Ebrahimi Pour S. et al.
May 2026
Urban Economics and Planning
Volume 7, Issue 2

Analyzing the realization of spatial justice in the indicators of an age-friendly city: a case study of mashhad

Saleh Ebrahimi Pour[1], Katayoon Alizadeh[2*], Mohammad Ali Ahmadian[3]

1. Ph.D. Candidate, Department of Geography, Ma.C., Islamic Azad University, Mashhad, Iran
2. Associate Professor, Department of Geography, Ma.C., Islamic Azad University, Mashhad, Iran
3. Assistant Professor, Department of Geography, Ferdowsi University, Mashhad, Iran

Case Study

Received: 2025/10/15
Revised: 2025/10/30
Accepted: 2025/10/31

HOW TO CITE THIS ARTICLE
Ebrahimi Pour S. Alizadeh K. Ahmadian M. A. Analyzing the realization of spatial justice in the indicators of an age-friendly city: a case study of mashhad. *Urban Economics and Planning* 7(2):122-141.

DOI: 10.22034/uep.2025.553328.1746

Abstract

With the growing elderly population, the realization of spatial justice in the distribution of urban services has become an increasingly necessary imperative. This research was conducted to measure spatial justice in the indicators of an age-friendly city in Mashhad. This descriptive-analytical study was conducted with the participation of 405 adults aged 60 and above. Data were collected using the standard WHO questionnaire and field observations, and were analyzed using ANOVA and GIS. The findings revealed significant spatial inequality. The mean satisfaction scores for physical indicators, including open spaces (3.85), public buildings (3.62), and housing (3.56), were significantly higher than those for social-supportive indicators such as social respect and inclusion (2.42), transportation (2.49), and social support and health services (2.52). Spatial analyses identified districts 7, 8, 9, and 13 as privileged, and districts 1, 3, 4, and 6 as deprived. Cluster mapping pinpointed central and southern areas as hotspots requiring urgent intervention. Differences in the expectations of the elderly also influenced their assessments; the elderly in affluent areas expressed lower satisfaction, while those in deprived areas reported higher satisfaction. This indicates that quantitative and spatial tools alone are insufficient, and combining them with qualitative data is essential for a deeper understanding of spatial justice. Overall, the study's results emphasize that achieving spatial justice in Mashhad requires multifaceted interventions, including the development of open spaces, improvement of public transportation, enhancement of health-social services, and the strengthening of social participation and inclusion for the elderly.

Keywords

Age-Friendly City
GIS
Mashhad
Quality of Life of the Elderly
Spatial Justice

* Corresponding Author: k.alizadeh@iau.ir

1. Introduction and problem statement

In recent decades, the growing elderly population worldwide, especially in developing countries, has become a significant urban and social challenge, described as a "global urgency" (Salmistu & Kotval, 2023; Jelokhani-Niaraki et al., 2019). Predictions suggest that by 2025, roughly 10% of the global population will be over 60 years old, increasing to more than 2.1 billion by 2050 (United Nations, 2024; WHO, 2025a). In line with this trend, the World Health Organization in 2024 emphasized the integration of the needs of older adults into the Sustainable Development Goals (World Health Organization, 2024; Van Hoof et al., 2025). The United Nations has also introduced the Decade of Healthy Ageing (2021–2030) as a global collaboration (WHO, 2025b; Elisabete Cidre, 2025). These developments, together with rapid urbanization, underscore the need for a fundamental revision in the design of urban environments to meet the needs of the aging population (United Nations, 2019a; Van Hoof & Yu, 2020; Wood et al., 2023).

In response, the World Health Organization (WHO) introduced the concept of the "Age-Friendly City" and its global network, aimed at improving the quality of life and creating environments where the elderly can stay active and healthy (WHO, 2007; Wiles et al., 2012; Greenfield et al., 2023). Achieving this goal, however, requires a focus on "spatial justice," with an emphasis on fair distribution of urban services and resources across all city areas (Soja, 2009; Fainstein, 2014). Accordingly, an age-friendly city must not only demonstrate positive indicators but also ensure their equitable distribution across all levels.

Within this context, Mashhad, as Iran's second metropolis and home to the Razavi Shrine, faces notable challenges. The city's elderly population grew from 202,000 (7.3%) in 2011 to 253,000 (8.2%) in 2016 (Mashhad Municipality, 2016; Tash Consulting Engineers, 2006), and migration of the elderly to Mashhad is also increasing. Nonetheless, field evidence indicates an unequal distribution of urban services, resulting in serious issues such as social isolation, limited access to health services, inadequate transportation, and a lack of green spaces in certain neighborhoods. Despite plans such as the Age-Friendly City Bill and initiatives within the Mashhad Comprehensive Plan (Alizadeh et al., 2013), there is little evidence of comprehensive and effective measures addressing spatial inequalities. Most previous research has focused on the "existence of indicators," neglecting their "spatial and equitable distribution" (Buffel & Phillipson, 2016; Biggs & Carr, 2015). This knowledge gap highlights the need for a spatial and justice-oriented approach in Mashhad, leading this study to focus on the spatial distribution of key indicators.

Aging is a natural stage of human life marked by gradual physical, psychological, and social changes (Purjafar & Montazerolhajeh, 2010). Biologically, this involves physiological and psychological shifts leading to a decline in capabilities (Manafifar et al., 2020). However, in the 21st century, aging is no longer seen solely as a biological process but as a complex socio-spatial construct. While the traditional approach of the World Health Organization (WHO, 2020) defines aging based on chronological age indicators, critics such as Levine (2013) argue that these indicators fail to reflect the real lived experiences of older adults. The biological reductionism in defining aging is evident in purely demographic classifications (Fathi, 2020) and age-based categorizations (Farrel, 1990; Brunner & Suddarth, 1988).

Conversely, a new paradigm views aging as a multidimensional process where biological, psychological, and social dimensions interact dynamically within spatial environments (Nikpour & Hasanakizadeh, 2020). This shift underpins the "Age-Friendly City" concept, emphasizing that aging is not purely a biological reality but a phenomenon whose experience is heavily influenced by the social, cultural, and spatial conditions of each society (Ameri et al., 2002; Roberts, 2021). Furthermore, the feeling of aging is subjective and influenced by individual conditions, which can impact the quality of life of older adults (Esther et al., 2016). Attention to these multiple dimensions facilitates the elderly's active participation in social, economic, and cultural processes, helping to prevent their exclusion.

The approach to health and disease prevention was established by WHO in the early 1960s, leading to the creation of the "Healthy City" movement in 1986 (Saberifar, 2020; Seyedjavadi & Pakfar, 2021). As aging populations grew rapidly, the WHO introduced the "Age-Friendly City" concept in 2005 and established its global network in 2010, to which over 533 cities across 37 countries joined by 2017 (WHO, 2020; Flores et al., 2019). The COVID-19 pandemic further prompted the declaration of the "Decade of Healthy Ageing 2021–2030" (WHO, 2020). According to WHO, an age-friendly city is one where services and infrastructure are designed to meet the needs of the elderly, promoting "active aging" through health, participation,

and safety (Phillipson & Buffel, 2016; Kumar, 2016). In this framework, an age-friendly city is essentially a city for all residents (Kiaie et al., 2019). In 2007, WHO identified eight key domains for these cities, expanding to nine indicators in 2022 with the addition of "Financial Situation" (WHO, 2007; WHO, 2022).

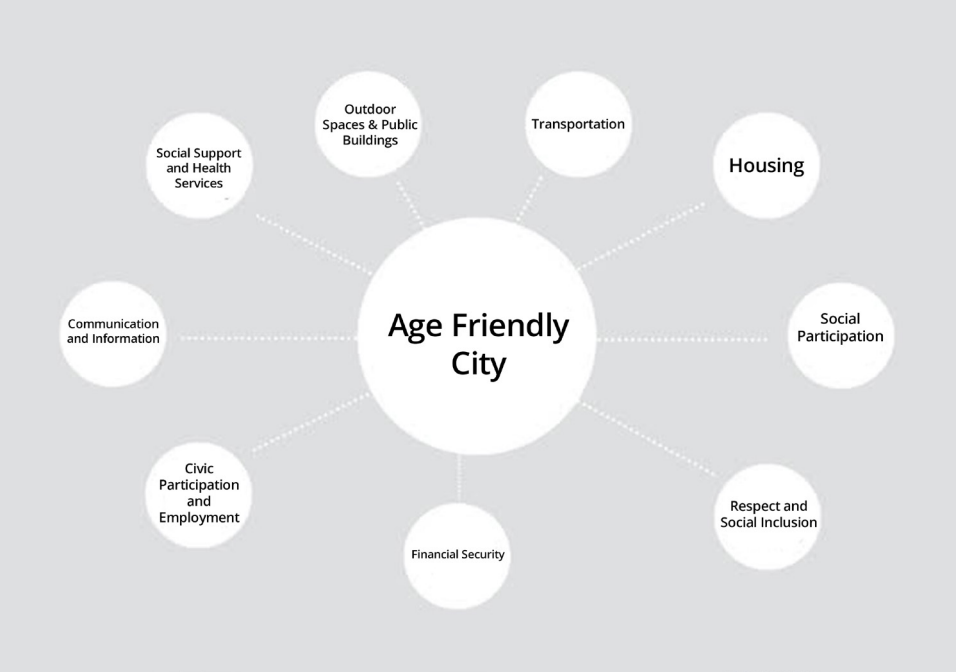

Figure 1. Key domains of an age-friendly city (WHO: 2022)

Although the WHO framework (2007, 2022) has taken an important step in standardizing age-friendly city indicators by introducing 9 key domains, this model faces several theoretical challenges:

1. Universalism vs. Localization: The WHO model, by emphasizing global indicators, often neglects contextual and cultural differences in the experience of aging. As studies in Iranian cities show, the spatial distribution pattern of the elderly population and their needs exhibit unique characteristics that do not fully align with global patterns.

