Development and validation of Elder-Friendly Urban Spaces Questionnaire (EFUSQ)

CURRENT STATUS: ACCEPTED

Azadeh Lak
Faculty of Architecture and Urban Planning, Shahid Beheshti University

Reihaneh Reihaneh Aghamolaei
Faculty of Fine Arts, Tehran University

Hamid Baradaran baradaran.hr@iums.ac.ir
Iran University of Medical Sciences
Corresponding Author
ORCiD: 0000-0002-5070-5864

Phyo K Myint
University of Aberdeen Institute of Applied Health Sciences

DOI:
10.21203/rs.2.11073/v2

SUBJECT AREAS
Geriatrics & Gerontology

KEYWORDS
Older People; Public Space; Age-friendly Environment; Active Aging
Abstract

Background Considering the lack of specific measurement tools to study elders' perceptions in outdoor spaces, the study objectives were to derive and validate a questionnaire that assesses the essential features of elderly-friendly urban spaces.

Methods We used closed-ended questions in two phases. In the first qualitative phase, a preliminary questionnaire was defined using grounded theory. In the second phase, the psychometric properties of the elderly-friendly urban spaces were examined through validity and reliability indices. Results The findings of the first phase led to a preliminary item extraction and questionnaire with 15 major domains based on three dimensions: place function, place preferences, and process. In the second phase, a 48-item questionnaire, based on three dimensions, in addition to personal characteristics, was introduced. Conclusions The Elderly-Friendly Urban Spaces Questionnaire (EFUSQ) can be adopted in various communities in understanding of how to create elder-friendly urban spaces to promote active aging.

Background

The population of older people aged ≥ 65 years is predicted to grow from 524 million in 2010 to approximately 1.5 billion by 2050 in an exponential trend globally (1). A high percentage of this drastic growth is expected to occur in urban areas (2). Studies have revealed the influence of the environment on older peoples’ health, physical activity, and well-being at the neighborhood and public space scales. Hence recent attention has been paid in making public spaces suitable for the active aging and aging in place of the population (3).

Open and green spaces provide social interaction opportunities and generate a sense of community. They also promote social engagement, physical activity, relaxation, and
interaction with nature (4). These places are accessible most of the time for the majority of the public with low cost (5). Research is needed to create valid and reliable tools for assessing age-friendliness of urban places to be used at baseline and follow-up so as to be able to evaluate improvements over time (6). However, a considerable gap exists between research run on age-friendly assessment methods and the evolving local community initiatives (6). Age-friendly studies highlight the importance of local surveys to precisely obtain information and incorporate them into local attributes through the application of grounded approaches (7).

It is, therefore, essential to develop population-specific tools to collect information on older people's expectation of public spaces. The objective of this study is to develop and determine the psychometric properties of a tool for measuring age-friendly urban spaces according to older people's preferences. This step is a critical prerequisite for developing age-friendly urban spaces to promote active aging cities.

Methods

Theoretical Background

According to the guidelines introduced by WHO, an age-friendly city encourages active aging by optimizing opportunities for health, participation, and security to enhance the quality of life (8). WHO has proposed 6 determinants for the concept of active aging in cities: (1) health and social services, (2) behavioral, (3) personal, (4) physical environment, (5) social, and (6) economic determinants (9). "Active aging" is perceived as the desire and ability of older people to integrate physical activity into their daily routines and engagement in economic and socially productive activities (10).

There are many different methods to assess the age-friendliness of urban spaces (6). Current methods of assessing older peoples’ view of the built environment can be categorized into 3 groups. Observational audit tools typically aimed to capture descriptive
and objective data on specific street-level attributes such as presence and qualities. The second method is a well-established tradition of perceived-environment measures through surveys to collect self-reported data (11, 12). Lastly, spatial qualitative methods use a more heterogeneous group of tools, comprising techniques such as photo-voice, walk-along interviews, or virtual reality experiments, as exemplified in a recent review of qualitative studies (11, 12).

The objective of this study was to develop and determine the psychometric properties of the developed questionnaire for measuring age-friendly urban spaces according to older peoples’ preferences. Developing the questionnaire and its validation is done in two phases (Figure 1).

The objective of the first phase was to develop the overall scheme of the questionnaire based on grounded theory (GT) and context characteristics. The extraction and design of the items and phrases of the initial questionnaire consisted of three steps: (1) adopting the GT (qualitative research and extracting appropriate phrases through content analysis technique), (2) conducting desk study and extracting the phrases and (3) designing the initial questionnaire.

The objective of the second phase was to validate the questionnaire developed in phase 1 by assessing the validity of the psychometric characteristics of the questionnaire and assessing reliability through structural validity, split-half analysis, and Cronbach's α coefficient in SPSS 22. Validity analysis was checked by 3 indicators of content, construct, and face validation according to Waltz and Bausell content validity index and Lawshe content validity ratio (13, 14). The study protocol was approved by the Ethics Board of Iran University of Medical Sciences.

**Grounded Theory (GT) and Item Extraction**

The purposeful sampling is used to have maximum variation in the age, sex, literacy,
physical and mental health status, and socioeconomic status with a high presence in neighborhoods' community centers with registered local information in the health department of the community center in Tehran's neighborhoods. Since the participants in the GT study were selected from older people living in Tehran. The inclusion criteria were (1) age over 65 years, (2) local residents in neighborhoods, (3) willing to participate in the study and (4) providing consent.

The interviews were carried out with 54 older participants who were presents in urban outdoors 3-5 times a week. They were chosen from different public spaces such as parks, streets, and squares in different neighborhoods with different socio-economic classes which have active community centres to collect the elders' health information from June and July 2018 (Table 1). The duration of the interviews was 20 to 45 minutes depending on the participant’s level of interest and cooperation (Table 1).

