices and then the mean rows. The results showed that Home likeness in nursing home had the highest coefficient (0.382) and educational and encouraging spaces with a coefficient of 0.048 had the least important and the smallest coefficient. The results show that the weighting coefficient for home likeness in nursing home is significantly different from that of other criteria; environmental desirability and comfort, personal peace and quiet, and perception of ownership have relatively similar weights, and educational and encouraging spaces has a very small relative weight.

The weights of sub-criteria and options in Fig. 8 show that in the criterion of home likeness of nursing home, the two sub-criteria of quality of living and reception rooms and proximity to other elderly people with a weight coefficient of 0.312 have the highest priority and significance. In the criterion of educational and encouraging spaces, the sub-criterion of educational and artistic spaces has the highest coefficient (0.458). In the environmental desirability and comfort criterion, the sub-criterion of sanitation, ventilation, and lighting has the highest weight (0.500). The most important sub-criterion for the personal peace and quiet criterion is private space with outdoor visibility with a weighting factor of 0.644. With regard to the perception of ownership criterion, the sub-criterion of owning a room with a sense of ownership has the highest significance and priority (0.642).

Based on the results, it can be said that according to the criterion of home likeness in nursing home, the options of nursing home and private home are the best options. It means that in such places, the seniors can change the place of furniture and the size and quality of spaces are acceptable to the seniors living in nursing homes in Tehran. In these places, through home modifications, e.g. the enhancement of accessibility and usability of environments, and also through comfortable and aesthetic spaces in nursing homes, personal and social meaning of home were strengthened.

With regard to the criterion of educational and encouraging spaces, nursing home is the best option. With regard to the criterion of educational and encouraging spaces, nursing home is the best option. According to the experts, nursing homes have educational spaces when they are compared to elderly village and private homes. Moreover, the experts indicated that in such nursing homes, educational spaces provide ease with which the seniors understand the layout of a place.

With regard to environmental desirability and comfort, elderly villages and private homes are the best options. In elderly village of Tehran, there are several large green and natural spaces. Moreover, the sanitation, ventilation and lighting of the rooms are better addressed in elderly villages compared to nursing homes of Tehran.

With regard to personal peace and quiet, private home is the best option. Unfortunately, there are a lack of private place for resting with outdoor visibility for the seniors in nursing homes and elderly villages. According to the experts, the seniors mostly complain about the noise pollution in such living spaces. Therefore, it is necessary to address personal peace and quiet criteria in nursing homes and elderly villages through a non-cluttered place with a nearby garden.

Considering the perception of ownership, nursing home is the best option. According to the experts, in the past, the seniors used to live with their family members. However, nowadays, due to the tendency of children to live separately from their parents, the seniors feel isolated which affects their QOL in a negative way. This feeling of loneliness decreases their perception of ownership towards the private home and changes the meaning of home for them. As a result, this meaning of home influences their decision to move. In this regard, meaning of home, as an element in the process of relocation to another place, can affect the QOL of the seniors in a positive way. Unfortunately, private housing in Iran has not been designed to accommodate the needs of lonely older people in terms of their needs, e.g. accessibility, independence, controllable spaces and etc. Therefore, such evidences lead to the design of suitable nursing homes for seniors to make them regard such places as their own home. Therefore, nowadays, nursing homes can be a best option for the perception of ownership of the seniors.

The final step of hierarchical analysis is to rank the options with respect to the objectives and criteria. The weights of options show that nursing home has the highest (0.365) and elderly village has the lowest coefficient (0.271). The results indicate that the relative weight of the two options of nursing home and private home is roughly the same. It can thus be concluded that the best types of accommodation fitting the factors that increase QOL in the elderly are nursing home and private home (Table 7).

It can be seen through the results of the Tables 6 and 7 that there are some similarities and differences between the rankings given by the elderlies and the ones given by the experts. The two factors of environmental desirability and comfort, and similarity to home space were among the important factors of the seniors' QOL from both respondents' point of view. The educational and encouraging spaces was among the least important compared

Table 7 The result of the final ranking of the options according to the respective points

Options	Relative weight	Options' ranking
Nursing home	0.365	1
Private home	0.364	2
Elderly village	0.271	3

to other factors. However, in spite of the fact that perception of ownership was the least important factor for the elderlies, the personal peace and quiet was considered as one of the least important factor by the experts for the elderlies' QOL. However, since the differences between the weights given by the experts to the factors of perception of ownership (0.194) and personal peace and quiet (0.181), it will not cause any significant contradiction between the overall results of the study.

After statistical analysis and discovering, a justification for the results pertaining to physical environment and QOL of the elderlies are necessary to be offered in this section. Therefore, the relationships between variables, the links between the results and the current literature are articulated in this section.