2. Static vs. Dynamic: The existing classification overlooks the dynamic evolution of the elderly population's needs over time, while researchers highlight the necessity of a "dynamic age-friendly ecosystem" adaptable to generational changes and social transformations.

3. Quantitative vs. Qualitative: The excessive focus on quantitative indicators ignores the qualitative and perceptual dimensions of the aging experience. Numerous studies have shown how mixed-methods approaches can reveal the gap between objective data and the subjective perception of the elderly.

To assess the status of cities, WHO released a guide in 2015 emphasizing three core principles: equity, accessibility, and inclusiveness (Rémillard-Boilard, 2020). Evaluation methods include standard questionnaires and analysis of statistical data (Rosenberg et al., 2009), international secondary data (Heart, 2010), the specialized AFCCQ tool (Dikken et al., 2020), GIS analysis for service distribution (Jelokhani-Niaraki et al., 2019), and participatory approaches involving the elderly (Shorabeh et al., 2019). This combination offers a comprehensive view of how age-friendly cities are (Buckner et al., 2019). Several theoretical models have also been developed: the "Good Urban Planning for Aging" model focusing on the built environment (Chao, 2018), the "Age-Friendly Ecosystem" model highlighting multi-sectoral interaction (Fulmer et al., 2020), and novel models such as the "Smart Age-Friendly Ecosystem" and the "Smart CASE Ecology" model centered on technology (Marston & van Hoof, 2019; van Hoof et al., 2021). The executive process of this framework is designed in a five-year cycle, covering planning, implementation, evaluation, and continuous improvement. Countries such as Canada have also developed specific rural adaptations (Kendig et al., 2014).

Overall, the concept of an age-friendly city extends beyond urban policy to foster a fair, inclusive, and

responsive environment. Despite some criticisms (Buffel & Phillipson, 2016), evidence indicates this approach can improve quality of life, promote social participation, and enhance spatial justice. Technologies such as digital health and smart transportation are crucial in bridging spatial and social gaps (van Hoof et al., 2021). These challenges suggest that to truly realize an age-friendly city, efforts must integrate the WHO framework with a spatial justice approach.

Spatial justice refers to the equitable distribution of resources and services across a geographical area, meaning that all individuals, regardless of their residence, have equal access to healthcare, green spaces, public transport, and cultural facilities (Soja, 2010; Fainstein, 2010). Originating from social justice theories in the 1980s, this concept advocates for equal treatment for all residents, regardless of their residence (Laurent, 2011; Meshkini et al., 2014), and can be examined from both distributive and procedural perspectives. The distributive dimension focuses on the equitable distribution of services in geographical space (Dadashpour et al., 2015; He, 2020), while the procedural dimension focuses on participation and capacity-building in planning processes (Dadashpour & Alvandipour, 2018).

The theoretical framework of spatial justice (Soja, 2010; Fainstein, 2010) offers a strong analytical perspective that complements the WHO model and itself warrants further development. Transitioning from distributive to procedural justice is especially important, as many studies only examine how services are distributed spatially, whereas a procedural approach emphasizes the mechanisms that produce inequality. Social and economic disparities lead to spatial segregation (Hataminejad et al., 2014); in this context, spatial justice reveals the link between space and social justice (Hafeznia et al., 2015). Spatial inequalities are both a result of and a contributor to social inequalities. Recognizing spatial justice is vital for safeguarding the citizenship rights of vulnerable groups, especially the elderly, as equal access to social and medical infrastructure increases their sense of peace and life satisfaction, reducing the risk of social crises (Hafeznia et al., 2015; Rostaei et al., 2020). Conversely, severe inequalities foster a sense of social injustice (Hataminezhad et al., 2008).

This research's theoretical framework combines the paradigms of the age-friendly city and spatial justice. This synthesis addresses the WHO model's gap regarding spatial distribution and the neglect of aging-specific needs in spatial justice theories. The core elements of this integrated framework include equitable distribution of urban services, spatial access to facilities, and the procedural participation of the elderly, ultimately leading to the realization of the "Just Age-Friendly City." Spatial justice is directly linked to the concept of the age-friendly city; realizing the nine indicators of these cities is only possible when services and new technologies are distributed equitably (Buffel et al., 2012). Geographers emphasize the role of housing, education, and employment opportunities as key factors shaping spatial justice (Kang et al., 2025). Additionally, perceptions of justice are relative, shaped by individual situations and values (Souche et al., 2012), and can strengthen citizens' participatory behaviors (Ebrahimpour et al., 2015). Ultimately, spatial justice ensures that the elderly across the city can access essential services and engage actively in society.

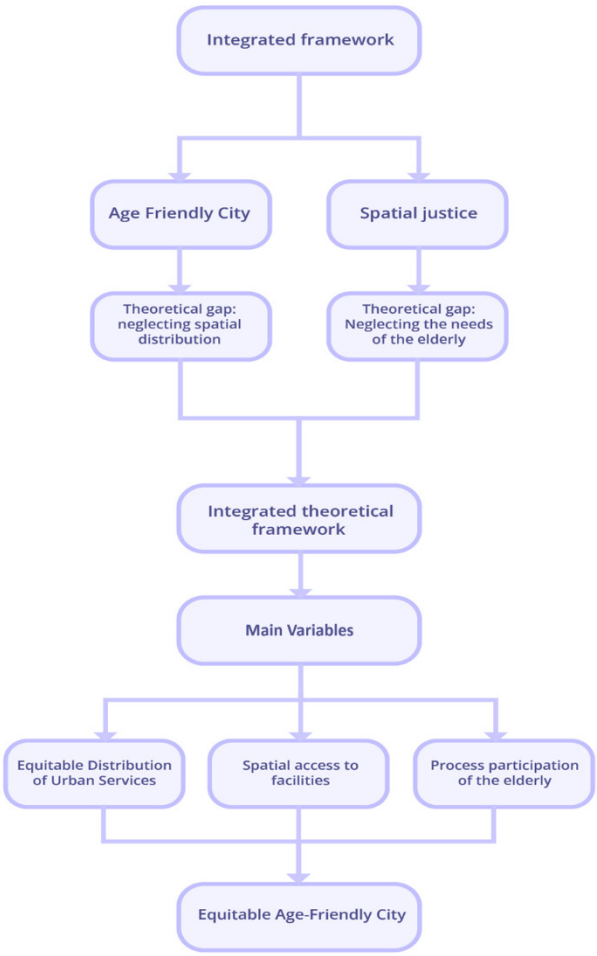

Figure 2. Research theoretical framework

The main objective of this study is to measure and analyze spatial justice in the distribution of age-friendly city indicators across the 13 districts of Mashhad. The findings aim to provide a solid foundation for prioritizing and allocating resources in urban policy-making. Other objectives include measuring the satisfaction level of the elderly with physical and social-supportive indicators, identifying spatial patterns using GIS, and analyzing significant differences between districts. To practically achieve these objectives, the central research questions have been formulated as follows: What is the pattern of spatial distribution of indicators and the extent to which spatial justice is achieved in the districts of Mashhad? Additionally, how can the satisfaction of the elderly and regional differences in this regard be assessed? Based on these questions and considering the literature, the research hypotheses are presented as a testable framework: 1) The existence of inequality and spatial injustice in the distribution of age-friendly city indicators among the districts. 2) The existence of a significant difference in the satisfaction level of the elderly between different districts. This logical chain from objectives to hypotheses provides a clear path for empirical testing and achieving practical results.

In the following, the theoretical foundations, research method, findings, discussion, and conclusion are presented.

2. Literature review

In recent years, spatial justice has been recognized as a key component in realizing age-friendly cities. Global studies indicate that urban planning must incorporate social and spatial justice, in addition to responding to the needs of the elderly, to enable independent and dignified living (Buffel et al., 2024). Bernardini (2024) considered population aging a novel challenge for spatial justice, highlighting the need to create fairer spaces. Case studies in countries such as Romania and Beijing reported an uneven distribution of elderly services (Ivan et al., 2020; Wang et al., 2020), while

Stearns et al. (2020) demonstrated the positive effect of the quality of public spaces and transportation on satisfaction of the elderly in Ohio. Recent studies suggest that service quality alone is insufficient, and the equitable spatial distribution of them in neighborhoods is the main condition for realizing "age-friendliness" (Greenfield, 2018). In the absence of attention to spatial inequalities, related programs can even exacerbate disparities (Buffel et al., 2020). Furthermore, mixed-methods and co-productive approaches—integrating questionnaires, interviews, and field observations—are effective in revealing the differences between the subjective perceptions of the elderly and objective spatial realities (Doran et al., 2023).

In Iran, attention to the connection between spatial justice and the age-friendly city has also increased in recent years. Shahipour et al. (2020) demonstrated that enhancing spatial justice through urban retrofitting directly correlates with the welfare of the elderly. Pirbabaei et al. (2019) highlighted the unfair distribution of services in District 15 of Tehran. Hosseingholizadeh et al. (2020) used the TOPSIS method to demonstrate that the quality of life of the elderly decreases from north to south in District 6 of Tehran. Izanloo et al. (2021) also emphasized the existence of spatial inequality in age-friendly city indicators. In Mashhad, Resideh et al. (2023) reported an unfavorable status of indicators, such as housing, outdoor spaces, and health services. Finally, Nazmfar et al. (2023) in Babol and Ziari et al. (2024) in Qom highlighted the importance of public spaces and changes in the distribution pattern of the elderly population.

A systematic review of previous research suggests that, despite a pivotal role of spatial justice in enhancing the quality of life of the elderly, the existing literature suffers from several fundamental gaps, including a theoretical gap where most studies have settled for simple relationships between variables and neglected to explain the complex causal mechanisms and multi-level relationships between age-friendly city variables and spatial justice. A methodological gap is also evident, as many studies have solely focused on quantitative methods, overlooking the richness and depth of qualitative data, without employing mixed-methods approaches that could bridge the gap between subjective perception and objective reality. Furthermore, a scalar gap is observed in numerous studies, which have primarily operated at the macro-urban scale and neglected micro-scale analysis at the neighborhood and urban district levels. Particularly in Mashhad, comprehensive studies based on GIS and comparative statistical methods are scarce, and many studies have not fully covered the WHO indicators. This study seeks to fill these gaps through the theoretical synthesis of the WHO framework and spatial justice, and the methodological combination of GIS spatial analyses with advanced statistical tests.