Moreover, a Focus Group Discussion (FGD) with 12 older peoples (7 women and 5 men) among interviewees was held for trustworthiness in the City Council of District 10 in Tehran Municipality in August 2018.

| Feature                                | Participants (n = 54)                      |
|----------------------------------------|------------------------------------------|
| Age group                              |                                          |
| 65-75:28                               |                                          |
| 75-85:26                               |                                          |
| Gender                                 |                                          |
| 29 F                                   |                                          |
| 25 M                                   |                                          |
| Education level                        |                                          |
| Undergraduate:19                       |                                          |
| Graduate:18                            |                                          |
| Postgraduate:17                        |                                          |
| General Health perception(self - reported) |                              |
| Good Health: 24                        |                                          |
| Moderate Health:12                     |                                          |
| Poor Health:18                         |                                          |
| Socio- economic status                 |                                          |
| Middle- High:28                        |                                          |
| Poor- low:26                           |                                          |
During the semi-structured interviews according (Appendix 1), the participants were asked the following questions: How do you like this place to be? What qualities should this place have so that you would want to spend more time in it? The subsequent questions were asked according to the participants’ responses to these two initial open-ended questions. The data were analyzed using Strauss and Corbin's coding supervised method by two people in the research team’s experts (15). The last five interviews and the FGD were conducted after reaching theoretical saturation for more certainty and validity. The credibility of data was assured through peer checking and member checking (16-18). Peer checks were conducted via weekly research team meetings during which the emerging data were discussed and reviewed and analyzed the data among research group. Member checks occurred by providing a summary of the analyzed interviews and extracted codes to participants so the research team could be asked and incorporated their feedback and ideas for corrections. In addition, the quality of public places was appraised through observational field studies by applying the urban design techniques to assess public spaces' qualities for instance Jan Gehl's toolbox (19). Thus, conformability was observed by considering the opinions of other researchers and transferability by fully describing all the stages of the procedure (18).

**Item Finalization**

The relevant literature was reviewed to validate the extracted subcategories. In this process, all of the extracted codes are assessed by similar concepts in the literature of this domain (Table 2).

The extracted items and gathered data from desk study are used to guide item development. The developed questionnaire consisted of three scales: place (functional dimension), place (preferred dimension) and process (environments). All items used in the
questionnaire were locally experienced items by the elder (Table 2).

The questionnaire was initially designed in the Persian language and then checked by two experts in Persian literature to assure cultural appropriateness. In addition, the questionnaire was piloted on a group of 18 older people, and modifications were made prior to the study.

Table 2- This table depicts the extracted items from GT and literature reviewed during phase 1.

| Domains/ Categories | Scales/ Subcategories |
|----------------------|-----------------------|
| Personal characteristics (socioeconomic status) | Age |
|                      | Gender |
|                      | Marital status |
|                      | Occupation |
| Place (functional dimension) | Density |
|                      | Amenities (Access to services) |
|                      | Safety (Traffic) |
|                      | Aesthetics (design) |
|                      | Landscaping |
|                      | Comfort |
|                      | Environmental cleanliness (Visual, air, noise, pollution) |
| Place (preferred dimension) | Security (Crime) |
|                      | Security (Fear of falling) |
|                      | Security (Fear of losing/ wayfinding) |
|                      | Aesthetics (experienced environment) |
| Process (environments) | Social environment |
|                      | Cultural environment |
|                      | Sense of belonging |
|                      | Life satisfaction |

As an initial instrument, the questionnaire of the frequency of use was devised based on a 5-point Likert-type scale (almost always, often, sometimes, seldom, and never) (Table 3). The reasons for selecting this scale were its pivotal role in building the older peoples'
preferences in public spaces and its focus on dynamic interactions between people and the environment (20).

Table 3- This table shows the scales, items, and the number of items presented in the questionnaire.

| Domains                        | Scales                                         | Number of items |
|--------------------------------|------------------------------------------------|-----------------|
| PF: Place (functional dimension) | Density                                       | 9               |
|                                 | Amenities (Access to services)                 | 10,11,12,13,14  |
|                                 | Safety (Traffic)                              | 15,16           |
|                                 | Aesthetics (Objective)                        | 26,27           |
|                                 | Landscaping                                   | 30,31,32        |
|                                 | Comfort                                       | 33,34,35,36     |
|                                 | Environmental cleanness (Visual, air, noise, pollution) | 37,38          |
| PP: Place (preferred dimension) | Security (Crime)                              | 17,18,19        |
|                                 | Security (Fear of falling)                    | 20,21,22,23     |
|                                 | Security (Fear of losing/ wayfinding)          | 24,25           |
|                                 | Aesthetics (Subjective)                       | 28,29           |
| PE: Process (environments)     | Social environment                            | 39,40,41,42     |
|                                 | Cultural environment                          | 43,44           |
|                                 | Sense of belonging                            | 45,46,47,48     |
|                                 | Life satisfaction                             | 49              |

**Questionnaire Validation**

After pilot testing and revisions of the questionnaire, a second pilot test was run on the intended respondents for initial validation among 42 elder people participated in the qualitative phase. After considering validity and reliability, the final version of the questionnaire was given to the specified sample of 350 respondents in two neighborhoods.

**Questionnaires' Validity**

In this section three concepts of content, face, and construct validity are considered to investigate the questionnaire validity.

**Content Validity**
Lawshe’s method was adopted for content validity analysis by calculating the Content Validity Ratio (CVR) (14). The questionnaire items were evaluated by a group of nine experts in landscape architecture, urban design, planning, and gerontology. The experts rated items either as essential, useful, or not necessary. A dichotomy was then devised from the 3-point rating scale into essential, useful, and not necessary. The revised binomial probability distribution for Lawshe’s critical values was applied in excluded items rated as not necessary (21). A scale content validity index (S-CVI) was calculated for each scale by averaging the CVR for all the retained items in the scale (22, 23). If CVI is higher than 0.9, it indicates excellent content validity at the scale level (22).

**Face Validity**

Initially, 18 older people were asked whether there was any ambiguity in items of the questionnaire, and if any, the items were modified. In the quantitative phase, the impact score (frequency in importance) was evaluated by nine experts considering difficulty, inappropriateness, and ambiguity of the phrases. Qualitative face validity was determined by a panel including three urban designers, three urban planners, two gerontologists and one epidemiologist. These specialists evaluated the level of difficulty, inappropriateness, and ambiguity of the phrases. Their comments were used in the questionnaire.