4.6 Justification of the results

The same as this research which considered 'Educational and artistic spaces' as an important sub-criteria to enhance QOL, Farzianpour et al. (2012), Abbasimoghadam et al. (2009) and Aghamolaei et al. (2010) indicated that QOL was influenced by the factor of education for elders. Salarvand and Abedi (2007) also highlighted the crucial role of nursing home environments in facilitating the elders' successful aging and QOL. This researcher showed that the majority of the seniors under study mentioned sense of being isolated and sense of having no power in making decisions (space controllability), which causes low QOL. Therefore, in this research, the solution of 'proximity to other elderly people' and also 'space controllability' considered to be among the important sub-criteria of the factors of 'Home likeness' and 'Perception of ownership'. Another study results suggest that social networks, such as friends living in close proximity can affect their decision to live in a place (Hansen and Gottschalk 2006). Therefore, it also supports the importance of 'Proximity to other elderly people' for the seniors' QOL.

In this research another criteria which was considered to be important for seniors' QOL was Environmental desirability and comfort as well as the perception of ownership. Golant (2011) and Wagner et al. (2010) also illustrated the importance of older adults' residential comfort and a sense of residential mastery over their lives which highlights the sub-criteria namely, owning a room with a sense of ownership as well as Sanitation, ventilation and lighting.

Barriers within the living place, such as a large house (Stimson and McCrea 2004) can affect seniors' QOL. It has been stated that seniors do not prefer large houses for the reason that such houses can be too large for their needs' (De Decker and Dewilde 2010). This is in line with this research which showed that 'the size and quality of spaces' is among significant sub-criteria for QOL of seniors. Another barriers within the living place which has a significant effect on seniors' willingness to stay in a place is the accessibility (Hansen and Gottschalk 2006). Therefore, the same as this study, it highlighted the importance of 'Accessibility of spaces' sub-criteria for the seniors' QOL.

The similarity of the results with previous researches are indicated in Fig. 10.

These criteria and sub-criteria, which considered to be important for QOL from seniors' perspective, can be considered as an assessment items for elderly living spaces in Iran.

Manser (1989) has addressed the needs of seniors from an architectural perspective, suggesting that a well-designed, well-proportioned building with generous windows and high levels of daylight will improve the QOL of the seniors. Therefore, the mentioned study supports the results of this study regarding the importance of the proportion as well as outdoor visibility and lighting of the spaces for the seniors' QOL. In a research