3. Materials and methods

The present study is a descriptive-survey research with practical objectives. The data collection tool was a 48-item questionnaire based on the World Health Organization (WHO) age-friendly city indicators, encompassing ten main domains (Housing, Social Participation, Respect and Social Inclusion, Civic Participation and Employment, Communication and Information, Social Support and Health Services, Outdoor Spaces and Public Buildings, Transportation, and Financial Security). The questionnaire was designed using a five-point Likert scale. After localization and confirmation of content validity by experts, the reliability of the questionnaire was examined. The Cronbach's alpha coefficient was reported as 0.779, which is acceptable.

The statistical population included all elderly individuals aged 60 and over in Mashhad (252,975 people). Based on Cochran's formula, the sample size was determined to be 384 individuals, which increased to 405 considering the stratified sampling design from the thirteen municipal districts and adjusting the design effect. Samples were allocated proportionally to the population of each district, and gender composition was balanced as much as possible. Data were collected through field questionnaires in public places frequented by the elderly (parks, nursing homes, and neighborhoods). The inclusion criteria were 60 years or above, residing in Mashhad, and the ability to respond to the questionnaire.

For data analysis, SPSS software and statistical tests were used: initially, descriptive statistics and normality tests (skewness and kurtosis) were performed. Then, Analysis of Variance (ANOVA) was used to compare differences between urban districts. To examine the spatial distribution of indicators, data were entered into a Geographic Information System (GIS), and analytical maps were prepared to identify spatial patterns and deprived areas.

3.1. Research conceptual model

The conceptual research framework is based on the integration of the World Health Organization's age-friendly city indicators and the spatial justice approach, aiming to identify and reduce spatial inequalities in access of the elderly to urban facilities. The conceptual model presented in this study, unlike previous static models, illustrates the dynamic and multi-level relationships between the variables of the age-friendly city and the indicators of spatial justice. This analytical-dynamic conceptual model, consisting of three parts—input, processing, and output—stands on three fundamental pillars: the interactive relationships between various components, the spatial scaling from macro to micro levels, and the mediating and moderating mechanisms that explain not only the pattern of spatial distribution of indicators but also the processes of production and reproduction of inequalities. The inputs of this model are the nine key domains of the age-friendly city: Outdoor Spaces and Public Buildings, Transportation, Housing, Social Participation, Respect and Social Inclusion, Civic Participation and Employment, Communication and Information, Social Support and Health Services, and Financial Security, which provide the theoretical basis and criteria for measuring spatial justice at the neighborhood level. The processing phase, titled Spatial Justice Assessment, consists of three stages: identifying gaps and inequalities in the distribution of urban services; spatial analysis using GIS for quantitative assessment and mapping of deprived areas; and statistical analysis using methods such as ANOVA and regression to test the significance of differences and discover relationships between indicators. The final output includes evidence-based and location-specific policy suggestions for planners, which can improve the equitable distribution of resources and realize spatial justice for the elderly. This framework, by combining global indicators with quantitative and spatial analyses, creates a bridge between theories and practice in urban planning, enabling evidence-based decision-making. Finally, the analytical review of the research background shows that the relationship between spatial justice and the fulfillment of age-friendly city requirements has been less systematically investigated. This study, by filling the existing gaps in the literature both theoretically and methodologically, paves the way for providing practical, evidence-based solutions grounded in precise spatial-statistical evidence and can significantly contribute to enriching the literature on spatial justice and the age-friendly city in Iran.

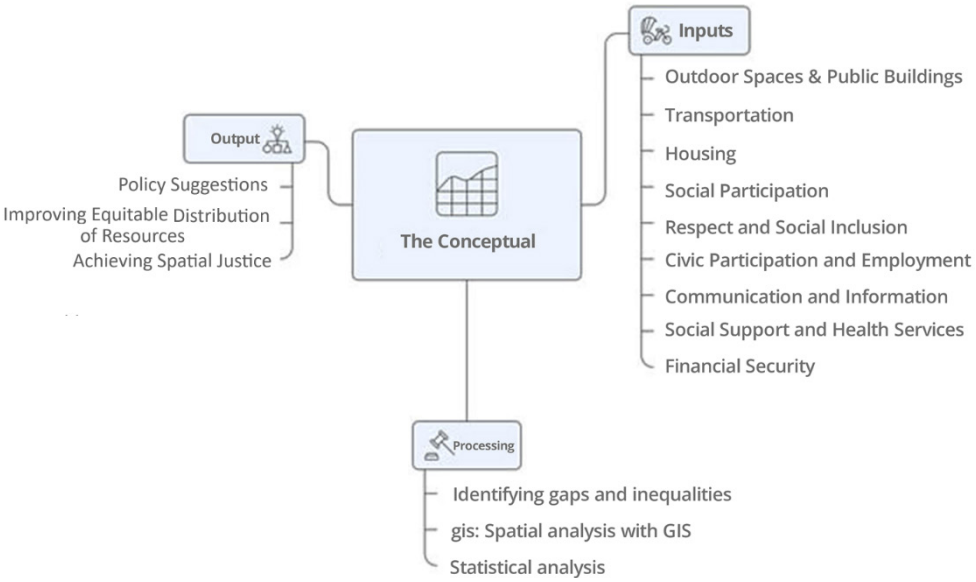

Figure 3. Conceptual research framework: age-friendly city and spatial justice

3.2. Study area

The holy city of Mashhad, the capital of Khorasan Razavi Province, covers an area of approximately 351 square kilometers and is located in northeastern Iran. According to the 2016 census, over 3 million people reside in this city, and its annual number of visitors and pilgrims exceeds 20 million (Mashhad Municipality, 2019). Spatially, Mashhad is divided into 13 districts, which constitute the study area of the present research. (Figure 4)

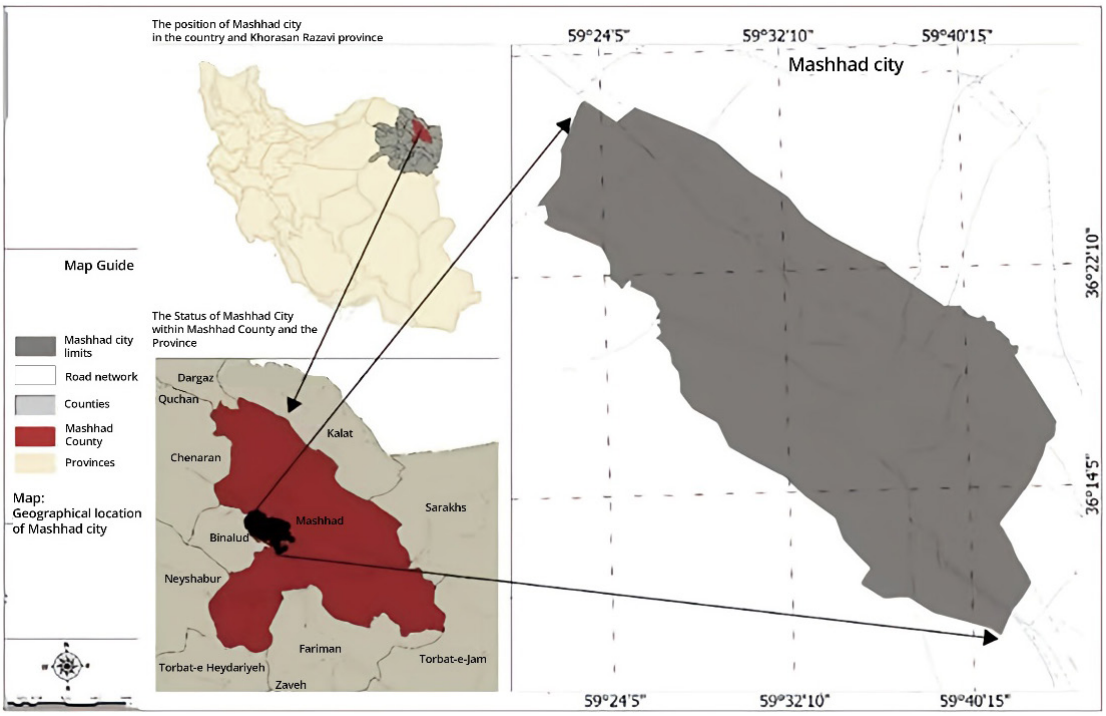

Figure 4. Location of mashhad in political divisions

According to the General Population and Housing Census in November 2011, the population of individuals over 60 years old in Mashhad was approximately 202,000, accounting for 7.3% of Mashhad's total population (Mashhad Municipality, 2016). In the General Population and Housing Census in November 2016, this number reached about 253,000, equivalent to 8.2% of the total population (Mashhad Municipality, 2016). Table 1 shows the growth rate of the population aged 60 and over from 1996 to 2016. As observed in the table, the elderly population of Mashhad, as the first religious metropolis, has experienced significant growth: it increased from 5.7% in 1996 to 8.2% in 2016.

Table 1. Growth rate of the elderly population in mashhad (Mashhad Municipality, 2016)

Year	Elderly Population (60 years and over)	Percentage of Total Population
1996	107,593	5.7%
2006	158,760	6.5%
2011	201,825	7.3%
2016	252,975	8.2%

For the coming decades, a population distribution with density in the middle-aged and then adult groups is predicted. Therefore, it is necessary to accurately examine and forecast the number of middle-aged and adult population groups in Mashhad, and meticulously study their physical, psychological, and other needs, to consider in the ongoing and future plans for urban development and service management.