The impact score was calculated for each question to determine the quantitative face validity (Equation 1) (24). For each of the 41 questions, a 5-point Likert scale was used to determine impact score. This scale range included strongly agree (score 5), agree (score 4), no idea (score 3), disagree (point 2), and strongly disagree (score 1). After completing the questionnaire by the target group (by 12 participants of FGD and 9 health expert), the face validity of the item was calculated by using the impact score equation (Equation 1). The impact scores equal to or greater than 1.5 are considered appropriate (25).

**Equation 1:** Impact Score = Frequency (%) × Importance value
Construct Validity

To examine the construct validity and internal consistency of the final questionnaire, a random sample of 350 older people (≥ 65 years old) from different public spaces in the selected district was invited to participate in answering the questionnaire in August and September of 2018. Stratified random sampling is used in this study to improve the representative ness of the sample. The population of the elders is divided into nine neighborhoods with different public spaces called sub-region and random samples are drawn from each of these public spaces (parks, community centres) in sub-regions. The time needed to complete the questionnaire was 30–40 minutes. Construct validity was determined by the Kaiser-Meyer–Olkin (KMO) value. The Bartlett's test of sphericity was used to test the sampling adequacy and the strength of correlations between each scale item, respectively (26).

We applied Partial least squares (PLS) to test the conceptual model. PLS is useful in structural equation modeling for applied research projects, especially when the participants are limited with skewed data distribution (27). To measure the validity in PLS, the 3 indicators of Average Variance Extracted (AVE), Confirmatory Factor Analysis (CFA), and Fornel and Larker methods were adopted (28). Fornel and Larker introduced the AVE criterion in 1981 to measure convergent validity and claimed that the critical number is 0.5. Any output of more than 0.5 indicates acceptable convergence (28). The AVE criterion indicates the shared average variance between any structures and the indices thereof, and the more the correlation, the greater the goodness-of-fit. Convergent validity was applied as the substantial criterion as the goodness-of-fit measuring model in PLS.

Questionnaires' Reliability

We evaluated the reliability of the questionnaire through internal consistent split-half reliability, composite reliability (CR), and item reliability.
**Split-Half & Internal Consistency**

The split-half method as an improvement method is used when it may not be possible to use the same test twice and to get an equivalent form of test especially among older adults (29). The items of a test were divided into two matched halves and, then, the score of the first half questions and that of the second half are calculated (30). The split-half method cannot be applied with heterogeneous questionnaires, as the division of the questionnaire will not yield equivalent forms. In this situation (heterogeneous questionnaires), one may repeat questions throughout the questionnaire, while only the original question is kept in the final form (30).

In this study to divide the measuring instrument into two halves, the correlation coefficient was calculated between scores of odd numbered and even numbered items based on Equation 2. Coefficient $\alpha$ represents the average of all possible split-half estimates.

Equation 2: Reliability coefficient = (Correlation Coefficient * 2) / (Correlation Coefficient + 1)

**Composite Reliability (CR)**

A more up-to-date PLS criterion named “composite reliability” is applied in relation to coefficient $\alpha$, as this criterion is introduced in 1974 (31). Here, the validity is measured in accordance with the correlations within, not in an absolute sense. Accordingly, both of these criteria are applied to measure validity in PLS more accurately. In case the CR volume for each structure is higher than 0.7, appropriate internal stability is assured for the measuring methods (32).

**Item Reliability (Factor Loading)**

Factor loading is calculated through analyzing the correlation values of a structures' indices in PLS. The obtained volume $\geq0.5$ indicates that the variance between the
structure and its indices are greater than its measuring error variance and that the validity of the measuring model is acceptable (33).

Results

**Questionnaires Development**

In the first step, participants' objective and subjective preferences were considered in a psychological process. Statements describing the preferences of older people were extracted from the interviews. At the initial stage, a total of 98 statements were extracted. After assessing contextual overlapping and closeness, they were reduced to 65 concepts, 15 subcategories, and three categories (Table 2 and Appendix 2).

In the next step, the related terms were searched in Google Scholar, Science Direct, Sage, Wiley online, Springer, and Scopus. In total, in this context, 25 measuring tools were found while "Age-friendly Cities Checklist of Essential Features" and "AARP Livable Communities" had the most appropriate statements (8). From these two questionnaires, eight appropriate concepts corresponding to the extracted qualities of the subcomponents were extracted.

Then, we combined all as 73 concepts (65 from the interviews and 8 from the literature review) and were assessed again for closeness, similarities, and relativeness. Factors with conceptual similarity and overlaps were eliminated, reducing the concepts to 40 statements. The environmental properties of the older people were categorized and the questionnaire with a Likert-type scale response was constructed as follows:

Statements in the first person singular, with a true and false response range. For instance, the signs and the buildings' façade in the neighborhood assist me to find my way (strongly disagree, somewhat disagree, neither agree nor disagree, somewhat agree, strongly agree).

Statements in the first person singular, with a range from none to many. For example, the path on the sidewalk from my home to the bus/ subway is comfortable (always, very frequently, rarely, very rarely, never).

Statements in second person singular such as the possibility of seeing friends per week (very high, above average, average, below average, and very low).

Question statements such as how clean is the air and is it good for taking a walk? (Excellent, above
average, average, below average, and very poor).

Finally, a 5-scale questionnaire was developed to assess and validate the temporal stability (always, very frequently, rarely, very rarely, and never) (Appendix 3).

**Questionnaire's Validation**

**Demographic Variables Analysis**

A total of randomly selected 350 older people from public spaces of Tehran 10th municipality region. This region is claimed partially as the highest populated region with the most the elder population in Tehran. According to the low area of residential settlements in this region, the majority of the older adults use neighborhoods' public spaces (34).

Their mean (SD) age was 76.3±9.2 years, and 61.3% of the total participants were male, 73.5% were married, and 27.2% had not finished high school (Table 4).

