Spatial Analysis and Evaluation Aging-Friendly City Indicators Using GIS: Study in 8 Districts of Ahwaz City, Southwestern Iran

Vafa Musavi , Tayebeh Rakhshani , Somayeh Fathtabar Firozjaee , Abdolrahim Asadollahi *

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Article

Spatial Analysis and Evaluation Aging-Friendly City Indicators Using GIS: Study in 8 Districts of Ahwaz City, Southwestern Iran

Vafa Musavi [1], Tayebeh Rakhshani [2], Somayeh Faththabar Firozjaee [2] and Abdolrahim Asadollahi [3-4-*]

[1] Dept. of Public Health, School of Health, Shiraz University of Medical Sciences, IRAN
[2] Geological Survey and Mineral Explorations of Southwest Region, Ahwaz, IRAN
[3] Dept. of Gerontology, School of Health, Shiraz University of Medical Sciences, IRAN
[4] The Middle East Longevity Institute in Abyad Medical Centre, Azmi Street, Tripoli, Lebanon
* **Permanent Address for Corresponding Author:** A. Asadollahi, PhD in Gerontology, Asist. Professor, Dept. of Gerontology, Faculty of Health, Shiraz University of Medical Sciences, 3rd Floor, Razi Ave. Postcode 7153675541, Shiraz, IRAN. Phone Number: +98-71-37251006, Email: a_asadollahi@sums.ac.ir

Abstract: Objectives: The present study was conducted to evaluate the indicators of the aging-friendly using GIS software in the eight districts of Ahwaz, southwest Iran in 2022. **Materials and methods**: this descriptive-analytical study was conducted on 317 older adults by stratified random sampling method. Data collection tools were demographic characteristics and aging-friendly city indicators. GIS methods were used for the spatial analysis and SPSS version 28 software was used to analyze descriptive statistics. **Results**: The mean age of the participants was 66.21±6.99 years. Most of the participants in this study were male (53.9%), illiterate (34.7%), married (84.9%) and residents of district 7 (22.1%). The findings of the present study showed that all 8 districts follow spatial autocorrelation and cluster pattern in all components of the aging-friendly city (urban open spaces, intra-urban transportation system, public and religious places and buildings, safety and ease of traffic, social participation and communication, social respect, culture-recreation, health and treatment). **Conclusion**: According to the results, the city of Ahwaz is far from the ideal level among the components of an aging-friendly city; therefore, provincial and city officials should pay more attention to these indicators and take more effective steps to increase their quality.

Keywords: aging-friendly city; Ahwaz; spatial analysis; hot spots indicator; geographic information system (GIS)

Introduction

According to the 2015 census, more than 7 million people (27.9%) of Iran's population are ≥60 years of age; It is predicted that if the trend of fertility indicators continues, more than 20% of Iran's population will be older adults in 2050 (1, 2). This demographic change creates social, economic and personal challenges for communities, families and individuals (3).

The increase in the aging of the population goes parallel with the increase in urbanization today. Iran is not exempt from this rule, i.e. the growth of population aging and urbanization. Currently, the growth of urbanization in Iran is increasing; so that the number of cities reached 1331 in 2010 and the number of megacities in the country is also increasing (4).

In recent years, various policies and strategies have been used for the special needs of the older adults and their quality of urban life. The terms "Aging-friendly city" and "active older adults" have been proposed to be a pioneer in this field. In fact, in the aging-friendly city, the environment is such that the older adults are able to participate socially and have an active presence in the society. For

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this reason, it becomes more necessary to address the urban needs and the living environment of the older adults in order to improve the quality of their urban life (5, 6).

Many cities in the world have always tried and pioneered in upgrading their urban infrastructure for the satisfaction of the older adults and the possibility of their presence in the community (7). In this regard, the World Health Organization has researched and published a project entitled "Aging-friendly cityin the Global Arena" to examine the growth trend of the population of people over 60 years old in the world, the aging of the population structure, active age and old age, as well as the indicators of the city. It has also reviewed the aging-friendly cityindicators. This project was proposed for the first time in 2005 and from 2006 member countries were invited to cooperate. Based on the standards of the World Health Organization, there are eight components for the aging-friendly cities, including urban open spaces, intra-urban transportation system, public and religious places and buildings, safety and ease of traffic, social participation and communication, social respect, culture-recreation, health and treatment. Each of these indicators will play an important and effective role in creating aging-friendly cities (8).