4. Results

The present research investigated 10 variables from various aspects of urban life as constituent elements of an age-friendly city. In this study, 405 elderly individuals from the city of Mashhad, aged 60 years and above (up to 80 years and over), participated. More than half of them were male (204 individuals, equivalent to 50.4%), and the majority were married (293 individuals, equivalent to 72.3%). Approximately 43% of the elderly had elementary education or literacy training. Furthermore, the findings indicated that most elderly individuals owned their homes (64.4%). Regarding income status, the group with a monthly income between 13 and 15 million Tomans had the highest frequency at 33.3%.

Table 2. Status of demographic variables of the elderly

Variable	Level	Frequency	Percentage
Gender	Male	204	50.4
	Female	201	49.6
Age Group	60-64	112	27.7
	65-69	110	27.2
	70-74	93	23.0
	75-79	79	19.5
	Over 80	11	2.7
Marital Status	Single	5	1.2
	Married	293	72.3
	Widowed	96	23.7
	Divorced/Separated	11	2.7
Educational Status	Illiterate	74	18.3
	Elementary and Literacy Training	174	43.0
	Middle School	98	24.2
	High School Diploma	41	10.1
	Higher Education	18	4.4
Income Status (Million Tomans)	5 to 7	11	2.7
	7 to 9	12	3.0
	9 to 11	44	10.9
	11 to 13	108	26.7
	13 to 15	135	33.3
	More than 15	95	23.5
Housing Status	Owned	261	64.4
	Rented	124	30.6
	Belonging to Relatives	11	2.7
	Nursing Home	9	2.2

According to Table 3, an individual's total score ranges from 48 to 240, and the lower the score, the less satisfied the individual is with the provision and distribution of suitable elderly urban services. All variables hold Cronbach's alpha values above 0.7, indicating the internal correlation of the questions.

Table 3. Measurement variables of the age-friendly city and reliability of variables

Variable	Number of Questions	Maximum Score	Minimum Score
Housing	3	15	3
Social Participation	8	40	8
Respect and Social Inclusion	3	15	3
Civic Participation and Employment	3	15	3
Communication and Information	3	15	3

Variable	Number of Questions	Maximum Score	Minimum Score
Social Support and Health Services	8	40	8
Outdoor Spaces	9	45	9
Public Buildings	4	20	4
Transportation	4	20	4
Financial Security	3	15	3
Total Questionnaire	48	240	48

Table 4 presents the central dispersion statistics of the main research variables, indicating that the highest satisfaction among the elderly is related to Outdoor Spaces, with a mean of 3.849, followed by Public Buildings (3.620) and Housing (3.562), indicating relatively favorable access and quality of these services. Social Participation (3.444) is at an acceptable but improvable level, Financial Security (3.305) is at a relatively suitable level, and Civic Participation and Employment (2.820) are evaluated as relatively limited. Access to Communication and Information (2.621) and Social Support and Health Services (2.523) require improvement, while Transportation (2.486) is in a poor state. The lowest mean belongs to Respect and Social Inclusion (2.416), indicating a serious weakness in this domain. Overall, the highest satisfaction is observed in Outdoor Spaces, and the lowest in Respect and Social Inclusion.

Table 4. Central dispersion statistics (mean and standard deviation) of the main research variables

Variable	Mean	Standard Deviation
Housing	3.562	0.853
Social Participation	3.444	0.453
Respect and Social Inclusion	2.416	0.622
Civic Participation and Employment	2.820	0.805
Communication and Information	2.621	0.716
Social Support and Health Services	2.523	0.807
Outdoor Spaces	3.849	0.641
Public Buildings	3.620	0.703
Transportation	2.486	0.581
Financial Security	3.305	0.787

As evident in Table 5, the skewness and kurtosis coefficients of all studied variables fall within the range (+2 and -2), and the standard error of the skewness and kurtosis coefficients also lies within the range (+2 and -2), indicating the normality of the data. Furthermore, according to the Central Limit Theorem, which states that if the statistical sample size increases (above 30), the distribution of the variable's data will approach a normal distribution, the distribution of data for all variables is normal or at least close to normal. Overall, variables such as Housing, Civic Participation and Employment, Public Buildings, Transportation, and Financial Security are closer to normality. Additionally, variables such as Social Participation and Respect and Social Inclusion show the most deviation from normality but are still acceptable.

Table 5. Skewness and kurtosis test for examining the normality of variable distributions

Variables	Skewness Coefficient	Kurtosis Coefficient	Test Result
Housing	-0.409	-0.263	Normal Data Distribution
Social Participation	-1.016	1.622	Normal Data Distribution
Respect and Social Inclusion	0.592	1.245	Normal Data Distribution
Civic Participation and Employment	-0.252	-0.532	Normal Data Distribution
Communication and Information	0.961	0.376	Normal Data Distribution
Social Support and Health Services	0.345	-0.953	Normal Data Distribution
Outdoor Spaces	-1.004	0.867	Normal Data Distribution
Public Buildings	-0.530	-0.446	Normal Data Distribution
Transportation	0.051	0.758	Normal Data Distribution
Financial Security	-0.504	-0.426	Normal Data Distribution

The results of Table 6 indicate that the status of age-friendly city indicators varies across the districts of Mashhad. The highest mean for Housing belongs to District 9 and the lowest to District 12. Social Participation is highest in District 8 and lowest in District 1. The Respect and Social Inclusion is highest in District 12 and lowest in District 13. The Civic Participation and Employment is highest in District 8 and lowest in District 4. The Communication and Information is highest in District 13 and lowest in District 5. The Social Support and Health Services is highest in District 13 and lowest in District 6. Both Outdoor Spaces and Public Buildings are highest in District 7 and lowest in District 1. The Transportation is highest in District 13 and lowest in District 6. The Financial Security is highest in District 7 and lowest in District 3. Overall, Districts 7, 8, 9, and 13 have a favorable status in most indicators, while Districts 1, 3, 4, and 6 have the weakest status.

Table 6. The mean research variables across different districts

Variables	Municipal Districts												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Housing	3.47	3.63	3.40	3.75	3.71	3.70	3.69	3.44	3.76	3.35	3.55	3.05	3.17
Social Participation	3.31	3.37	3.35	3.42	3.47	3.56	3.57	3.69	3.52	3.40	3.39	3.37	3.50
Respect & Social Inclusion	2.74	2.40	2.52	2.41	2.26	2.19	2.37	2.42	2.31	2.41	2.43	2.79	2.17
Civic Part. & Employment	2.77	2.79	2.97	2.59	2.74	2.65	2.82	3.42	2.71	2.77	2.88	3.17	3.00
Communication & Information	3.07	2.58	2.64	2.63	2.37	2.38	2.57	2.73	2.77	2.45	2.65	3.00	3.17
Social Support & Health Services	2.98	2.41	2.82	2.31	2.34	2.21	2.30	2.67	2.46	2.45	2.79	3.03	3.06
Outdoor Spaces	3.14	3.79	3.73	4.08	3.97	4.12	4.13	3.76	3.96	3.85	3.88	3.40	3.61
Public Buildings	2.96	3.68	3.50	3.58	3.72	3.74	3.91	3.48	3.65	3.76	3.84	3.26	3.63
Transportation	2.68	2.40	2.48	2.54	2.37	2.33	2.53	2.66	2.46	2.35	2.43	2.93	3.25
Financial Security	3.28	3.34	3.07	3.44	3.25	3.56	3.57	3.25	3.46	3.11	3.11	3.08	3.33

The results in Table 7 indicate that district 8 (Samen) has the highest overall mean score of 3.18, making it rank first among the districts. This is followed closely by districts 8 (3.152), 7 (3.146), and 3 (3.148). In contrast, District 10 has the lowest rank with a score of 2.99, while Districts 1 (3.04) and 5 (3.02) follow in the

subsequent ranks. When examining specific indicators, District 7 has the highest score for Outdoor Spaces at 4.13, followed by District 6 (4.12), District 4 (4.08), and District 2 (3.79). District 8 leads in Social Participation with a score of 3.69, and it also ranks highest in Public Buildings with a score of 3.63.

The lowest indicators are as follows: Transportation in Districts 1 (2.68) and 10 (2.35); Respect and Social Inclusion in Districts 8 (Samen) (2.17), 6 (2.19), and 12 (2.79); and Social Support and Health Services in Districts 4 (2.31) and 7 (2.30). Overall, District 8 excels in Social Participation, while Districts 7 and 6 have outstanding performance in Outdoor Spaces. In contrast, District 10 faces challenges in Transportation, and District 8 (Samen) struggles with Respect and Social Inclusion.

Table 7. The status of age-friendly city indicators in different urban districts

District	Overall Mean	Highest Indicator	Lowest Indicator
1	3.04	Housing (3.47)	Transportation (2.68)
2	3.039	Outdoor Spaces (3.79)	Transportation & Respect/Social Inclusion (2.40)
3	3.148	Public Buildings (3.50)	Transportation (2.48)
4	3.075	Outdoor Spaces (4.08)	Social Support & Health Services (2.31)
5	3.02	Outdoor Spaces (3.97)	Respect and Social Inclusion (2.26)
6	3.044	Outdoor Spaces (4.12)	Respect and Social Inclusion (2.19)
7	3.146	Outdoor Spaces (4.13)	Social Support & Health Services (2.30)
8	3.152	Social Participation (3.69)	Respect and Social Inclusion (2.42)
9	3.106	Outdoor Spaces (3.96)	Respect and Social Inclusion (2.31)
10	2.99	Outdoor Spaces (3.85)	Transportation (2.35)
11	3.095	Outdoor Spaces (3.88)	Transportation & Respect/Social Inclusion (2.43)
12	3.108	Outdoor Spaces (3.40)	Respect and Social Inclusion (2.79)
Samen	3.18	Public Buildings (3.63)	Respect and Social Inclusion (2.17)

The provided maps illustrate the status of different districts in Mashhad based on the nine age-friendly city indicators and the financial indicator. Analysis of the maps reveals that for the Housing indicator, northern and northwestern districts have a more favorable status, while southern and southeastern districts are weaker. Social Participation is highest in District 8 and lowest in District 1, whereas Respect and Social Inclusion is relatively better in northern and central districts, and southern and southwestern districts perform weaker. Civic Participation and Employment is highest in Districts 8 and 7 and lowest in Districts 4 and 5. The Communication and Information indicator is highest in District 13 and lowest in District 5. Social Support and Health Services is better in District 13 and weaker in District 6. Outdoor Spaces and Public Buildings have a better status in District 7 and the northwest, while southern and eastern districts show the lowest indicators. Transportation is most favorable in District 13 and weakest in District 6. The Financial Security of the elderly is best in District 7 and weakest in District 3. Finally, the overall Age-Friendly City index is highest in District 8 (Samen) and lowest in District 10. In general, the maps reveal spatial and service inequality: the north and west of the city are better off economically, socially, and in terms of infrastructure, while southern and central districts require more attention for improving the indicators. Furthermore, no district is entirely favorable, and only the basic needs of the elderly population are met.