**Table 4- Summary of participants’ demographic information for the questionnaire validation phase.**

| Variables   | N (%)      |
|-------------|------------|
| Gender      |            |
| Male        | 252 (61.3 %) |
| Female      | 157 (38.4 %) |
| Marital status |        |
| Single      | 17 (4.1 %)  |
| Widow       | 91 (22.1 %) |
| Married     | 302 (73.5 %) |
| Education   |            |
| No literacy | 143 (34.8 %) |
| Lower of diploma | 153 (37.2%) |
| Diploma     | 84 (20.4 %) |
| Academic    | 26 (6.3 %)  |
| Occupation  |            |
| Employed    | 50 (12.1 %) |
| Housewife   | 122 (29.7 %) |
| Retired     | 238 (57.9 %) |

**Questionnaires' Validity**
**Content Validity and Face Validity**

The Lawshe method of content validation was used to validate the questionnaire and showed the content index and validity ratio of 0.82 and 0.79, respectively. According to Lawshe, the minimum acceptable CVR is 0.78 and CVI ≥0.82 (14). However, if a question has a value <0.78 and the mean of judgments >1.50, it is acceptable. Moreover, face validity with the impact score of 1.8 is considered appropriate (Table 5).

Table 5- This table shows the content validity of domains used in the questionnaire
| Domains                                      | CVI (%) | CVR (%) |
|----------------------------------------------|---------|---------|
| Density                                      | 0.81    | 0.7     |
| Amenities (Access to services)               | 0.71    | 0.6     |
| Safety (Traffic)                             | 0.7     | 0.7     |
| Aesthetics (Design)                          | 0.82    | 0.8     |
| Landscaping                                  | 0.89    | 0.7     |
| Comfort                                      | 0.9     | 0.9     |
| Environmental cleanliness (Visual, air, noise, pollution) | 0.95 | 0.9 |
| Security (Crime)                             | 0.92    | 0.9     |
| Security (Fear of falling)                   | 0.95    | 0.9     |
| Security (Fear of losing/ wayfinding)        | 0.75    | 0.7     |
| Aesthetics (Subjective)                      | 0.79    | 0.7     |
| Social environment                           | 0.79    | 0.7     |
| Cultural environment                         | 0.92    | 0.7     |
| Sense of belonging                           | 0.82    | 0.7     |
| Life satisfaction                            | 0.83    | 0.7     |

**Construct Validity:**

The construct validity of all the respondents was analyzed using CFA. To extract the underlying factors, the principal component analysis was run through varimax rotation.
The sampling adequacy and sphericity were tested using KMO and Bartlett's test, respectively. The findings indicated strong significance for Bartlett's test ($x = 9951$ and $p < 0.001$). Moreover, the KMO value was measured to be 0.88, indicating that the correlations among the items of each scale were sufficiently strong for the factor analysis (26, 35).

The AVE and Fornel and Larker methods were applied to measure validity, and the findings are presented in table 6. In this study, the AVE for all variables was more than 0.5, which showed the convergent validity (CV) (Table 6) (26, 35).

Table 6- This table shows the validity of AVE on older people preferences and place attributes.

| Variables               | AVE  |
|-------------------------|------|
| Older people preferences| 0.7844 |
| Place                   | 0.8240 |

As observed in tables 7 and 8, all relationships were statistically significant because of their absolute value, which was less than 1.69. The factor loadings and the path coefficients, >0.4, showed that the analyzed variables had acceptable validity (Table 7 and 8).

Table 7- The factor loading calculated for the subcategories of PF, PP, and PE
| Place Function (PF)          | Density                     | 0.8849 |
|------------------------------|-----------------------------|--------|
|                              | Amenities (Access to services) | 0.8864 |
|                              | Safety (Traffic)             | 0.5679 |
|                              | Aesthetics (Objective)       | 0.5938 |
|                              | Landscaping                  | 0.7277 |
|                              | Comfort                      | 0.6552 |
|                              | Environmental cleanliness (Visual, air, noise, pollution) | 0.6903 |

| Place Preferences (PP)       | Security (Crime)             | -0.2212 |
|------------------------------|------------------------------|---------|
|                              | Security (Fear of falling)   | 0.6091  |
|                              | Security (Fear of losing/ wayfinding) | 0.3721 |
|                              | Aesthetics (Subjective)      | 0.5368  |

| Place Environment (PE)       | Social environment           | 0.743   |
|------------------------------|------------------------------|---------|
|                              | Cultural environment         | 0.7908  |
|                              | Sense of belonging           | 0.4175  |
|                              | Life satisfaction            | 0.5111  |

Table 8- The results of factor loadings and path coefficient for the place and older people preferences and three dimensions of PF, PP, and PE

| Path coefficients (factor loading) |
|------------------------------------|
| PLACE -> Older peoples' preferences | 0.548 |
| PF -> Older peoples' preferences   | 0.315 |
| PF -> Place                        | 0.576 |
| PE -> Older peoples' preferences   | 0.578 |
| PP -> Older peoples' preferences   | 0.276 |
| PP -> Place                        | 0.503 |

The third method for assessing validity is Fornell - Larker's method, which analyzes convergence validity. Results showed that the AVE value for the main matrix diameter was more than its lower number of the main dimension, thus convergent validity was
confirmed (28) (Table 9).

Table 9- This table shows the discriminant validity of Fornell-Larcker test for the main domain of the questionnaire

|                          | Older people preferences | Place   | PF      | PE      | PP      |
|--------------------------|--------------------------|---------|---------|---------|---------|
| Older people preferences | 1                        | 0       | 0       | 0       | 0       |
| Place                    | 0.8753                   | 1       | 0       | 0       | 0       |
| PF                       | 0.8639                   | 0.9272  | 1       | 0       | 0       |
| PP                       | 0.7414                   | 0.9052  | 0.697   | 0.4703  | 1       |
| PE                       | 0.8887                   | 0.5655  | 0.5767  | 1       | 0       |

**Questionnaires' Reliability**

The composite reliability (CR) was measured in PLS (Table 10 and 11). Results showed that the Cronbach’s alpha was 0.81, the Spearman-Brown coefficient 0.72, and the Guttman split-half coefficient 0.73, suggesting high stability and internal consistency of the items. In this context, scores were calculated and the correlation between scores for both measurement times was determined using the Spearman correlation coefficient, revealing 0.85 at p < 0.001. As the observed results were less than thus appropriate stability was approved for all variables (Table 10 and 11).