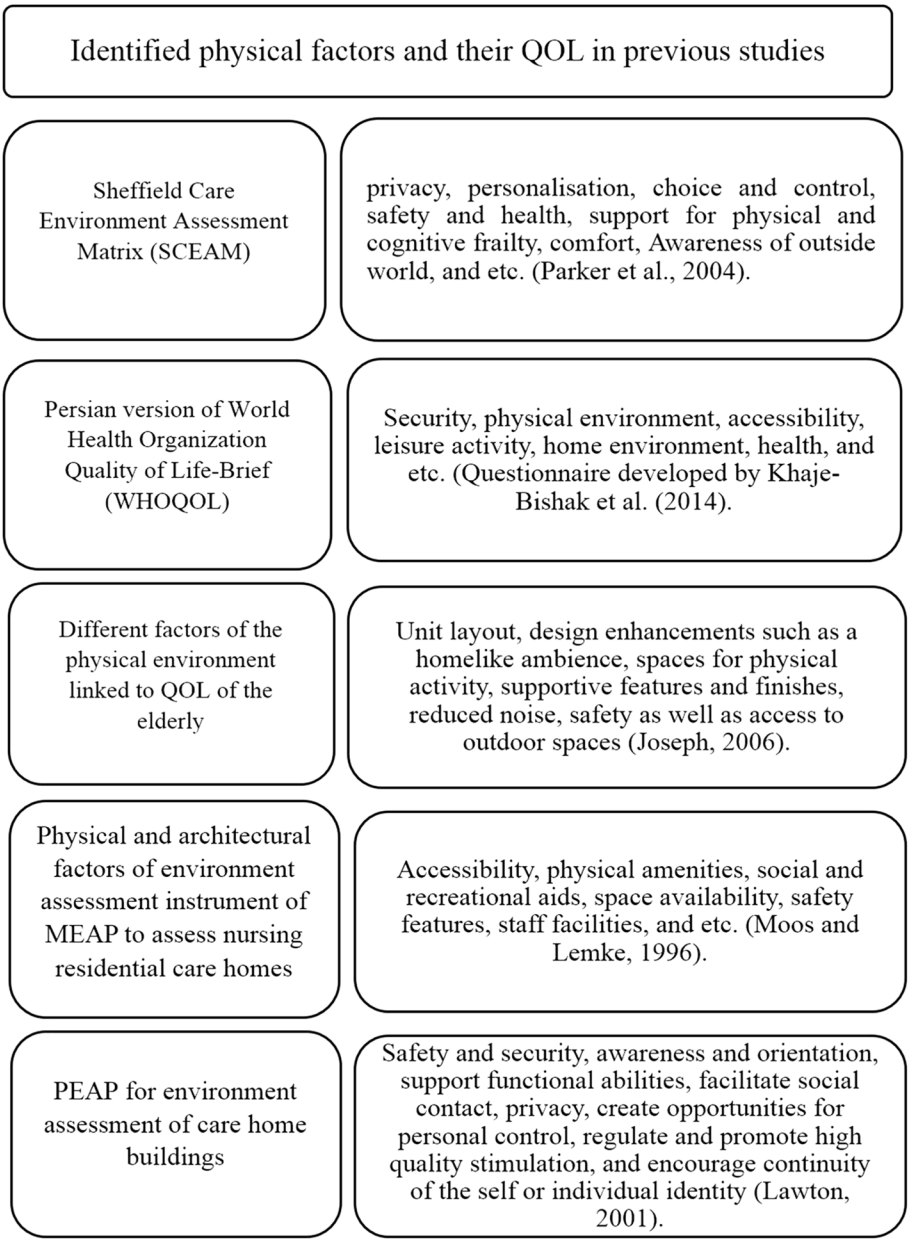

Fig. 10 Significant relationship between the results of this study and previous studies in terms of physical environment factors for seniors' QOL enhancement

conducted by Brawley (2001), a garden and outdoor spaces of the care setting can provide older people with spaces for privacy and activity which can also contribute to an improved QOL. The obtained result from this research shows that Green and natural

spaces (Environmental desirability and comfort) and Private space with outdoor visibility (Personal peace and quiet) have high priority in comparison to the others.

In order for design practitioners and architects of care home buildings to understand these environment-related factors of QOL, the design solutions for seniors' QOL adopted by previous researches can be seen through Fig. 11.

5 Conclusion

The same as previous researches that investigated different domains (environmental, social, and etc.), this study provided an assessment system assessing Iranian seniors' QOL based on the identified criteria and sub-criteria in terms of physical environment of care home buildings in Iran. A system that accords with the preferences and the needs of the elderly from a living place can have a positive impact on the seniors' QOL by meeting their expectancy from an elderly home in Iran. Unfortunately, in Iran, the tendencies of the elderly in terms of the physical environment have not been thoroughly investigated. It should be noted that previous papers conducted in Iran mostly used QOL questionnaires from other countries. However, the culture of the elderly in a country is different from other countries. Therefore, in this study, efforts were made to create a guideline for practitioners to see the entire process from the beginning of the questionnaire design, which is based on the elderly likings, to the final stage, e.g. the prioritization of the factors from the experts' point of view.

Design Solutions	Criteria				
	Educational and encouraging environment	**Environmental desirability and comfort**	**Personal peace and quiet**	**Ownership perception**	**Home likeness**
	• Designing educational, sport and artistic environment, the legibility of spaces, and the proportions of spaces and their compatibility with physical disabilities of seniors • Creating spaces such as solitary and private greenhouse gardens or art and educational workshops where elderly people can work in as a daily job and, while filling their leisure time, take advantage of their practical life experiences to reduce economic problems and enhance their sense of dignity.	• Lighting, ventilation, the presence of sleeping space for 2 to 3 people, sanitation and cleaning of indoor common spaces, easy and convenient access to all spaces and equipment, and the presence of green and natural spaces	• Noise reduction, presence of shadowy trees outside the building, presence of outdoor furniture such as benches and trash bins, indoor space with personal privacy and a good view, presence of fountains, waterfalls and ponds, and the presence of open space resting areas • (Nakajo, 2013) found that natural environments have a positive effect on the elderly with dementia.	• Allocating private bedrooms, quality of bedroom, living space controllability, presence of recreational areas such as chess chamber and entertainment spaces, and the size of kitchen	• The quality of living and reception rooms, the size and the quality of the adjoining spaces (bathrooms and toilets), the ability to change the place of indoor furniture, and proximity to other seniors • Comfort, safety, naturalness of materials, freedom in choosing (Lundgren, 2000). • Availability of personal effects in private rooms, as they reflect the personality of the individual (van Hoof et al., 2016). • Seniors of large apartments introduced furniture as an important option, while residents of small rooms introduced smaller objects such as boards and smaller furniture pieces.

Fig. 11 Design solutions for seniors' QOL adopted by previous researches

This research can be considered as a basis for future studies regarding the implementation of the identified factors in the environment and the measurement of the quality and their degree of impact on the seniors' QOL. Therefore, there is a need for a reference that first establishes a comprehensive framework of the characteristics of the physical environment, which was proven to have a significant impact on the QOL through this study. In fact, the first step in measuring the QOL of the elderly is to find important factors based on the preferences of the elderly and their expectation from the physical environment. Measuring the QOL of seniors based on the factors found in this study, can be considered as a research objective to be implemented more deeply as well as confirming the association between these factors and QOL.

Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest.

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