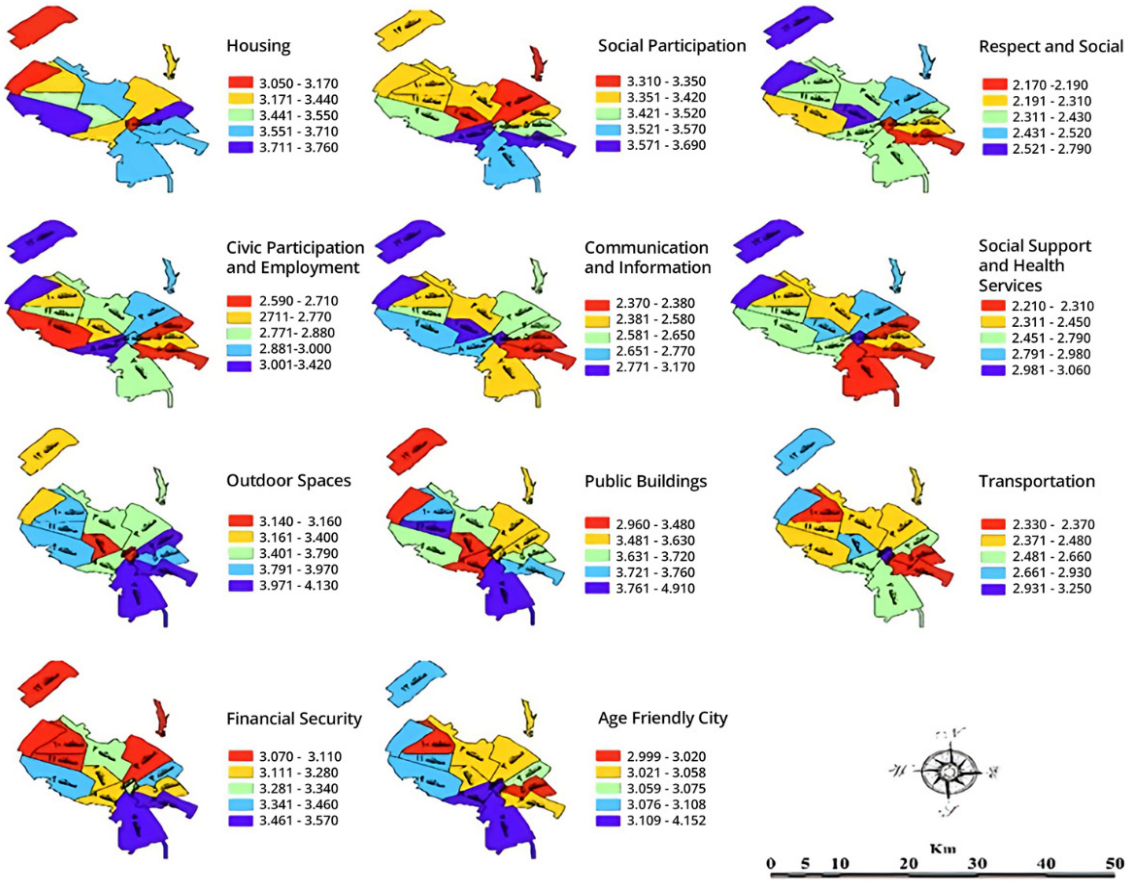

Figure 5. Age-friendly city indicators in different districts of mashhad

Based on Table 8, the ANOVA test for examining the mean differences of the research variables between different districts indicates that some variables show significant differences, while others do not. Variables such as Respect and Social Inclusion (Sig = 0.011), Communication and Information (Sig = 0.001), Social Support and Health Services (Sig = 0.000), Outdoor Spaces (Sig = 0.000), Public Buildings (Sig = 0.000), and Transportation (Sig = 0.003), given their higher F-value and significance level less than 0.05, have a significant difference across the districts, and the null hypothesis is rejected. This indicates that the means of these variables differ significantly across the districts, highlighting the importance of regional policies and planning to address them. In contrast, variables such as Housing (Sig = 0.075), Social Participation (Sig = 0.103), Civic Participation and Employment (Sig = 0.057), and Financial Security (Sig = 0.059) have a significance level higher than 0.05; therefore, the mean difference of these variables across the districts is not significant, and the null hypothesis is confirmed. The variations of these variables across the districts are relatively similar, and no statistically significant difference can be established between them.

In summary, the districts differ significantly in terms of access to and quality of Outdoor Spaces, Public Buildings, Transportation, Social Support, Communication, and Social Respect, while they have approximately similar conditions regarding Housing, Social Participation, Civic Participation, and Financial Security. This pattern of differences can guide the prioritization of interventions and regional policy-making.

Table 8. ANOVA test for examining research variables' means across different districts

Variables	F-value	Significance Level (Sig)	Result
Housing	1.653	0.075	Not Significant
Social Participation	1.552	0.103	Not Significant
Respect and Social Inclusion	2.217	0.011	Significant
Civic Participation and Employment	1.736	0.057	Not Significant
Communication and Information	2.803	0.001	Significant
Social Support & Health Services	3.825	0.000	Significant
Outdoor Spaces	6.593	0.000	Significant
Public Buildings	3.992	0.000	Significant
Transportation	2.514	0.003	Significant
Financial Security	1.727	0.059	Not Significant

Figure 6 (Moran's Diagram) illustrates that the Z-score and P-value are key tools for spatial cluster analysis, determining the type of data distribution across different areas. The analysis of results revealed that the distribution of variables across districts is not random, and significant spatial patterns exist. Z-score values higher than 1.96 with P<0.05 indicate substantial spatial clustering and the concentration of features in certain areas; Z-score values less than -1.96 with P<0.05 indicate significant dispersion and non-uniform distribution of data; and Z-score values near zero (-1.65 to 1.65) and P>0.10 suggest a random distribution and the absence of specific clustering or dispersion. These results emphasize that the Z-score and P-value analysis is an effective tool for identifying areas with concentration or dispersion of variables and can form the basis for decision-making and prioritization of regional interventions in the research.

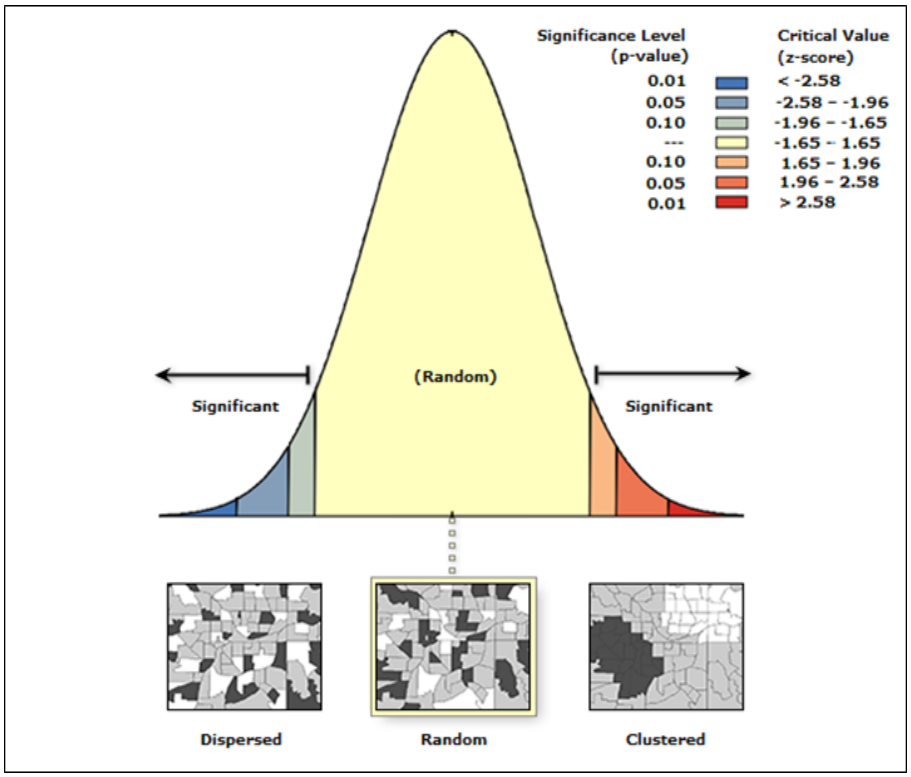

Figure 6. Moran's diagram for spatial cluster analysis

Illustrating the spatial clustering of Mashhad using GI Z-score, Figure 7 categorizes the districts into hotspots and coldspots. Districts with highly negative Z-scores (such as Districts 1, 2, 8, 9, 11, and 12) are identified as coldspots, indicating a low concentration of the studied variable, while districts with highly positive Z-scores (such as Districts 4, 6, 7, and 10) are considered hotspots, showing a high density of the phenomenon. Districts with Z-scores near zero (intermediate and neutral) have a balanced distribution that is neither hot nor cold. Overall, the northern and western districts of the city exhibit a low concentration of the variable and enjoy a more favorable status. In contrast, the southern and central districts show a high density of the studied phenomenon, requiring more attention and interventions. This pattern indicates that the spatial distribution of variables is uneven, and spatial analysis can serve as a foundation for policy-making and regional resource allocation.