Table 10 - Cronbach Alpha for the extracted dimensions
| Dimensions            | Domains                          | Cronbach alpha (%) |
|-----------------------|----------------------------------|--------------------|
| PF (function)         | Density                          | 0.88               |
|                       | Amenities (Access to services)   | 0.87               |
|                       | Safety                           | 0.75               |
|                       | Aesthetic                        | 0.79               |
|                       | Landscape                        | 0.87               |
|                       | Comfort                          | 0.91               |
|                       | Cleanness                        | 0.95               |
| PP (preference)       | Security (crime)                 | 0.87               |
|                       | Security (Fear of falling)       | 0.87               |
|                       | Security (Fear of getting lost)  | 0.88               |
|                       | Aesthetic (Image)                | 0.84               |
| PE (environment)      | Social Environment               | 0.78               |
|                       | Cultural Environment             | 0.90               |
|                       | Sense of Belonging               | 0.90               |
|                       | Life Satisfaction                | 0.81               |

Table 11- Reliability indicator tested for older people preferences and place attributes

| Variables               | Cronbach's α | CR     |
|-------------------------|--------------|--------|
| Older people preferences| 0.725        | .879   |
| Place                   | 0.786        | .903   |

Discussion

This study reported the development and validation of an older people-friendly public space tool as a measure based on the perceived and preferred outdoor urban environment in a special context. This type of instrument fills important research and implementation gaps to define the older people needs and expectations of active living. The study highlighted that this developed tool would be suitable for the assessment of public spaces based on adults' preferences.

Results of the present study indicate that public spaces evaluation scale incorporate density, amenities (access to services), safety aesthetic (design), landscaping, comfort, cleanness, security (from crime), security (fear of falling), security (fear of getting lost),
aesthetic (image), social environment, cultural environment, sense of belonging, and life satisfaction. These indicators are useful in assessing the older peoples’ perception of age-friendly environments in urban neighborhoods in Tehran.

Public places are important for older people’s health and thus it is important to understand which aspects of built and social environments are essential in improving the use of public spaces with the view of promoting active aging and aging in place. Creation of age-friendly active living cities has increasingly been recognized as an important health policy strategy and require robust new methods that are suitable for intersectoral actions and transdisciplinary approaches (36). Implementation of such methods promotes the participation of adults in public spaces and their involvement in urban planning and design (37).

The scales and dimensions for all the constructs measured in the questionnaire met the standard criteria for excellent content validity (22). CVR and CVI validity indices were in line with the existing literature (38). The results of construct validity revealed an appropriate correlation between extracted items; however, the multidimensionality of different scales was observed. The observed dimensions or subscales were in parallel with the content of the urban design guidelines examined. The experiences about density, amenities (access to services), safety (traffic), aesthetics (design), landscaping, comfort, and environmental cleanness (visual, air, noise, pollution) were measured through place function dimension. Adherence to security (crime), security (fear of falling), security (fear of losing/wayfinding), and aesthetics (image) was evaluated using place preference scale. Social environment, cultural environment, sense of belonging, and life satisfaction were measured using process scale. Also, age, gender, marital status, occupation, and education were measured using person statues scale (38, 39).

The findings are compatible with those of previous studies, as all of those attributes that
can compromise the basic qualities of public spaces are partially dependent on characteristics of the physical environment. However, they are also influenced by “soft” aspects of the environment and can significantly add or detract from the incentives and subjective experience of a particular public space. Furthermore, the findings of this study fit well with the 4 main features of Pikora conceptual framework for assessing environmental determinants of active travel functionality, safety, aesthetics, and destinations, and reviews (40).

WHO defines age-friendly outdoor spaces as public spaces that have the following criteria: clean and pleasant; sufficient green spaces and landscape; well-maintained and safe; well-maintained pavements; free of obstructions; non-slip pavements; comfortable for wheelchairs; accessible and safe design for traffic and pedestrians at intersections and pedestrian crossings; street lighting; and police patrols and community education (8). "Livable Communities: An Evaluation Guide" claims that walkable communities improve active aging. The required indicators are designing high-quality sidewalks and their maintenance, traffic signals, pedestrian amenities, safety and security (lighting, sight Lines, eye/ear isolation, entrapment areas, escape routes, sense of ownership/maintenance, and police services) (41).

Analysis of item-to-total correlation confirmed that each item belonged to its corresponding subscale. The internal consistency analysis with Cronbach’s α revealed an acceptable level of internal consistency for the total scales and subscales identified through factor analysis for PF, PP, and PE domains. Although certain subscales have moderate alpha values, the Cronbach’s α, within 0.5 and 0.8 range, has been reported in the literature (38).

Furthermore, the moderate Cronbach’s α for items in each scale or subscale indicates that items are interrelated with little redundancy (42). Thus, each item in each scale measures
something different. The low inter-item correlation indicates lower homogeneity, which is preferable, particularly for application in areas of motivation and personality, and is the case in this questionnaire (42).

In terms of temporal stability, the scores for all the retained items in the different scales and subscales indicated a level of good to excellent stability (43). The results for the temporal stability of the current scales corresponded to the reliability results of the age-friendly public spaces of WHO checklist and livable communities (6, 44).

Age-friendly community initiatives have excellent opportunities to combine the advantages of qualitative and quantitative methods to conduct a baseline assessment that is comprehensive and representative of the diverse older adult population. Therefore, this study has provided the first validated psychometric tool for assessing older peoples' preferences in public spaces as age-friendly public places in Iran. The results indicated that the developed scales are valid and reliable to measure the corresponding constructs on a constant basis.

This tool includes items that are interrelated within each scale or subscale, as measured by Cronbach’s $\alpha$ statistic, with little redundancy. This tool measures the type and level of the likability of public places in the older peoples' perspective. Further, it can measure the environmental potential to encourage older people to spend more time in outdoor spaces.