Improving the quality of urban life for the older adults requires evaluating the quality of services and urban infrastructure and the city's compliance with the theme of an aging-friendly city; because based on these evaluations, it is possible to implement the planning of aging-friendly cities (5). For this reason, an efficient and effective health system must act in such a way that, while paying attention to the needs of vulnerable groups, it systematically monitors the geographical areas it covers and identifies the emergence of new health issues in the shortest possible time. Maps, especially digital types, play a valuable role in improving the decision-making efficiency of health managers. The geographic information system is one of the new technologies to facilitate the process of obtaining information and making decisions about the healthcare system (9, 10). In general, GIS is used as a very useful auxiliary in health education, planning, monitoring and evaluation of health programs (11).

Since it is necessary to evaluate the aging-friendly city using the traditional, centralized, expert-oriented and top-down approach, rather than a more general, collaborative, communicative and older adults-oriented approach, GIS software could be effective in this regard (5).

Considering the importance of an aging-friendly city, there is little research background in Iran, especially in Khuzestan province, and on the other hand, all countries around the world are looking for active and successful aging; that one of the most basic requirements of this approach is to have an aging-friendly city. The present study was conducted to evaluate the indicators of the aging-friendly using GIS software in the eight districts of Ahwaz, Iran in 2022.

Materials and methods

This descriptive-analytical study was conducted on 317 older adults who met the inclusion criteria.

The sample size was first determined 382 (in the statistical population of 87,784 older people) using NCSS PASS version 15 software used in cross-sectional studies with CI=7 and CL=93%, according to the confidence level of 95%, the significance level of 0 .05, and the standardized deviation squared score in 2 similar studies (6, 12). However, due to the fact that in the first stage of sampling, 65 older adults selected from the Sib system in different areas of Ahwaz were excluded because of death, migration, non-cooperation, change of address registered in the system, or lack of access.

Sampling

The older adults were selected by random stratified method in several stages; According to the division of Ahwaz municipality, it is divided into eight districts. Also, the city of Ahwaz has two health centers, East and West. The former has 19 urban health centers and the latter has 15 urban health centers. Based on proportional stratified sampling, at first, according to the distribution of the older adults in each districts, the contribution of each of the eight districts was determined.

In the next step, spatial analysis was done using ARCMAP software; In this way, the number of main streets or municipal blocks in each area was determined and according to that, the sample size

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calculated for that area was divided equally between the main neighborhoods or streets; So, for example, if the share of district 1 of older adults participants was estimated to be 30 people, considering that this area has 10 main streets, 3 older people were selected from each street.

Inclusion and exclusion criteria

Inclusion criteria were age over 60 years, living in Ahwaz city for at least one past year, willingness to participate in the study and the ability to communicate (not suffering from severe visual and hearing defects that cannot be corrected with glasses and hearing aids). The exclusion criterion was suffering from known mental disorders such as Alzheimer's and depression.

Data collection

Data were collected using two questionnaires: 1) Demographic characteristics (age, sex, education, marital status, employment, number of times leaving home, economic status); 2) Aging-friendly cityIndicators: This questionnaire was compiled according to the results obtained from the comprehensive project of cities suitable for the older adults, which was implemented by the World Health Organization in 33 cities from 22 countries of the world. It was first published as a checklist in 2007 under the name "Checklist of Essential Characteristics of Aging-Friendly Cities". This questionnaire has been designed and compiled in 8 areas (urban open spaces, intra-urban transportation system, public and religious places and buildings, safety and ease of traffic, social participation and communication, social respect, culture-recreation, health and treatment) including 73 questions. The questionnaire is scored based on a five-point Likert scale (from completely disagree with a score 1 to completely agree with a score of 5). In the localized version by Olfat et al., the obtained reliability of the questionnaire using Cronbach's alpha coefficient showed that all the variables measured by the questionnaire have acceptable reliability and the Cronbach's alpha value is greater than 0.70(13). In this study, the internal reliability of this questionnaire was examined and Cronbach's alpha was 0.971.