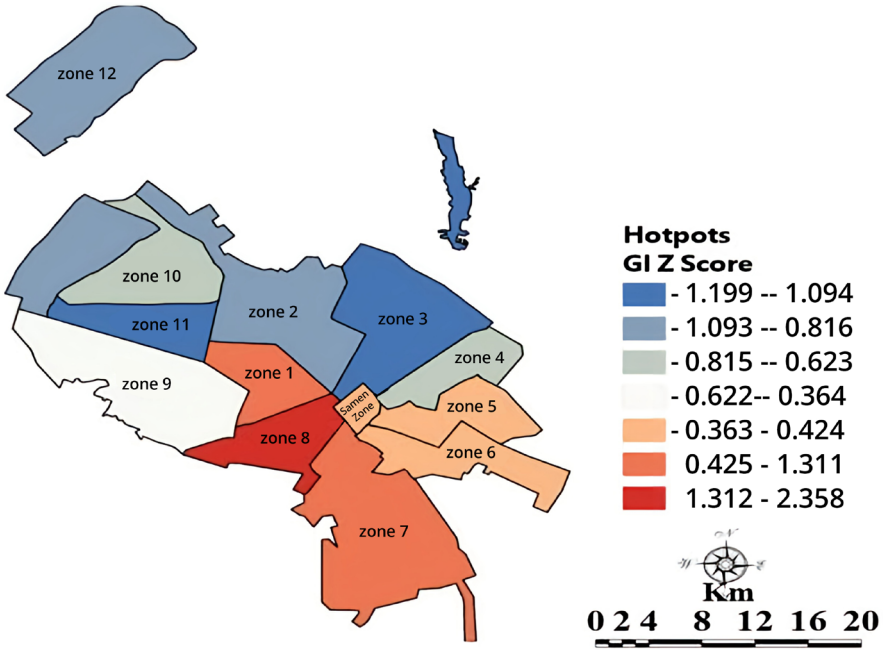

Figure 7. Map of mashhad districts based on hotspots and coldspots

4.1. Examination of research hypotheses:

Hypothesis 1: There is inequality and spatial injustice in the distribution of age-friendly city indicators among the 13 districts of Mashhad.

Data analysis suggests that the mean of indicators varies across the districts; Districts 7, 8, 9, and 13 have a more favorable status, while Districts 1, 3, 4, and 6 demonstrate the weakest status. The hotspot and coldspot map and Moran's diagram also confirm significant spatial patterns, and the ANOVA test reveals that variables such as Respect and Social Inclusion, Communication and Information, Social Support and Health Services, Outdoor Spaces, Public Buildings, and Transportation have significant differences across districts. Therefore, the first hypothesis is confirmed, and spatial inequality exists among the districts of Mashhad.

Hypothesis 2: The satisfaction level of the elderly population with the distribution of indicators differs significantly across districts.

The data indicate that the satisfaction of the elderly with the indicators varies; the highest satisfaction relates to Outdoor Spaces and Public Buildings, and the lowest to Respect and Social Inclusion and Transportation. The mean satisfaction also shows noticeable differences across the districts; Districts 7 and 8 have the highest satisfaction, and District 10 has the lowest. Given the normality of the data, the ANOVA test is applicable, and the results confirm the significance of differences. Therefore, the second hypothesis is also confirmed, and the satisfaction of the elderly population differs across the districts of Mashhad.

Overall, data analysis suggests that spatial inequality and injustice exist in the distribution of age-friendly city indicators in Mashhad, and the elderly's satisfaction with these indicators differs significantly across the districts. The southern and central districts

require attention and service improvements, while the northern and western districts enjoy a relatively favorable status. The results of ANOVA, hotspot and coldspot maps, and Moran's diagram simultaneously confirm these differences and can form a basis for prioritizing regional policies and interventions.

5. Discussion and conclusion

5.1. Discussion and analysis of findings

This research responds to the primary question of the study, focusing on the spatial distribution of age-friendly city indicators and the extent to which spatial justice is achieved in the Mashhad districts. The findings reveal significant spatial inequality in the distribution of indicators across the districts. Physical indicators, including Outdoor Spaces (3.849), Public Buildings (3.620), and Housing (3.562), demonstrate the highest satisfaction levels; while social-supportive indicators, such as Respect and Social Inclusion (2.416), Transportation (2.486), and Social Support and Health Services (2.523), receive the lowest satisfaction scores. Spatial analyses (GIS) confirm a non-random, clustered distribution pattern of the indicators. Accordingly, the northern and western districts (with positive Z-scores) enjoy a more favorable status, while the central and southern districts are identified as "Hot Spots" with high density and an urgent need for resource allocation. The favorable performance of Districts 7, 8, 9, and 13 compared to the unfavorable status of Districts 1, 3, 4, and 6 highlights the imperative for regional planning.

The results of the ANOVA test suggest that the indicators of Outdoor Spaces, Public Buildings, Transportation, Respect and Social Inclusion, Communication and Information, and Social Support and Health Services have significant differences across the districts ($p < 0.05$). These indicators require targeted and regional policy-making. In contrast, indicators such as Housing, Social Participation, Civic Participation, and Financial Security have a more even distribution across the city.

A key finding of this research is the moderating role of the expectations and socio-economic characteristics of the elderly in their assessment of urban services. It appears that elderly residents in privileged districts show lower satisfaction with more stringent criteria, whereas residents in less privileged districts express relatively higher satisfaction despite more limited access. This phenomenon, known in the literature as "Perceptual Differences in Satisfaction with Urban Services", is also confirmed by Wong et al. (2022) in Hong Kong and Karakaya and Dincer (2021) in Turkey. Ozdemir (2024) and Wang et al. (2024) respectively linked this issue to the socio-economic level and the limited options available to the elderly. This explains the gap between quantitative questionnaire data and field reality, highlighting the necessity of employing Mixed Methods, including in-depth interviews and focus groups (Doran et al., 2023), for a comprehensive understanding of the lived experience of the elderly.

In summary, this research indicates that spatial justice in terms of age-friendly city indicators has not been achieved in Mashhad. Realizing this justice requires integrated and multidimensional interventions that prioritize strengthening social-supportive indicators (especially transportation, social respect, and health services) in the deprived central and southern districts. The successful northern and western districts can serve as models, and the active participation of the elderly in the planning process will ensure the effectiveness and sustainability of these interventions.

5.2. Conclusion

Relying on statistical and spatial analyses, this research answered the main question of the study on the "distribution pattern of age-friendly city indicators and the extent of realization of spatial justice in the Mashhad district". The findings demonstrated that spatial justice has not been achieved in the city of Mashhad, and a pattern of structural inequality prevails between the northern-western (privileged) and central-southern (deprived) districts. The deep gap between the acceptable performance of physical indicators (mean: 3.68) and the very poor performance of social-supportive indicators (mean: 2.47) directly responds to another part of the research question, indicating that the main issue is not a shortage of services, but their unfair distribution.

This research is innovative not only due to the integration of quantitative and spatial methods, but also for presenting a "Three-Level Framework for Action" that, for the first time, implements solutions to achieve spatial justice from the metropolitan scale to the neighborhood level.

At the Immediate Strategy Level (6-month deadline): Establishing a "Headquarters for Spatial Justice and Aging" in Mashhad Municipality with the membership of senior managers and representatives of elderly NGOs, launching "Silver Line Bus Routes" with fixed routes to connect deprived central districts to main

service hubs, and constructing "Elderly Service Stations" in critical points as pilots are proposed.

At the Medium-Term Strategy Level (12 to 18 months): Developing a "Budget Allocation Document Based on the Spatial Deprivation Index", implementing the "Neighborhood Elderly Companion Plan" to utilize intra-community capacities, and equipping public buildings in target districts with a "Mandatory Accessibility Package" are essential.

At the Long-Term and Sustainable Strategy Level (3 to 5 years): Creating a "Spatial Justice Development Fund for the Elderly" with a sustainable budget, approving the "Special Plan for the Development of Intergenerational Collective Spaces" in deprived neighborhoods, and integrating the elderly spatial justice indicator into the municipality's "Smart City Monitoring System" for real-time monitoring of changes are proposed.

The realization of these solutions will only be possible under strong political will, transparent governance, and the structured participation of the elderly themselves. This research proves that the problem is not the absolute poverty of resources, but the poverty of equitable distribution, and the proposed framework of action shows the path from identifying the problem to solving it.

Authors' Contributions

The authors contributed to the preparation and compilation of the article as follows:

First Author: Study design, data collection and analysis, and writing the initial draft (50%).

Second Author: Data analysis, revision, and editing of the scientific content (30%).

Third Author: Interpretation of findings and final revision of the article (20%).

Acknowledgments

The present research was conducted without receiving any financial support from domestic or foreign institutions or organizations. We sincerely thank all participants in this study who assisted us in conducting this research.

Conflict of Interest

According to the authors' statements, there is no conflict of interest related to this article.

References

Alizadeh M., Fakhrazadeh H., Sharifi F., Mohammadi Azar M., & Nazari N. (2013). A Review Analysis of the Performance of Responsible Organizations in the Country's Aging Program. *Iranian Journal of Diabetes and Metabolism*, 13 (1): 74–81. [In Persian]

Ameri F., Ghavari F., Nazari T., Rashidinejad M., & Afsharzadeh P. (2002). Definitions and Theories of Aging. *Hayat*, 8 (1); 4–13. [In Persian]

Bernardini, M. G. (2024). Old Age as a "New Frontier" of (Spatial) Justice. *The Age of Human Rights Journal*, 23, e8997. https://doi.org/10.17561/tahrj.v23.8997

Biggs, S., & Carr, A. (2015). Age- and child-friendly cities and the promise of intergenerational space. *Journal of Social Work Practice*, 29 (1), 99–112. DOI: 10.1080/02650533.2014.993942

Brunner, L. S. & Suddarth, D. S. (1988). Textbook of medical-surgical nursing (6th Ed.). Philadelphia: Lippincott.