In summary, through analyzing older peoples' experience we have developed tools to measure the possibility and concreteness of age-friendly environment at micro, meso, and macro scales. The extracted components from qualitative studies have led to developing a psychometrical tool to measure the validity and stability of age-friendly public spaces based on the older peoples' experience fit for local communities. We have shown the robustness of this method by systematically examining the validity and reliability thus such methodology can be adopted in various communities in understanding of how best to
create age-friendly urban spaces to promote active aging.

This study, however, has several limitations. First, the questionnaire does not include all the proposed dimensions of the elders' preferences of desired public spaces because of integration of all dimensions could result in developing an instrument with many items, making it very challenging to be applyed for the seniors. Second, the validity and reliability of the questionnaire were tested in only one region in Tehran as known to comodate the highest rate of older adult in Tehran . Therefore, it strongly advises that the generalization of the findings should be done with caution. Third, the sample size was about 350 peolple which is recommended for more than 480 older people to validate this questionnaire. Finally, most of recruited participants in qualitative phase had high education to be more familiar in interviewing process. More studies are required to refine items and generalize the findings to other industries or organizations. In addition, another limitation of this study is that no bias analysis was performed between the participants.

Conclusions

It is conluded that the Elderly-Friendly Urban Spaces Questionnaire (EFUSQ) can be adopted in various communities in understanding of how to create age-friendly urban spaces to promote active aging.

List Of Abbreviations

**AVE**: Average variance extracted

**CFA**: Confirmatory factor analysis

**CR**: Composite reliability

**CVR**: content validity ratio

**CVI**: content validity index

**FGD**: Focus Group Discussion
GT: Grounded Theory

KMO; Kaiser-Meyer- Olkin

PLS: Partial least squares

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

This research was approved by the Iran University of Medical Sciences Ethical Review Board (Ethics Code Number; IR.IUMS.REC.1397.148). All participants agreed to be interviewed in this study and verbal consent was obtained.

Consent for publication

Not applicable.

Availability of data and material

An anonymized dataset is available by request from corresponding author.

Competing interests

The authors declare that they have no competing interests.

Funding

There is no funding in this study.

Authors' contributions

AL and RA carried out interview and focus groups discussion. AL and HRB performed all statistical analyses, interpreted the results, and wrote the paper. PKM contributed to interpret the results and revising the paper. All authors read and approved the final manuscript.

Acknowledgements

All the authors wish to express their gratitude to department of Cultural & Social & affairs located in Distric 10 of Tehran Municipality
References

1. WHO. World Health Organization: World report on ageing and health: World Health Organization; 2015.

2. WHO. Multisectoral action for a life course approach to healthy ageing: draft global strategy and plan of action on ageing and health. World Health Organization: Geneva, Switzerland. 2016:1-37.

3. Yen IH, Fandel Flood J, Thompson H, Anderson LA, Wong G. How design of places promotes or inhibits mobility of older adults: realist synthesis of 20 years of research. Journal of aging and health. 2014;26(8):1340-72.

4. Yung EH, Conejos S, Chan EH. Social needs of the elderly and active aging in public open spaces in urban renewal. Cities. 2016;52:114-22.

5. Pleson E, Nieuwendyk LM, Lee KK, Chaddah A, Nykiforuk CI, Schopflocher D. Understanding older adults’ usage of community green spaces in Taipei, Taiwan. International journal of environmental research and public health. 2014;11(2):1444-64.

6. Dellamora MC, Zecevic AA, Baxter D, Cramp A, Fitzsimmons D, Kloseck M. Review of assessment tools for baseline and follow-up measurement of age-friendliness. Ageing International. 2015;40(2):149-64.

7. Yung EH, Conejos S, Chan EH. Public open spaces planning for the elderly: The case of dense urban renewal districts in Hong Kong. Land use policy. 2016;59:1-11.

8. WHO. Global age-friendly cities: A guide: World Health Organization; 2007.

9. Kalache A, Gatti A. Active ageing: a policy framework. Advances in gerontology=Uspekhi gerontologii. 2003;11:7-18.

10. Michael YL, Green MK, Farquhar SA. Neighborhood design and active aging. Health & place. 2006;12(4):734-40.
11. Paisana-Morais V, Bispo S, Encantado J, Carvalho C. Acessibilidade pedonal percebida em maiores de 65 anos: instrumento de avaliação. Psicologia, Saúde & Doenças. 2014;15(1):25-35.

12. Almeida MF. Age-Friendly Walkable Urban Spaces: A Participatory Assessment Tool. Journal of Housing For the Elderly. 2016;30(4):396-411.

13. Waltz CF, Bausell BR. Nursing research: design statistics and computer analysis: Davis FA; 1981.

14. Lawshe CH. A quantitative approach to content validity 1. Personnel psychology. 1975;28(4):563-75.

15. Corbin J, Strauss A, Strauss AL. Basics of qualitative research: sage; 2014.

16. Beck CT. Qualitative research: The evaluation of its credibility, fittingness, and auditability. Western journal of nursing research. 1993;15(2):263-6.

17. Lincoln YS. Emerging criteria for quality in qualitative and interpretive research. Qualitative inquiry. 1995;1(3):275-89.

18. Schwandt TA, Lincoln YS, Guba EG. Judging interpretations: But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. New directions for evaluation. 2007;2007(114):11-25.

19. Gehl J, Svarre B. How to study public life: Island press; 2013.

20. Mohammadi E, Allahyari T, Darvishpoor Kakhaki A, Saraei H. Determining Psychometric Properties of Iranian Active Aging Measurement Instrument. Iranian Journal of Ageing. 2018;12(4):414-29.

21. Ayre C, Scally AJ. Critical values for Lawshe’s content validity ratio: revisiting the original methods of calculation. Measurement and Evaluation in Counseling and Development. 2014;47(1):79-86.

22. Polit DF, Beck CT. The content validity index: are you sure you know what's being
reported? Critique and recommendations. Research in nursing & health. 2006;29(5):489-97.

23. DeVon HA, Block ME, Moyle-Wright P, Ernst DM, Hayden SJ, Lazzara DJ, et al. A psychometric toolbox for testing validity and reliability. Journal of Nursing scholarship. 2007;39(2):155-64.

