

# Geographical Access of Elderly to Health Care Centers during a 20 Years Period (1996-2016): a Case Study of Kermanshah , Iran

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## Research article

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# Abstract

## Background

Identifying the spatial distribution of Health Care Centers (HCC) and equitable access for all members of society (especially the elderly), can be effective in health policy making. This study aimed to determine the geographical accessibility of elderly to HCC in Kermanshah metropolis during a 20 year period (1996-2016).

## Methods

This was a cross-sectional applied study. The statistical population included all elderly people in Kermanshah metropolis (65 years and above). The data of this study included statistical blocks and locations of Health Centers of Kermanshah during 1996 to 2016. After data collection through the Iranian Statistical Center and Kermanshah Health Center, digitization of HCC and urban roads network was done in Geographic Information System (GIS). In addition, the walking of 12.30 minutes was determined as access time for the elderly, and the number of elderly with appropriate and inappropriate access was determined using the Network Analysis tool. Finally, the Standard Deviation Ellipse (SDE) model was used for spatial analysis of HCC and the distribution of the elderly population.

## Results

The elderly people with inappropriate access to HCC was 48.15%, 47.85%, and 36.12% in 1996, 2006 and 2016, respectively. The results also showed that there was a 14% increase in the number of new HCC in the period of 1996-2006 (14%) and 136% during 2006 to 2016. During the 20 years, the expansion of HCC was toward the northwest and west of city, and the trend of elderly population expansion was toward the south and central parts of Kermanshah.

## Conclusion

Despite the doubling of HCC during 1996-2016, more than one-third of the elderly still do not have appropriate access to HCC. This situation indicates inappropriate spatial distribution of HCC in Kermanshah metropolis and should be considered as a challenge by health managers and policy makers.

## Background

Elderly is a natural phenomenon with decrease in one's physical, mental and psychological activities. These changes occur in everyone, but the speed of change may be different influenced by some life factors (1). Ignoring body and mind in adulthood can accelerate aging process and premature death. Aging is generally a critical period of life and it is imperative to pay attention to the issues and needs of this stage (2). Today, the growing population of the elderly known as the silent revolution is a global challenge. (3). It is reported that 10% of the world's population is over 65 years of age (4), and is predicted to be doubled in the next 40 years (5). The population of the elderly in Iran has also increased from 4.83%

to 6.18% from 2006 to 2018 (4), which indicates a rapid growth of the elderly population (6, 7). Iran is currently in transition from youth to middle-aged population, and in the near future will be experiencing population aging. The growth of the elderly population is a warning sign to planners and policymakers. They have to pay more attention to the various components of aging life and appropriate health and socio-economic planning and policy making for elderly (6). Although aging is an undeniable phenomenon, it should be addressed as one of the future challenges. Elderly people go to the doctor on average five to seven times more than other population groups (8) and 37% of health care costs are annually spent for those (9), therefore, decision and policy makers need to focus on the needs of the elderly.

Identify the spatial distribution of and the equitable access to health care centers (HCC) are factors that can influence the future decisions in the community (10). In developing countries, we are usually seeing poor service delivery and inappropriate distribution of HCC (11). Imbalance in the geographical distribution of health care centers can lead to the inefficiencies in service delivery and access inequality, and consequently can be one of the causes of health inequalities (12). In contrast, the equitable access of all members of society (especially the elderly) to health services can promote health and development in the country (13). This issue requires a comprehensive understanding of the current state of health services in society, but unfortunately few countries have collected related comprehensive information, and in others has been neglected especially in countries such as Iran (14).

Geographic Information System (GIS) is a useful tool to studying the accessibility to health services in different groups, and it has attracted the attention of health professionals in recent years (15-17). GIS is considered as a valuable tool to ensuring access of vulnerable and disadvantaged populations to health services and primary health care. It also has been proposed as a necessary technology to collection, storage, processing, analysis and visualization of geo-spatial data (18).

Given that Kermanshah as one of the deprived (19) and semi-developed areas of Iran (20) faces inequality in the distribution of health services (10, 11, 17), and also considering the priority of the elderly in accessing health services; this study was conducted to determine the geographical accessibility of elderly to HCC in Kermanshah metropolis during a 20 years period from 1996 to 2016.