Ethical consideration

After obtaining the code of ethics for this research from the Research Ethics Committee of Shiraz University of Medical Sciences, the researcher, carrying the project implementation permit, visited all the urban health centers in Ahwaz for sampling. Then, according to the address registered in the Sib system, for each older adults, the participants randomly were selected and interviewed by phone. At the end of the interview, the older adults were asked to complete an informed written consent and complete the questionnaire.

After finishing the work, the data of the study was entered into the GIS software. To clarify the index distribution pattern in space, exploratory spatial data analysis (ESDA) in GIS was used to measure spatial correlation characteristics. Spatial autocorrelation can explain the degree of correlation between a certain geographical phenomenon in one unit and the same phenomenon in a neighboring regional unit. It can be divided into global spatial autocorrelation and local spatial autocorrelation. Moran's method quantitatively describes the dependence of objects and space. It can be used to analyze whether a particular variable is spatially correlated and how much it is spatially correlated. Through this method, it is possible to observe whether the level of aging-friendly indicators is spatially concentrated, dispersed or evenly distributed from a general perspective. Also, hot spots method has been used for the spatial analysis of the indicators of the aging-friendly city in the urban areas of Ahwaz. The hot spot analysis tool evaluates whether high or low values of a variable are spatially clustered.

Data analysis

SPSS version 26 software was used to analyze descriptive statistics (mean, standard deviation, frequency and frequency percentage) and demographic characteristics.

Findings

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Most of the participants in this study were male (53.9%), illiterate (34.7%), housewives (42.6%), married (84.9%). Also, most of them lived with their spouses and children (60.3%). Their economic status was average (61.8%). Most of the participants went outside the house 2-3 days a week (28.7%). Most of them lived in district 7 of Ahwaz Municipality (22.1%). The mean age of the participants was 66.21 ± 6.99 years. (Table 1)

Table 1. Demographic characteristics of study participants (n=317).

Variable	Category	P	N
Sex	Female	1.46	146
	Male	9.53	171
Education	Illiterate	7.34	110
	Primary school	6.19	62
	Secondary school	4.11	36
	High school	23.3	74
	Post diploma	4.1	13
	B.A.	5.4	17
	M.A.	1.6	5
Employment	Retired	20.5	65
	Self-employed	21.1	67
	Housewife	42.6	135
	Unemployed	8.2	26
	Other	7.6	24
Marital status	Married	84.9	269
	Single	0.9	3
	Widowed	13.6	43
	Divorced	0.6	2
Living condition	With wife	24.3	77
	With children	11.7	37
	With family	60.3	191
	Other	0.9	3
	Alone	2.8	9
Economic status	Weak	31.2	99
	Moderate	61.8	196
	Good	6.9	22
Number of leaving home	Daily	28.4	90
	2-3 days per week	28.7	91
	3-4 days per week	16.4	52
	2-1 days per week	21.5	68
	2-1 days per month	3.2	10
	other	1.9	6
Place of residence	District 1	8.2	26
	District 2	9.1	29
	District 3	6.6	21
	District 4	7.3	23
	District 5	12.3	39
	District 6	18.9	60
	District 7	22.1	70
	District 8	15.5	49

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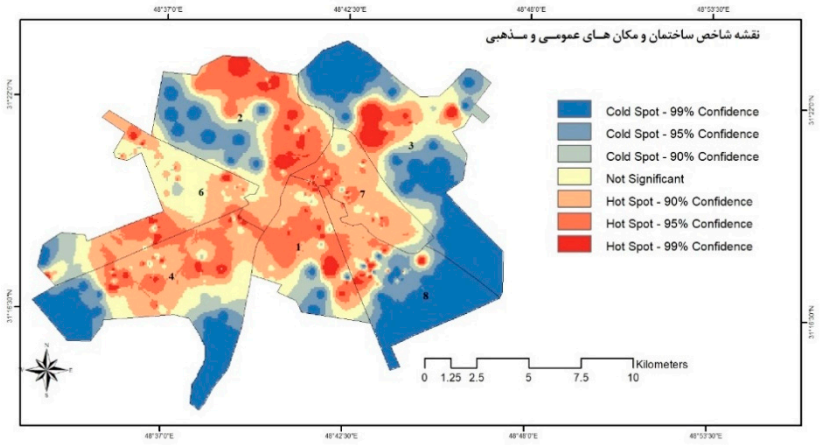
According to Table 2, the weakest indicator of the aging-friendly city was safety and ease of transportation with a score of 9.02±2.88. Also, the indicator of urban open spaces obtained the highest score of 31.52 ± 9.89.