24. Neuendorf KA. The content analysis guidebook: Sage; 2016.

25. Lacasse Y, Godbout C, Series F. Health-related quality of life in obstructive sleep apnoea. European Respiratory Journal. 2002;19(3):499-503.

26. Pett MA, Lackey NR, Sullivan JJ. Making sense of factor analysis: The use of factor analysis for instrument development in health care research: Sage; 2003.

27. Wong KK-K. Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. Marketing Bulletin. 2013;24(1):1-32.

28. Fornell C, Lacker D. Evaluating structural equation modeling for travel behavior research. Transportation research part B, University of Michigan. 1981;37:1-25.

29. Smith G, Del Sala S, Logie RH, Maylor EA. Prospective and retrospective memory in normal ageing and dementia: A questionnaire study. Memory. 2000;8(5):311-21.

30. Del Greco L, Walop W, McCarthy RHJCCMAJ. Questionnaire development: 2. Validity and reliability. 1987;136(7):699.

31. Werts CE, Linn RL, Jöreskog KG. Intraclass reliability estimates: Testing structural assumptions. Educational and Psychological measurement. 1974;34(1):25-33.

32. Nunnally J, Bernstein I. Psychometric Theory McGraw-Hill New York Google Scholar. 1978.

33. Rivard S, Huff SL. Factors of success for end-user computing. Communications of the ACM. 1988;31(5):552-61.

34. Rashedi V, Asadi-Lari M, Foroughan M, Delbari A, Fadayevatran R. Prevalence of
disability in Iranian older adults in Tehran, Iran: A population-based study. Journal of Health and Social Sciences. 2016;1(3):251-62.

35. Lak A, Aghamolaei R, Azizkhani E. From segregation to integration of new developments in historic contexts: Rural texture in Iran. Journal of Settlements and Spatial Planning. 2018;9(1):59-66.

36. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. Annu Rev Public Health. 2006;27:297-322.

37. Buffel T, Phillipson C, Scharf T. Ageing in urban environments: Developing ‘age-friendly’cities. Critical Social Policy. 2012;32(4):597-617.

38. Ruza J, Kim JI, Leung I. Sustainable, age-friendly cities: An evaluation framework and case study application on Palo Alto, California. Sustainable Cities and Society 2014;14(1).

39. Annear M, Keeling S, Wilkinson T, Cushman G, Gidlow B, Hopkins H. Environmental influences on healthy and active ageing: a systematic review. Ageing & Society. 2014;34(4):590-622.

40. Pikora T, Giles-Corti B, Bull F, Jamrozik K, Donovan R. Developing a framework for assessment of the environmental determinants of walking and cycling. Social science & medicine. 2003;56(8):1693-703.

41. Pollak PB. Liveable communities: An evaluation guide: AARP Washington, DC; 1999.

42. Panayides P. Coefficient alpha: interpret with caution. Europe’s Journal of Psychology. 2013;9(4):687-96.

43. Fleiss JL. Design and analysis of clinical experiments: John Wiley & Sons; 2011.

44. Kano M, Rosenberg PE, Dalton SD. A Global Pilot Study of Age-Friendly City Indicators. Social Indicators Research. 2017:1-23.
Appendices

Appendix 1 - Survey questions in phase 1

1. Gender
2. Education level
3. Income level
4. Address (as in neighborhood only)
5. How frequent do you visit public places?
6. How much time approximately do you spend on each visit?
7. What makes this place special or likable?? If likable why?
8. Why do you like this place?
9. What do you like about this place?
10. What needs to be improved?
11. What are the contributions of the visiting public spaces to your life?

Appendix 2 - Concepts and Subcategories of Age-Friendly Public Spaces by Interviewees

| Category: Place | Preference Dimension | Category: Process |
|-----------------|----------------------|-------------------|
| Functional Dimension | Preference Dimension | Social Dimension | Cultural Dimension | Sense of Belonging | Life Satisfaction |
| Low density | Green space | Social | Segregated | Keep old | Sense of home |
| Proper walking path | Plant and water | interaction | space for | memories | Filling yard |
| Sanitary service | Tree | Friends and | female and | Old habits | Sense of home |
| Closeness to home | Cosines | next of kin | male | Friendly | Social capital |
| Easy commute to and from home | Openness | Social wealth | Segregate | relations | Sense of home |
| Appropriate urban furniture | Spatial variety | (good people) | space for older peoples and | Social relations | Sense of home |
| Safety traffic signs | Past memories | Foreigner hater | house pets | | |
| Establish library for the older people | Traditional design and old moments | No street vendors | | | |
| Chess game | Sense of richness in hearing | Home space satisfaction | | | |
| Indoor space Protection from cold | Presence of artists, poet, Iranian idioms | | | | |
| Sporting equipment | Public memories | | | | |
| Safety | (sticking to old names) | | | | |
| Security | Need for space | | | | |
| Relatively low aesthetics | | | | | |
| Need for space to sit | Legibility |
|----------------------|------------|
| Need for a hangout   | Not falling Pavement |
| Need for environmental comfort | Security |
| Need for illuminate (Natural or artificial) | Familiarity |
| Need for cleanness | No crime |
| Need for tidiness | No theft |
| Need for law and order | No graffiti |
| Need for calmness | No incivility |
| Need to be safe from possible harms due to children’s play | Easy to wayfinding |
| Noise pollution (non-traffic) | Order and symmetric design |
| Need to separate older peoples’ zone from the children’s game yards | Good pavement |
| Noise pollution | No slippery Surface |
| Need for proper pavement, not slippery | No nuisance |
| Civic misdemeanor, improper behavior | |
| Civic misdemeanor, motor-bike in the park | |
| Civic misdemeanor, having pets in the park | |
| Need for security (without a police) | |
| Need for security (due to presence of too many rascals) | |
| Need for security (too many open access ways) | |
| Need for security (its generality) | |
| Need for security (for the health of animals in | |
Need for small
convenient stores
Face lifting the old
buildings
Need for parking
Weakness in service
Need for sporting and
training equipment
Need to reduce the slops
Need to disperse the
drug addicts
Need for arbor
Need for traffic control
Need to control the
Youths