## Methods

### Objective, study design and setting

The objectives of this study were assessing the pattern of HCC distribution and evaluate the accessibility of elderly of Kermanshah metropolis to the HCC during a 20 years period from 1996 to 2016. This research was a descriptive cross-sectional study. The statistical population of this study was all elderly people in Kermanshah metropolis (65 years and older).

**Data collection** The data of this study included statistical blocks as well as locations of HCC of Kermanshah, the main city in the west Iran during 20 years (1996-2016). Data were collected through

## Procedure

Digitization of HCC and urban roads was done in three periods of (1996-2006-2016) in GIS. Next, in the Arc Catalog, the topology and the spatial relationship between the passages were created and also the rules for walking time were applied with the Network Analysis tool. In transport technical calculations, a person's walking speed is normally 0.75 to 1.25 meter per second (m/s) (21). The standard radius was also set at 750 m for access to HCC (11, 22). Therefore, in the present study the average speed of an elder's walking was assumed to be 1 m/s, and considering the standard radius of access and speed rate of each person, the time of 12.5 minutes walking from home to HCC considered as access time for elderly. Then boundaries were created for the areas of health services provided by HCC in terms of citizens' access in real time through real passages using the features of the Network Analysis tool.

## Statistical analyses

The number of elderly population with appropriate and inappropriate access calculated using GIS capabilities. Standard Deviation Ellipse (SDE) model was used to spatial analysis of HCC, the trend of city expansion, and population distribution over three time periods (1996-2006-2016). The calculation of SDE is as follows:

$$\begin{pmatrix} \text{var}(x) & \text{cov}(x,y) \\ \text{cov}(y,x) & \text{var}(y) \end{pmatrix} = \frac{1}{n} \begin{pmatrix} \sum_{i=1}^n x_i^2 & \sum_{i=1}^n x_i y_i \\ \sum_{i=1}^n x_i y_i & \sum_{i=1}^n y_i^2 \end{pmatrix} \text{Where}$$

$$\text{var}(x) = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2 = \frac{1}{n} \sum_{i=1}^n x_i^2$$

$$\text{cov}(x,y) = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) = \frac{1}{n} \sum_{i=1}^n x_i y_i$$

$$\text{var}(y) = \frac{1}{n} \sum_{i=1}^n (y_i - \bar{y})^2 = \frac{1}{n} \sum_{i=1}^n y_i^2$$

Where x and y are the coordinates for feature i, (X Y) represent the Mean Center for the features and n equals to the total number of features. The sample covariate matrix is factored into a standard form which results in the matrix being represented by its Eigen values and eigenvectors. The standard deviations for the x- and y-axis are then:

$$\sigma_{1,2} = \left( \frac{\left( \sum_{i=1}^n x_i^2 + \sum_{i=1}^n y_i^2 \right) \pm \sqrt{\left( \sum_{i=1}^n x_i^2 - \sum_{i=1}^n y_i^2 \right)^2 + 4 \left( \sum_{i=1}^n x_i y_i \right)^2}}{2n} \right)^{1/2}$$

It is noteworthy that in order to calculate the percentage growth of HCC in 1996, the comparison of the number of centers from 1986 to 1996 was used.

## Results

Results showed that in 1996 (48.15%), 2006 (47.85%) and 2016 (36.12%) of the total elderly population of Kermanshah metropolis did not have proper access to HCC (Table 1).

Figure 1 shows the growth of HCC, and also the population of the elderly of Kermanshah who had poor access in 1996-2016. Accordingly, we are seeing an increase of 14% in the period of 1996-2006 and a significant increase in the construction of new HCC in the period of 2006-2016 (136%). In addition, the elderly population with inappropriate access had a slight downward trend.

Figure 2 shows the coverage and spatial distribution of HCC in Kermanshah during 1996-2016. Statistics showed that Kermanshah metropolis had a population of 693157 people with 29 HCC in 1996. In 2006, the city had a population of 794863 with 33 HCC, and in 2016, the population has increased to 946651, and HCC to 78. Analysis showed that HCC grew by 13.79% during 1996 to 2006 and increased by 136.6% during 2006-2016.

According to Figure 3 and the results of the SDE test during the study period, the trend of expansion of the city has been to the north-east and south-west while the trend of expansion of HCC has been towards the north-west and west. At the same time, the trend of expansion of the aging population was to the south and central parts of the Kermanshah metropolis.