Table 2. Mean and SD of indicators of an aging-friendly city from the point of view of the older adults (n=317).

Indicators	M	SD
Urban open spaces	31.52	9.89
Public and religious places	22.89	6.68
Safety and ease of traffic	9.02	2.88
Social indicators	25.58	8.62
Cultural and recreational indicators	18.25	6.20
Health and treatment	18.93	7.35
Total	126.18	33.34

According to Map 1, districts 1 and 2 have the highest density of hot spots (red color); which shows the high degree of clustering of the public and religious places and buildings. Most parts of the 6th districts are categorized as no specific pattern. Districts 3, 4 and 7 have almost the same category. And most parts of 8th district also indicate a low cluster pattern. Therefore, it can be said that, on average, the urban areas of Ahwaz follow a specific spatial pattern based on this map, and the distribution of the indicator of public and religious places and buildings was not random.



Map 1. Public and religious places and buildings.

According to Map 2, the north and northwest part of the 7th district, in terms of social indicators, has a high amount of red and orange hot spots. Districts 4 and 1 city are in the next category, which covers most of the area in orange color. The eastern and southern parts of district 6 are also mostly covered with orange color. The north and southwest parts of district 2 are mostly red and orange spots. Red and orange hot spots have also covered the northern part of the 8th district.

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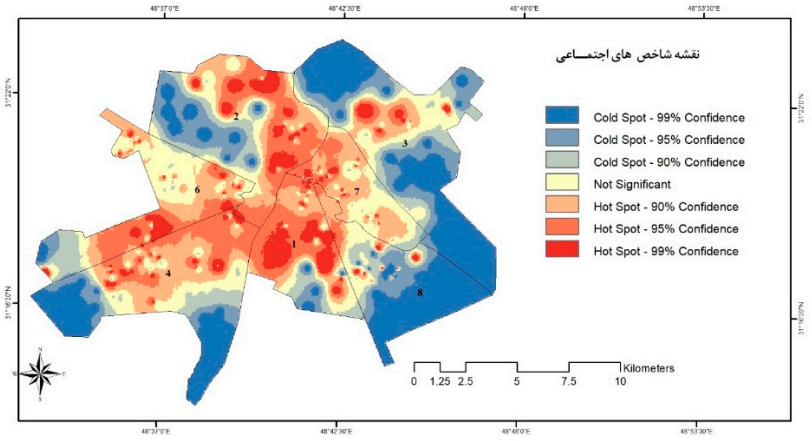
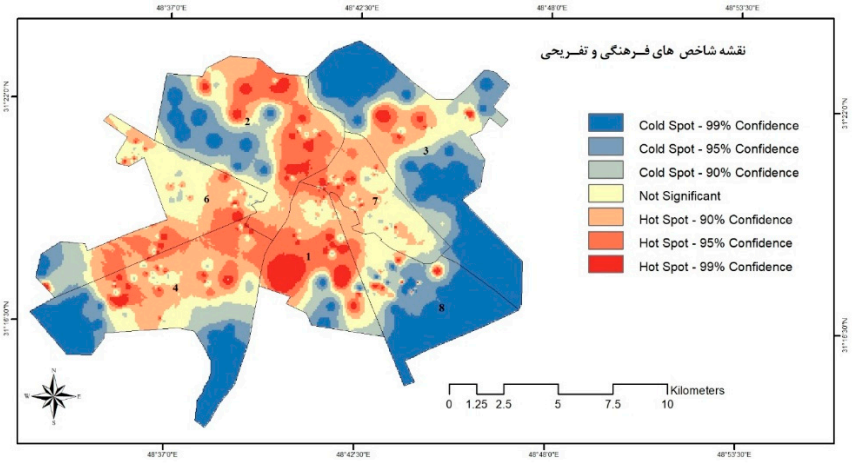


Map 2. Social indicators.

According to Map 3, the north and northwest part of the 7th district, in terms of cultural and recreational indicators, has a large amount of red and orange hot spots. Districts 4 and 1 are also in the next category. Most parts of these districts are covered by orange color, which are classified as hot spots in categories 5 and 6. The eastern and southern parts of district 6 are also mostly covered with orange color. The north and southwest parts of district 2 are mostly red and orange spots. The northern part of the 8th district is also covered by red and orange hot spots.