Buckner, S., Pope, D., Mattocks, C., & Lafortune, L. (2019). Developing Age-Friendly Cities: An Evidence-Based Evaluation Tool. *Journal of Population Ageing*, 12 (2), 203-223. DOI: 10.1007/s12062-017-9206-2

Buffel, T., & Phillipson, C. (2016). Can global cities be age-friendly cities? Urban development and ageing populations. *Cities*, 55, 94–100. https://doi.org/10.1016/j.cities.2016.03.016

Buffel, T., Doran, P., Goff, M., Lang, L., Lewis, C., Phillipson, C., & Yarker, S. (2020). COVID-19 and inequality: developing an age-friendly strategy for recovery in low-income communities. *Quality in Ageing and Older Adults*, 21 (4), 271-279. https://doi.org/10.1108/QAOA-09-2020-0044

Buffel, T., Yarker, S., & Doran, P. (2024). Conclusion: reimagining age-friendly cities and communities. *Reimagining Age-Friendly Communities: Urban Ageing and Spatial Justice*, 143. https://doi.org/10.51952/9781447368571.ch012

Buffel, T., Phillipson, C., &Scharf, T. (2012). Ageing in Urban Environments: Developing age-friendly cities. *Critical Social Policy*. https://doi.org/10.1177/0261018311430457

Chao, T.-Y.S. (2018). *Planning for Greying Cities. Age-Friendly City Planning and Design Research and Practice*. Routledge—Taylor & Francis Group: Abingdon, UK. ISBN 978-0-367-33190-0.

Cidre, E. (2025). Active (and healthy) ageing in the built environment. *Journal of Urban Design*, 30 (2), 141-142. https://doi.org/10.1080/13574809.2025.2471152

Dadashpour H., Alizadeh B., & Rostami F. (2015). Determination of Conceptual Framework from Spatial Justice in Urban Planning with Focus on the Justice Concept in Islamic Schools. *Naqshejahan- Basic studies and New Technologies of Architecture and Planning*, 5 (1); 75-84.Dor: 20.1001.1.23224991.1394.5.1.1.2 [In Persian]

Dadashpour H., & Alvandipour N. (2018). Spatial Justice and Regional Inequality: An Interdisciplinary Systematic Review. *Interdisciplinary Studies in the Humanities*, 10 (3): 79-112. https://doi.org/10.22035/isih.2018.284 [In Persian]

Dikken, J., van den Hoven, R. F., van Staalduinen, W. H., Hulsebosch-Janssen, L. M., & Van Hoof, J. (2020). How older people experience the age-friendliness of their city: Development of the age-friendly cities and communities' questionnaire. *International journal of environmental research and public health*, 17 (18), 6867. https://doi.org/10.3390/ijerph17186867

Doran, P. (2023). A critical reflection on aging in place: including end of life in age-friendly policy. *Innovation in Aging*, 7 (Suppl 1), 120. https://doi.org/10.1093/geroni/igad104.0391

Doran, P. (2023). Using transdisciplinary co-production to gain in-

sights into spatial justice and age-friendly cities. *Innovation in Aging*, 7(Suppl 1), 314. DOI: 10.1093/geroni/igad104.1043

Ebrahimpour D., Javanpour A., & Hosseini Asl V. (2015). The Relationship between Perceived Social Justice and the Level of Citizen Participation in the Development of Tabriz City. *Urban Sociological Studies (Urban Studies)*, 5 (16): 119-141. Retrieved from https://sid.ir/paper/210277/fa [In Persian]

Esther H.K. Yung, Sheila Conejos, Edwin H.W. Chan (2016), Social needs of the elderly and active aging in public open spaces in urban renewal. *Cities*, 52, 114–122. http://dx.doi.org/10.1016/j.cities.2015.11.022

Fainstein, S. (2014). "The Just City." *International Journal of Urban Sciences* 18 (1), 1–18. https://doi.org/10.1080/12265934.2013.834643

Fainstein, S.S. (2010). *The Just City*. Cornell University Press.

Fathi, E. (2020). *The Phenomenon of Population Aging in Iran and Its Future*. Statistical Research and Training Center (SRTC). [In Persian]

Flores, R., Caballer, A., & Alarcón, A. (2019). Evaluation of an age-friendly city and its effect on life satisfaction: A two-stage study. *International journal of environmental research and public health*, 16 (24), 5073. DOI: 10.3390/ijerph16245073

Fulmer, Terry & Patel, Pinkey & Levy, Nicole & Mate, Kedar & Berman, Amy & Pelton, Leslie & Beard, John & Kalache, Alexandre & Auerbach, John. (2020). Moving toward a global age-friendly ecosystem. *J. Am. Ger. Soc.*, 68. DOI: 10.1111/jgs.16675

Greenfield, E. A. (2018). Age-friendly initiatives, social inequalities, and spatial justice. *Hastings Center Report*, 48, S41-S45. DOI: 10.1002/hast.912

Greenfield, E. A. (2018). Getting started: An empirically derived logic model for age-friendly community initiatives in the early planning phase. *Journal of Gerontological Social Work*, 61 (3), 295-312. DOI: 10.1080/01634372.2018.1432736

Greenfield, E. A., Oberlink, M., Scharlach, A. E., Neal, M. B., & Stafford, P. B. (2023). Age-friendly community initiatives: Theory, practice, and future directions. *The Gerontologist*, 63 (1), 1–13. https://doi.org/10.1093/geront/gnac083

Greenfield, E., Pope, N., & Pestine-Stevens, A. (2023). Age-friendly cities and communities: research on local practice to strengthen the movement's future. *Innovation in Aging*, 7(Suppl 1), 103. DOI: 10.1093/geroni/igad104.0334

Hafeznia M. R., Ghadiri Hajat M., Ahmadi Pour Z., Rokn al-Din A., & Gohari M. (2015). Designing a Model for Assessing Spatial Justice, Case Study: Iran. *Spatial Planning and Geomatics*, 19 (1): 33–52. [In Persian]

Hataminejad H., Vahedian Beiki L., & Parnoon Z. (2014). The Spatial Distribution Pattern of Urban Services Measurement in the Fifth Region of Tehran Using Entropy and Williamson Models. *GeoRes*, 29 (3):17-28. http://georesearch.ir/article-1-341-fa.html [In Persian]

He, S. Y. (2020). Regional impact of rail network accessibility on residential property price: Modelling spatial heterogeneous capitalization effects in Hong Kong. *Transportation Research Part A: Policy and Practice*, 135, 244-263. https://doi.org/10.1016/j.tra.2020.01.025

Heart, U. (2010). Urban health equity assessment and response tool. World Health

Hosingholizade A., Jelokhani M., Mahsa N., & Hajilo F. (2020). Spatial Analysis and Evaluation of Urban Spaces from the Elderly-Friendly City Perspective (Study Area: District 6 of Tehran, Iran). *Geographical Urban Planning Research (GUPR)*, 8 (2); 371-389. DOI: 10.22059/jurbangeo.2020.295771.1215 [In Persian]

Ivan, L., Beu, D., & Van Hoof, J. (2020). Smart and age-friendly cities in Romania: An overview of public policy and practice. *International Journal of Environmental Research and Public Health*, 17 (14), 5202. DOI: 10.3390/ijerph17145202

Izanloo M., Basakha M., Mohaqeqi Kamal S. H. (2021). Spatial Justice in the Age-Friendly City Index of Tehran. *Joge*, 6 (2); 19-29. URL: http://joge.ir/article-1-477-fa.html [In Persian]

Jelokhani-Niaraki, M., Hajiloo, F., and Samany, N. N. (2019). A Web-Based Public Participation GIS for Assessing the Age-Friendliness of Cities: A Case Study in Tehran, Iran. *Cities*, 95, 102471. http://dx.doi.org/10.1016/j.cities.2019.102471

Kang, L., Liu, C., & Ma, X. (2025). How does geographical environment affect residents' perception of social justice: An empirical study from low-income communities in Beijing. *Cities*, 156, 105531. https://doi.org/10.1016/j.cities.2024.105531

Karakaya, Ö., & Dincer, I. (2021). Spatial justice for older adults: Accessibility of urban services in Istanbul. *Cities*, 110, 103071. https://doi.org/10.1016/j.cities.2020.103071

Kendig, H., Elias, A. M., Matwijiw, P., & Anstey, K. (2014). Developing age-friendly cities and communities in Australia. *Journal of Aging and Health*, 26 (8), 1390–1414. https://doi.org/10.1177/0898264314532687

Kiaie M., Motalebi S. A., Mirzadeh M., & Mohammadi F. (2019). Evaluating Age-Friendly City Indicators in Qazvin: Urban Open Spaces, Buildings, and Public Places. *Journal of Inflammatory Diseases (The Journal of Qazvin University of Medical Sciences)*, 23(5 (106)): 430-439. SID. https://sid.ir/paper/49309/en [In Persian]

Kumar, R. (2016). *Walkability of neighborhoods*. Lambert Academic Publishing.