## Discussion

This study is one of the leading studies in Iran that has investigated the status of geographic access of elderly to HCC using GIS and network analysis. The results of this study showed that inappropriate access to HCC in the elderly population of Kermanshah metropolis had a slight downward trend during 1996-2016; however, at the end of the study period, more than 30 percent of the geriatrics still did not have appropriate access to HCC. These results are consistent with the studies of Sharifzadegan et al. (23), Ebrahimzadeh et al. (24), Ahadinejad et al. (25) and Rashadat et al. (10). It should be noted that this study exclusively examined the elderly group, which was different from the target population in the above studies.

The study shows an increase in the number of HCC in the Kermanshah metropolis during 1996 to 2006; an increasing from about 29 HCC in 1996 to 33 in 2006, means about 14% growth. The number of these centers in 2016 reached 78 center, which has increased more than doubled. It is important to note that despite the significant increase in the number of HCC during 2006 to 2016, the elderly access to HCC during the same period has not increase in line with the increase in the number of centers. This situation reflects inappropriate spatial distribution of HCC in Kermanshah metropolis. These findings were in line with the results of the study by Reshadat et al. (2014), which examined the access of Kermanshah general population to HCC using GIS (11). The results of the SDE test also showed that the elderly population has expanded to the south and central parts of Kermanshah during 1996-2016, but the trend of expansion of HCC was to the northwest and west. This means the trend of expansion of HCC has

varied with the distribution of the elderly population. Despite the increasing number of HCC, it seems that due to the lack of attention to the growing needs of the elderly to the health care and easy access to health services, there has been no significant improvement in elderly access to HCC. In fact, the share of the elderly in access to HCC is low, despite the significant increase in both the elderly population and HCC over a 20-year period. Consequently, despite the doubling of HCC during this period, more than one-third of the elderly still do not have adequate access to HCC. Health sector policies and programs seem to have failed to provide adequate and equitable access for elderly people in Kermanshah metropolis. Other studies have also shown the impact of adopting incorrect management strategies on resource wastage in this area (26). Failure to meet the principle of social justice and responding to life needs will create some threats for vulnerable groups such as the elderly. It will also lead to an increase in injustice and inefficiency in the health management system, and a misspending the budget. Elderly access to HCC services is more important when the elderly live alone and are isolated from those around them (27).

The results of this study showed that the population with inadequate access was slightly higher in the elderly men group (Table 1). Although this finding is not definitive but should be considered as an important point in future policy making considering this fact that the tendency and use of health services are more pronounced in women and they are more concerned with their health issues (28-31). Qian et al. (2017) also noted gender differences in the tendency to using governmental care among the elderly in China (32). According to the study by Khayatan et al. (2010), gender identified as one of the moderately influencing factors on access to HCC facilities (33). It should be noted that the previous study (33), had the methodological differences with our study, in which the factors affecting citizen access were identified based on the views of HCC staff.

On the other hand, some HCC in Kermanshah especially the new ones that have been established in recent years, do not have a fixed location and their buildings are rented. These centers may be relocated annually and their accessibility may change, which may have a negative impact on access for the elderly and should be a particular concern of health managers and policymakers. This situation can also threaten other segments of society including women and children, in which we need to conduct further researches to determine the accessibility of other population groups to HCC in Kermanshah. One of the limitations of our study was the renting HCC which can change the reliability and sustainability of our results. In this study, we were not able to measure the accessibility of elderly people with disability, motor paralysis, and Alzheimer disease, so it is recommended that future studies be conducted to determine their accessibility.

## **Conclusion**

Over the 20-year period from 1996 to 2016, the population of the elderly with inappropriate access to HCC in Kermanshah declined and at the same time the number of HCC doubled but still more than one-third of the elderly in Kermanshah do not have appropriate access to health facilities. This situation indicates inappropriate spatial distribution of HCC in Kermanshah metropolis and should be considered as a challenge by health managers and policy makers.

# Declaration

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## Authors' contributions

AA and SHS apprehended the idea. AZ designed and analyzed it. MKH, YS, MS, NRG interpreted the results and drafted the manuscript. All the authors take responsibility for the integrity of the work as a whole from inception to published article. AA is the guarantor. All the authors read and approved the final manuscript.

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## Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics approval and consent to participate

This study received ethics approval from the Research Ethics Committee of Kermanshah University of Medical Sciences (No: IR.KUMS.REC.1397.275).