Map 3. Cultural and recreational indicators.

According to Map 4, most of the districts 4 and 7 are covered by orange and red spots in terms of health and treatment indicators. The eastern and southwestern part of the 6 district has a high percentage in terms of cluster pattern.

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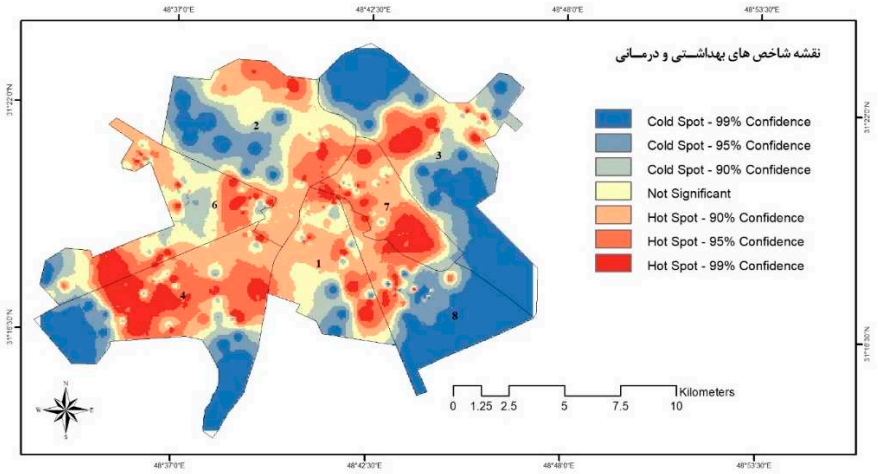
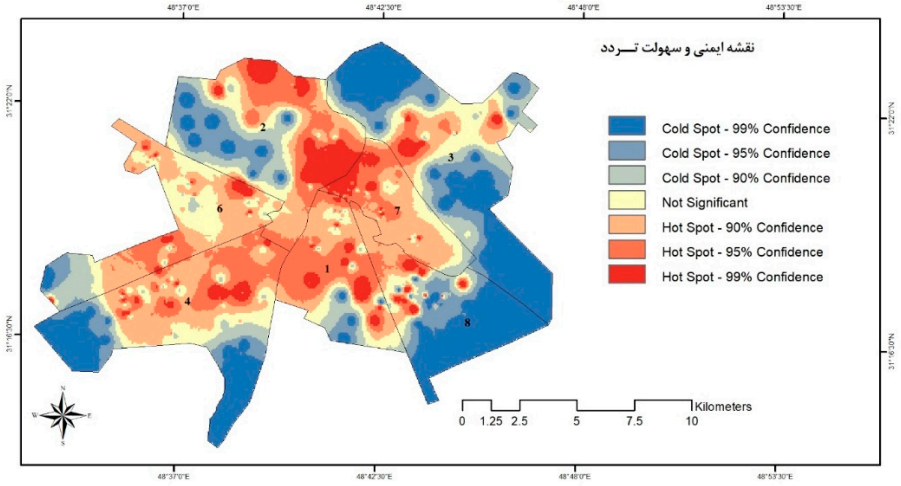


Map 4. Health and treatment indicators.

According to Map 5, districts 1 and 2 have the highest density of hot spots (red color), which shows the high degree of clustering of safety and ease of traffic indicator. Most of the areas of the 6th district are also in the category of no special pattern. Districts 3, 4, and 7 also have almost the same categorization, with the difference that the central part of district 3 is in the red and orange category. And most parts of district 8 also indicates a low cluster pattern. Therefore, it can be said that, on average, all of the 8 districts follow a specific spatial pattern based on this map, and the distribution of the safety and ease of traffic is not random.



Map 5. Safety and ease of traffic indicators.

According to Map 6, districts 1 and 2 have the highest density of hot spots (red color); which shows the high degree of clustering of the urban open spaces indicator.