### Appendix 3- Older people-Friendly Public Space Questionnaire

|   |   |   |   |
|---|---|---|---|
| 1 | Age |   |   |
| 2 | Marital status | Single | widowed | Married |
| 3 | Education level | Illiterate | lower than High school | Diploma | University |
| 4 | Monthly expenses |   |   |   |
5. Occupation: 1-Employed, 2-Housewife, 3-Retired

6. How long have you lived in this neighborhood?

7. Address: Ave., St., Alley?

8. Why did you choose this neighborhood for living?

9. The congestion in the streets and public spaces prevent my walk.
   - Never
   - Rarely
   - Sometimes
   - Very often
   - Always

10. Access to the store, bank, mosque, pharmacy, clinic from my home is an easy walk.
    - Never
    - Rarely
    - Sometimes
    - Very often
    - Always
|   | Description                                                                 | Never | Rarely | Sometimes | Very Often | Always |
|---|------------------------------------------------------------------------------|-------|--------|-----------|------------|--------|
| 11. | Access to path to bus-stop and metro-station is easy.                       |       |        |           |            |        |
| 12. | There are sufficient and clean public sanitary services in the green space of the neighborhood. |       |        |           |            |        |
| 13. | The neighborhood streets have sufficient sidewalks for pedestrians.         |       |        |           |            |        |
| 14. | There is only one park and green space close to my house.                   |       |        |           |            |        |
| 15. | The speed of motor bikes and automobiles in the streets and cross roads of the neighborhood is low, thus walking is safe. |       |        |           |            |        |
| 16. | The pedestrian signs, street lines, and lights are helpful.                 |       |        |           |            |        |
|   |                                                                 |   | Never | Rarely | Sometimess | Very often | Alwmys |
|---|----------------------------------------------------------------|---|-------|---------|-----------|-----------|----------|--------|
| 17. | The streets of the neighborhood are well-lit.                   |   |       |         |           |           |          |        |
| 18. | The lighting in the neighborhood’s green space is sufficient.  |   |       |         |           |           |          |        |
| 19. | The public and green space here is safe and there are no drug dealers. |   |       |         |           |           |          |        |
| 20. | The street and green space sidewalks are smooth with no cracks or holes. |   |       |         |           |           |          |        |
| 21. | The sidewalks’ slopes are acceptable.                           |   |       |         |           |           |          |        |
| 22. | The sidewalks are not slippery, and thus are appropriate and safe. |   |       |         |           |           |          |        |
| 23. | The width of the sidewalks is appropriate for                    |   |       |         |           |           |          |        |
|   |   |   |   |
|---|---|---|---|
|   | pedestrians. |   |   |
| 24. | The billboards and the façade of the buildings help me to find my way in the neighborhood. | Never | Rarely | Sometimes | Very often | Always |
| 25. | I am familiar with the public spaces here and find my way easily. | Never | Rarely | Sometimes | Very often | Always |
| 26. | The neighborhood’s public green spaces are neat and beautiful. | Never | Rarely | Sometimes | Very often | Always |
| 27. | There are new and beautiful buildings here. | Never | Rarely | Sometimes | Very often | Always |
| 28. | The tall buildings make the neighborhood look boring. | Never | Rarely | Sometimes | Very often | Always |
| 29. | The green spaces are cozy and refreshing. | Never | Rarely | Sometimes | Very often | Always |
|   |   |   |   |   |
|---|---|---|---|---|
| 30. | The streets and green spaces are provided with clean and comfortable urban furniture. | Never | Rarely | Sometimes | Very often | Always |
| 31. | The drinking water units, arbors, and recreational facilities in the public and green spaces are sufficient and accessible. | Never | Rarely | Sometimes | Very often | Always |
| 32. | The green spaces of the neighborhood are full of trees, flowers, and fountains. | Never | Rarely | Sometimes | Very often | Always |
| 33. | The green spaces for children are separate from those of the older peoples. | Never | Rarely | Sometimes | Very often | Always |
| 34. | There are some shady sections in the open space to prevent extreme sunshine and cold. | Never | Rarely | Sometimes | Very often | Always |
| 35. | The municipality maintains the good quality of the greenery in the park, streets, and sidewalks. | Never | Rarely | Sometimes | Very often | Always |
|   | The municipality is responsible for maintaining the greenery and furniture in the park. | Never | Rarely | Sometimes | Very often | Always |
|---|-----------------------------------------------------------------|-------|--------|-----------|------------|--------|
| 36. | The air quality and temperature are fair here for taking walks. | Never | Rarely | Sometimes | Very often | Always |
| 37. | The sidewalks and public spaces are clean with no garbage, thus there is no bad odor. | Never | Rarely | Sometimes | Very often | Always |
| 38. | The public green space is the place for meeting friends. | Never | Rarely | Sometimes | Very often | Always |
| 39. | In the public green space people behave in a polite manner. | Never | Rarely | Sometimes | Very often | Always |
| 40. | The neighborhood residents are helpful and assist one another. | Never | Rarely | Sometimes | Very often | Always |
|   |   |   |   |   |
|---|---|---|---|---|
| 42. | People in my neighborhood take part in religious ceremonies. | Never | Rarely | Sometimes | Very often | Always |
| 43. | In the public green space, the house pets like cats and dogs do not disturb older peoples. | Never | Rarely | Sometimes | Very often | Always |
| 44. | Space separation for men and women contribute to more comfort of the older peoples. | Never | Rarely | Sometimes | Very often | Always |
| 45. | I admire my neighborhood and I will not live it. | Never | Rarely | Sometimes | Very often | Always |
| 46. | I have many great memories of this neighborhood. | Never | Rarely | Sometimes | Very often | Always |
| 47. | The green space makes me feel as comfortable as my own back yard. | Never | Rarely | Sometimes | Very often | Always |
| 48. | People participate in protecting and cleaning the | Never | Rarely | Someti... | Very often | Always |
public spaces of their neighborhoods.

49. My home is comfortable to live in with adequate space.

Figures

![Diagram of questionnaire development process](image)

**Figure 1**

This diagram shows the process of questionnaire development including identification and validation phases.