Laurent, E. (2011). Issues in environmental justice within the European Union. *Ecological Economics*, 70 (11), 1846–1853. https://doi.org/10.1016/j.ecolecon.2011.06.025

Levine, M. E. (2013). Modeling the rate of senescence: can estimated biological age predict mortality more accurately than chronological age? *Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences*, 68 (6), 667-674. DOI: 10.1093/gerona/gls233

Manafifar S. F. Z., Ghaffari F., Faramarzi M., Youseframaki M., Shamsalinia A. (2020). What is healthy ageing? Definitions and Effective Factors. *Cjhaa*, 5 (1): 27-34. DOI: 10.22088/cjhaa.5.1.5 [In Persian]

Marston, H. R., & Van Hoof, J. (2019). "Who doesn't think about technology when designing urban environments for older people?" A case study approach to a proposed extension of the WHO's age-friendly cities model. *International journal of environmental research and public health*, 16 (19), 3525. DOI: 10.3390/ijerph16193525

Mashhad Municipality. (2016). *Mashhad Statistical Yearbook (2015-2016)*. Mashhad, Iran: Deputy of Planning and Development, Mashhad Municipality. [In Persian]

Mashhad Municipality. (2019). *Mashhad Statistical Yearbook (2018-2019)*. Mashhad, Iran: Deputy of Planning and Devel-

opment, Mashhad Municipality. [In Persian]

Meshkini A., Lotfi S., & Ahmadi Kourd Asiabi F. (2014). Investigating the Function of Urban Management in Spatial Justice among Urban Districts (A Case Study of Qaemshahr). *Spatial Planning (Modares Human Sciences)*, 18 (2): 153-174. SID. https://sid.ir/paper/171877/en [In Persian]

nazmfar H., shirnia parijani A., Shokri Firoozjah P., & Hatami Khanghahi T. (2023). Evaluation of the Indicators of an Elderly-Friendly City: the Case Study of Babol City Areas. *Geographical planning of space quarterly journal*, 13 (1): 39-56. DOI: 10.30488/gps.2022.340310.3533 [In Persian]

Nikpour A. & Hasanakizadeh M. (2020). Spatial Analysis of Elderly Indices in Urban and Rural Areas of Iran. *Human Geography Research*, 52 (3); 921-937. DOI: 10.22059/jhgr.2019.256357.1007696 [In Persian]

Ozdemir, S. (2024). Perceptions of age-friendliness in disadvantaged urban neighborhoods: The role of expectations and satisfaction among older adults. *Journal of Aging Studies*, 63, 101145. https://doi.org/10.1016/j.jaging.2024.101145

Pirbabaei, M. T., Hashempour, P., & Zadebagheri, P. (2019). Explaining Spatial Justice from the Perspective of Health Service Provision in Urban Spaces and Land Uses for the Elderly (Case Study: District 15 of Tehran). *New Attitudes in Human Geography (Human Geography)*, 12 (1): 345–362. https://dor.org/20.1001.1.66972251.1398.12.1.18.6 [In Persian]

Purjafar M. R., & Montazerolhajeh M. (2010). *Urban Signs: Definitions, Typology, Location, Planning and Design*. Tehran, Iran. [In Persian]

Rémillard-Boilard, S. (2020). *Developing age-friendly cities: a public policy perspective*. The University of Manchester (United Kingdom).

Resideh B., Marsoosi N., Taleshi M., & Moosa Kazemi S. M. (2023). Analysis of the Infrastructure Index of an Elderly-Friendly City in Mashhad Metropolis. *Journal of Urban Ecology Research*, 14 (3): 1-16. DOI: 10.30473/grup.2023.65521.2736 [In Persian]

Riahi M. E. (2008). A Comparative Study on the Status of the Elderly in Traditional and Modern Societies. *Salmand: Iranian Journal of Ageing*, 3 (3 and 4):10-21. URL: http://salmandj.uswr.ac.ir/article-1-96-fa.html [In Persian]

Roberts, A. (2021). Age-Friendly Urban Policy and City Design in Toyama City, Japan. *Urban Design*, (158).

Rosenberg, D., Ding, D., Sallis, J. F., Kerr, J., Norman, G. J., Durant, N., & Saelens, B. E. (2009). Neighborhood Environment Walkability Scale for Youth (NEWS-Y): reliability and relationship with physical activity. *Preventive medicine*, 49 (2-3), 213-218. https://doi.org/10.1016/j.ypmed.2009.07.011

Rostaei S., Hakimi H., & Alizadeh S. (2020). Study of Space Equity of Quantitative and Qualitative Indicators of Housing in Urban Areas (Case Study: Urmia City). *Human Geography Research*, 52 (3): 1009-1029. DOI: 10.22059/jhgr.2019.255578.1007679 [In Persian]

Saberifar R. (2020). Assessing the Realization of Healthy City Policies Based on Local and Regional Needs, Case Study: South Khorasan Province. *Journal of Urban Ecology Research*, 11 (21): 29-42. DOI: 10.30473/grup.2020.7470 [In Persian]

Salmistu, S., & Kotval, Z. (2023). Spatial interventions and built environment features in developing age-friendly communities from the perspective of urban planning and design. *Cities*, 141, Article 104417. https://doi.org/10.1016/j.cities.2023.104417

Seyedjavadi M., & Pakfar Z. (2021). The Relationship between Active Aging and Mental Health in Elderly Patients. *MEJDS*, 11:18-18.doi: 10.29252/mejds.0.0.68 [In Persian]

Shahipour S., Tavaklan A., & Sarver R. (2020). Analyzing the Relationship between Urban Space Justice through Urban Adaptation Strategies and the Welfare of the Elderly in Different Urban Spaces (Case Study: Tehran Region 3). *Geography*, 17 (63): 76-91. [In Persian]

Shorabeh, S. N., Firozjaei, M. K., Nematollahi, O., Firozjaei, H. K., & Jelokhani-Niaraki, M. (2019). A Risk-Based Multi-Criteria Spatial Decision Analysis for Solar Power Plant Site Selection in Different Climates: A Case Study in Iran. *Renewable Energy*, 143 (6), 958–973. https://doi.org/10.1016/j.renene.2019.05.063

Soja, E. 2009. The City and Spatial Justice. Justice Spatiale | spatial justice 1 (September 2009). Accessed 3 April 2021. https://www.jssj.org/wp-content/uploads/2012/12/JSSJ1-1en4.pdf.

Soja, E.W. (2010). *Seeking Spatial Justice*. University Of Minnesota Press.

Souche, S., Raux, C., & Croissant, Y. (2012). On the perceived justice of urban road pricing: An empirical study in Lyon. *Transportation Research Part A: Policy and Practice*, 46 (7), 1124-1136. https://doi.org/10.1016/j.tra.2012.01.009

Tash Consulting Engineers. (2006). *Executive plan for the context surrounding the holy shrine of Imam Reza (A.S.): Urban design criteria and land use allocation (2nd Ed.)*. Omran & Maskan Sazan-e Region-e Samen. [In Persian]

United Nations. (2019a). *World Urbanization Prospects: the 2018 Revisions*. Department of Economic and Social Affairs: Population Division, New York.

United Nations (2019b). *World Population Ageing 2019*. Department of Economic and Social Affairs: Population Division, New York.

United Nations. (2024). *World Population Prospects*. Department of Economic and Social Affairs: Population Division, Online Edition. https://population.un.org/wpp/ [Accessed on 09.06.25]

United Nations. (2020). *United Nations Decade of Healthy Ageing 2021–2030*. Retrieved 30 April 2021. https://www.who.int/initiatives/decade-of-healthy-ageing

Van Hoof, J., Marston, H. R., Kazak, J. K., & Buffel, T. (2021). Ten questions concerning age-friendly cities and communities and the built environment. *Building and Environment*, 199, 107922. https://doi.org/10.1016/j.buildenv.2021.107922

Van Hoof, J., Soebarto, V., Ayalon, L., Marston, H. R., Zander, K. K., Dikken, J., & Kazak, J. K. (2025). Ten questions concerning older people and a sustainable built environment. *Building and Environment*, 274, Article 112742. https://doi.org/10.1016/j.buildenv.2025.112742

Van Hoof, J., & Yu, C.W. (2020). Ageing communities, supportive housing and enabling built environments. *Indoor Built Environ*. 29 (3), 295–298. https://doi.org/10.1177/1420326X20905916.

Wang, J., Zhang, L., & Xu, Y. (2024). Spatial inequality and perceived fairness in age-friendly cities: Evidence from Chinese

urban communities. *Habitat International*, 141, 102043. https://doi.org/10.1016/j.habitatint.2023.102043

Wang, Y., Gonzales, E., & Morrow-Howell, N. (2017). Applying the WHO's age-friendly communities framework to a national survey in China. *Journal of Gerontological Social Work*, 60 (3), 215-231. DOI: 10.1080/01634372.2017.1292980

WHO. (2007). Global age-friendly cities: A guide from the World Health Organization.

WHO. (2025a). "Ageing and Health." Accessed February 18, 2025. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health

WHO. (2025b). "WHO's Work on the UN Decade of Healthy Ageing (2021–2030)." Accessed February 18, 2025. https://www.who.int/initiatives/decade-of-healthy-ageing.

Wiles, J. L., Leibing, A., Guberman, N., Reeve, J., & Allen, R. E. (2012). The meaning of "aging in place" to older people. *The Gerontologist*, 52 (3), 357–366. DOI: 10.1093/geront/gnr098

Wong, M., Chau, P. H., & Woo, J. (2022). Variations in older adults' satisfaction with urban environments: The role of socioeconomic disparities in Hong Kong. *Cities*, 123, https://doi.org/10.1016/j.buildenv.2021.107922

Wood, G. E. R., Pykett, J., Banchoff, A., King, A. C., Stathi, A., & Scientists, I. Y. L. A. C. (2023). Employing citizen science to enhance active and healthy ageing in urban environments. *Health & Place*, 79, 102954. DOI: 10.1016/j.healthplace.2022.102954

World Health Organization. (2020). *Decade of healthy ageing connection series no. 1 - COVID-19*. Geneva: World Health Organization. Retrieved from: https://www.who.int/publications/m/item/decade-connection-series-no1 (Last access: 20/04/2025).

World Health Organization. (2024). *Making older persons visible in the Sustainable Development Goals' monitoring framework and indicators*. World Health Organization.

World Health Organization (2020). What is the decade of healthy ageing? https://www.who.int/initiatives/decade-of-healthy-ageing .Accessed 20 Jan 2020

Ziari K., Tavakoli M., & Khani H. (2024). Analysis of the Distribution and Spatial Pattern of the Elderly with an Emphasis on the Elderly-Friendly City: the Case Study of Qom City. *Geographical Urban Planning Research (GUPR)*, 12 (3): 23-40. DOI: 10.22059/JURBANGEO.2024.378784.1962 [In Persian]