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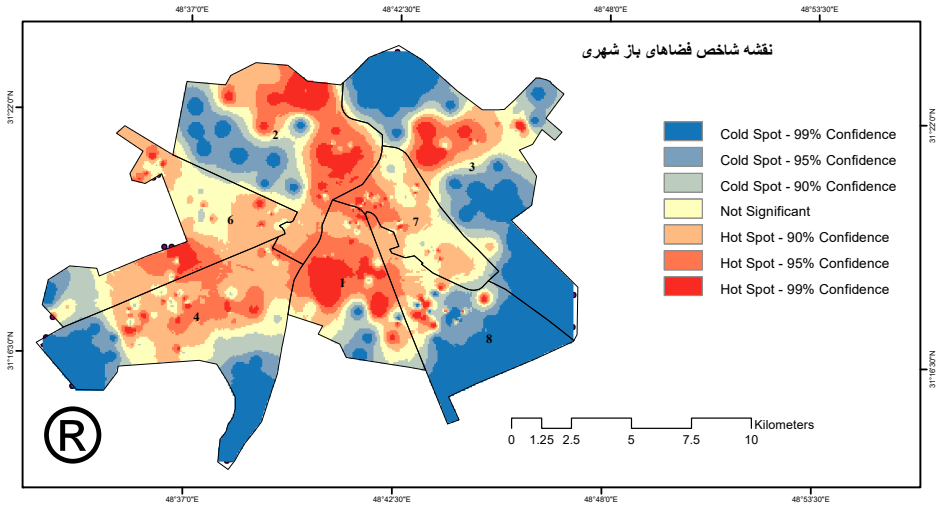
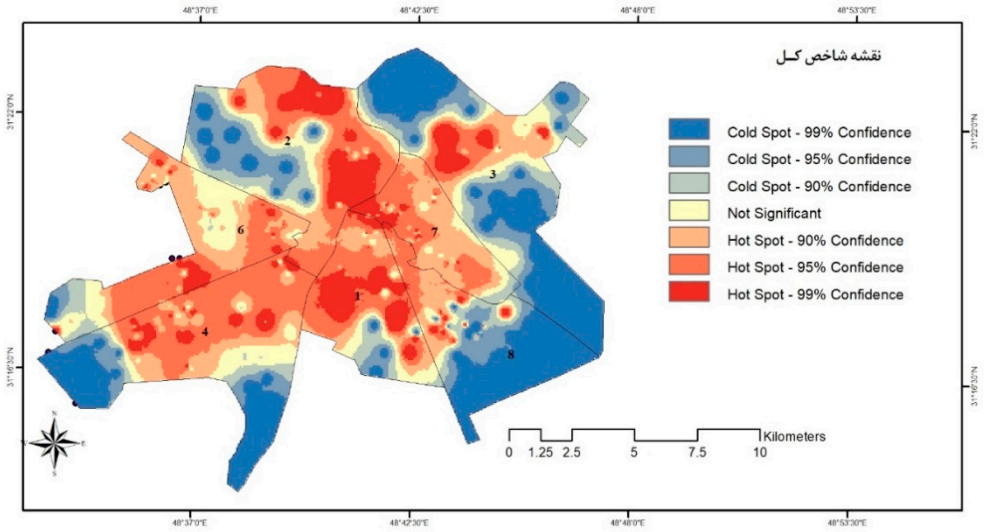


Map 6. Urban open spaces indicators.

According to Map 7, in terms of spatial distribution, using the hot spot method, on average, all the 8 districts follow a cluster pattern.



Map 7. Indicator of the aging-friendly city as a whole.

As can be seen in Table 3, all indicators of the aging-friendly city are significant in terms of Moran's index, indicating that all these indicators follow the cluster pattern of distribution.

Table 3. Moran's spatial autocorrelation of indicators of the aging-friendly city.

Indicators	p-value	z-score	Moran's Index	Pattern of distribution
Urban open spaces	001.0	2.3	37.0	Cluster
Public and religious places	002.0	08.3	38.0	Cluster
Safety and ease of traffic	0009.0	3.3	4.0	Cluster
Social indicators	005.0	7.2	33.0	Cluster
Cultural and recreational indicators	005.0	7.2	33.0	Cluster
Health and treatment	03.0	08.2	25.0	Cluster
Total	001.0	2.3	39.0	Cluster

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Discussion and conclusion

In the present study, the indicators of the aging-friendly city in Ahwaz city were evaluated using Geographical Information System (GIS) in 2021. It was found that the 3rd and 4th districts of Ahwaz have the highest frequency of older people with poor economic status. But in district 7, the older adults were in an average economic situation. Districts 2 and 3 were also the most frequent in terms of good economic status in this ranking. Considering that the economic indicator is one of the basic factors, very important and influential on the quality of life of citizens (14), it is suggested to identify the causes of the economic weakness of the older adults in districts 3 and 4 and to take effective steps to solve them.

Social indicators with a score of 25.58±8.62 and the indicator of public and religious buildings and places with a score of 22.89±6.68 obtained an acceptable score from the point of view of the participants. Also, according to the results of these indicators in other districts of Ahwaz, it can be said that, on average, all of the 8 districts of Ahwaz follow a specific spatial pattern in terms of social indicators, public buildings and places, and the distribution of these indicators in the city is not random.

In a study by Zarghani et al., from the perspective of the older adults living in Mashhad, the social indicators were at an average level (15). But in the study of Nazmfar et al., it was found that the social indicator in Bukan city is lower than the standard and there is a long way to reach the desired level (16).

Cultural and recreational indicators scored 18.25 ± 6.20 from the perspective of the older adult participants in this study. It was also found that this indicator follows a specific spatial pattern in the eight districts of Ahwaz and the distribution of this indicator in the city is not random.

In a study by Zarghani et al., from the point of view of the older adults living in Mashhad, the indicator of cultural and recreational services was at an average level (15). In a study by Asadi et al., it was found that the quality of life in the two districts of Mashhad city was almost acceptable, because the majority of neighborhoods had favorable recreational indicator coverage (14). However, in a study by Nazmfar et al., it was found that the cultural and recreational indicator in Bukan city is below the standard and there is a long way to reach the desired level (16).

The indicators of healthcare services obtained a score of 18.83 ± 7.35 from the perspective of the older adults participating in this study. Also, according to the results of this indicator in the 8 districts of Ahwaz, it can be said that, on average, all districts follow a specific spatial pattern in the indicators of health and treatment services, and the distribution of this indicator in the city is not random.

In a study by Zarghani et al., from the perspective of the older adults living in Mashhad, the indicator of public health services was at an average to low level (15). Also, in a study by Sharqi et al., it was found that optimal health services are not provided for the older adults in Tehran (17). In the study by Nazmfar et al., it was also found that the health-treatment indicator in Bukan city is lower than the standard and there is a long way to reach the desired level (16).

The results of a study by Carpentieri et al. showed that the entire older adult population living in the city of Naples (Italy) is dissatisfied with the level of access to primary healthcare services, especially in the outskirts of the city (18).

Meanwhile, access to healthcare services has a direct relationship with quality of life (14). And the older adults have a greater need for healthcare services due to their high vulnerability and high probability of contracting a chronic disease and, in most cases, several diseases at the same time. Therefore, it is necessary to take an effective step to solve the problems of access to healthcare services for the older adults.

The indicators of safety and ease of traffic obtained a score of 9.02 ± 2.88 among the indicators of the aging-friendly city from the perspective of the older adults participants.

Also, according to the results of this indicator in the eight districts of Ahwaz, it can be said that, on average, the 8 districts of Ahwaz follow a specific spatial pattern in terms of safety and ease of traffic indicators, and the distribution of this indicator in the city is not random.

In a study by Sharqi et al., the transportation in Tehran city was not favorable for the older adults (17). Most of the traffic problems included: heavy traffic, bad condition of the roads, lack of lighting

in the streets, inappropriate marking of the streets so that the signs are not well visible, and generally there are problems in the design of public vehicles for the older adults (12).

In a study by Taraqqi, it was also found that most of the older adults evaluated the access of the older adults with various disabilities to city buses as bad to very bad (21); however, in a study by Kiaei et al., the indicators of safety and ease of transportation were in standard condition according to the older adults in Qazvin city (20).

The issue of safety is of special importance and necessity for the older adults group. Therefore, in recent years, increasing the safety and security of the urban environment in order to realize a healthy and safe city is one of the most important approaches that urban planners and officials have paid attention to (22). However, according to the results obtained in Ahwaz study, it is necessary for the relevant authorities to give double importance to the promotion of this indicator.

The indicator of urban open spaces with a score of 31.52 ± 9.89 obtained the highest score among the indicators of an aging-friendly city from the perspective of the older adults participants. It was also found that this indicator had a cluster pattern in its distribution like other examined indicators.

These results were consistent with the results of a study by Shariat et al. (12), though inconsistent with a study by Sharqi et al. (17).

In previous studies, it has been emphasized that urban spaces are not defined only in geometrical dimensions, but also aesthetic quality, ease of social communication and behavior on a higher level that give character to a space. In fact, the surrounding environment should be such that it can attract the opinion of the older adults and make it possible for them to function optimally (12). This is because many older people use urban spaces to spend their free time and have fun with their peers (23).

The indicator of the aging-friendly city as a whole obtained a score of 126.18 ± 33.34 from the perspective of the older adults who participated in this study. Also, according to the results of the investigation of this indicator in the eight districts of Ahwaz, it can be said that, on average, the urban areas of Ahwaz follow a specific spatial pattern in the aging-friendly city indicators, and the distribution of this indicator in the city level is not random, but in the form of scattered clusters.

As stated earlier, an ideal urban space is a space where citizenship is respected. In fact, the older adults are part of the vulnerable citizens of the city, and if urban spaces are adapted for the older adults, it will have a positive effect on other sections of the society as well (15).

In a study by Nikpour and Hasanalizadeh, it was found that all four indicators of old age were more at the level of central neighborhoods of Babol city than peripheral neighborhoods, and all four indicators had spatial independence and cluster pattern (24).

In a study by Asadi et al, it was found that the neighborhoods that are at very low levels in terms of economic and social indicators are at an average level in terms of accessibility (14).

The results showed that all the indicators of the aging-friendly city are significant in terms of Moran's indicator, indicating that all these indicators follow the cluster pattern of distribution.

In a study by Asadi et al., it was found that the quality of life followed a spatial pattern (14). Meanwhile, many older people use urban spaces to spend their free time and have fun with their peers (23). In this regard, efforts should be made in order for the older adults to benefit more from the services of urban spaces, which are directly related to other important indicators such as social indicators. In order that the older adults fully take advantage of all urban areas, the needs of the older adults in these areas should be examined and relevant and effective solutions should be thought of. For example, it has been stated in past studies that the structure of urban spaces should be designed in such a way that older people can benefit from urban services without dependence and by receiving minimal assistance (25).

Considering that the phenomenon of aging is a universal issue, preparing the population for old age should be an inseparable aspect of social and economic development policies and should be accompanied by great efforts at all national, local, family and individual levels (16). Since the urban space is the meeting place of behavior, thoughts and at the same time the place of some of the daily needs of citizens, the vitality and dynamism of cities is well felt in urban spaces (26).

Limitations

The first limitation of this study was the coincidence of its implementation with the outbreak COVID-19. In addition to the lack of access to the older adults in the city due to the home quarantine, and conducting the study over the phone, the caused complications may have affected the answers of the participants. Therefore, it is suggested that in the future, other studies with similar goals and subjects be conducted on the older adults of Ahwaz city and the results be compared with the results of the present study. Also, interviewing the older adults requires a lot of patience and enough time. In this regard, the use of questionnaires with fewer questions can increase the quality of the interview and also reduce the costs of prolonging the studies. Therefore, it is suggested to prepare and validate a short version of the questionnaire of the aging-friendly city indicators.

Conclusion

The present study was conducted to evaluate the indicators of the aging-friendly using GIS software in the eight districts of Ahwaz, Iran in 2022. The findings of the present study showed that all 8 districts follow spatial autocorrelation and cluster pattern in all components of the aging-friendly city. Also, the indicators of urban open spaces scored the highest points and the safety and ease of traffic indicators scored the lowest points.

Recommendations

It is necessary that the trustees of urban services in Khuzestan province, especially in Ahwaz city, to create the comfort and well-being of the older adults, to give more importance to the indicators of an aging-friendly city, and to spend more effort to improve them. Using the results of the present study could be helpful in this regard.

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Conflict of interest: According to the authors, this article has no conflict of interest.

Ethical considerations: The present study was approved by the Ethics Committee of Shiraz University of Medical Sciences with the ethics code IR.SUMS.SCHEANUT.REC.1400.065. The participants were assured of the confidentiality of their obtained information and informed written consent was obtained from them.

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