## Consent for publication

Not applicable.

## Competing interests

The authors declare that they have no competing interests.

# Abbreviations

HCC: Health Care Centers; GIS: Geographic Information System; SDE: Standard Deviation Ellipse

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## Table

Table 1: Comparison of appropriate and inappropriate access in elderly men and women of Kermanshah during 1996 to 2016

		1996		2006		2016	
		N	%	N	%	N	%
Male	Population with appropriate access	9328	51.77	10608	51.41	17561	63.16
	Population with inappropriate access	8689	48.23	10026	48.59	10241	36.86
	Total	18017	100	20634	100	27802	100
Female	Population with appropriate access	7643	51.95	9623	53	19305	64.55
	Population with inappropriate access	7069	48.05	8535	47	10600	35.46
	Total	14712	100	18158	100	29905	100
Total population	Population with appropriate access	16971	51.85	20231	52.15	36866	63.88
	Population with inappropriate access	15758	48.15	18561	47.85	20841	36.12
	Total	32729	100	38792	100	57707	100

## Figures

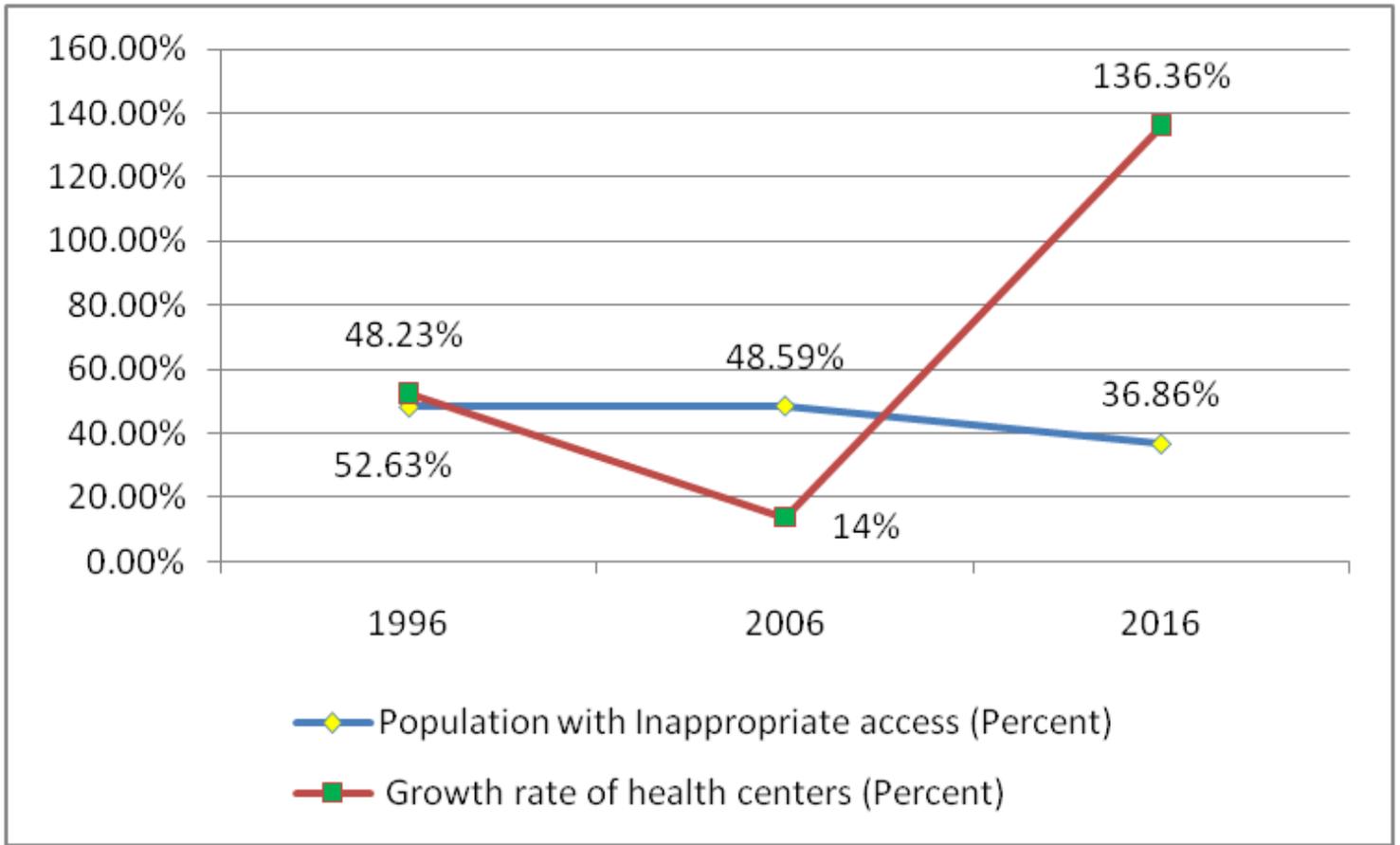
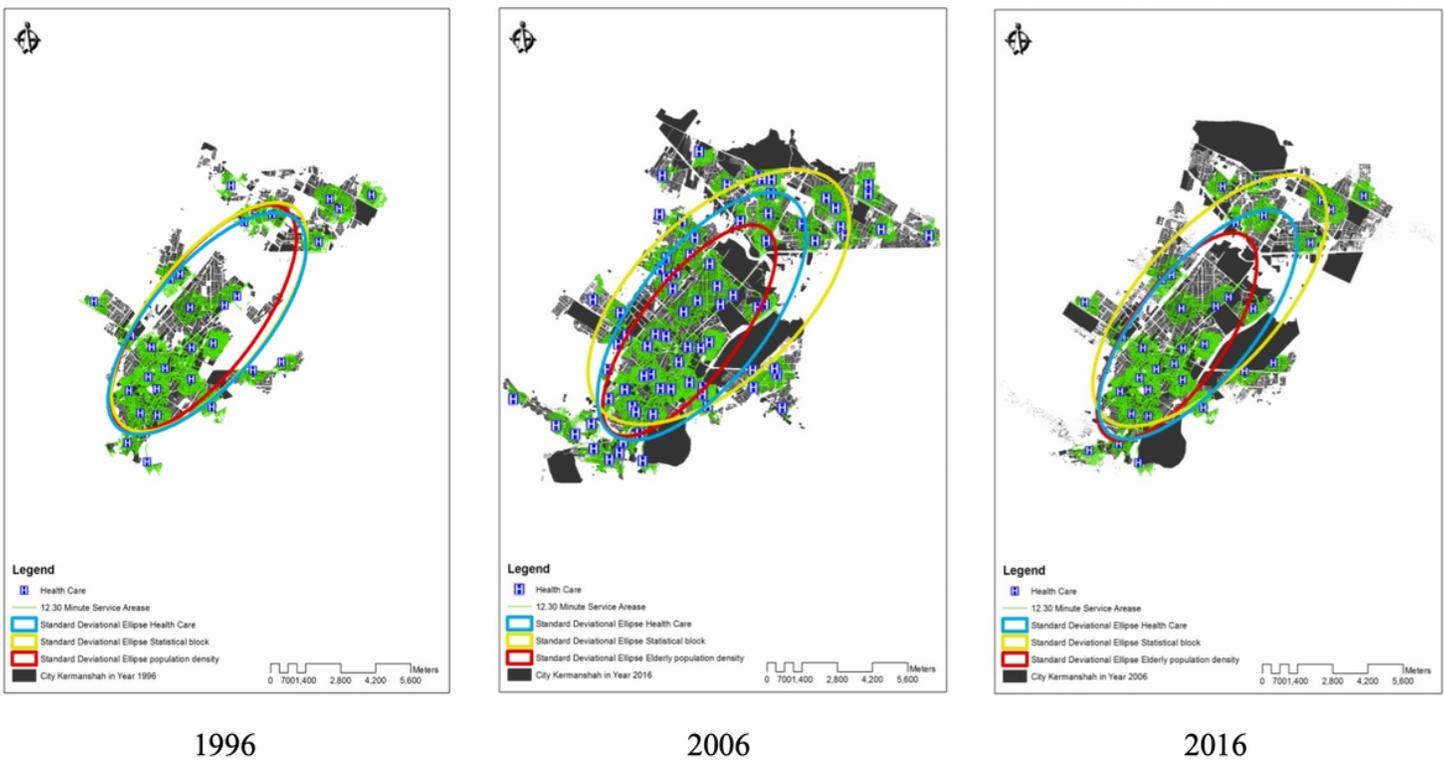


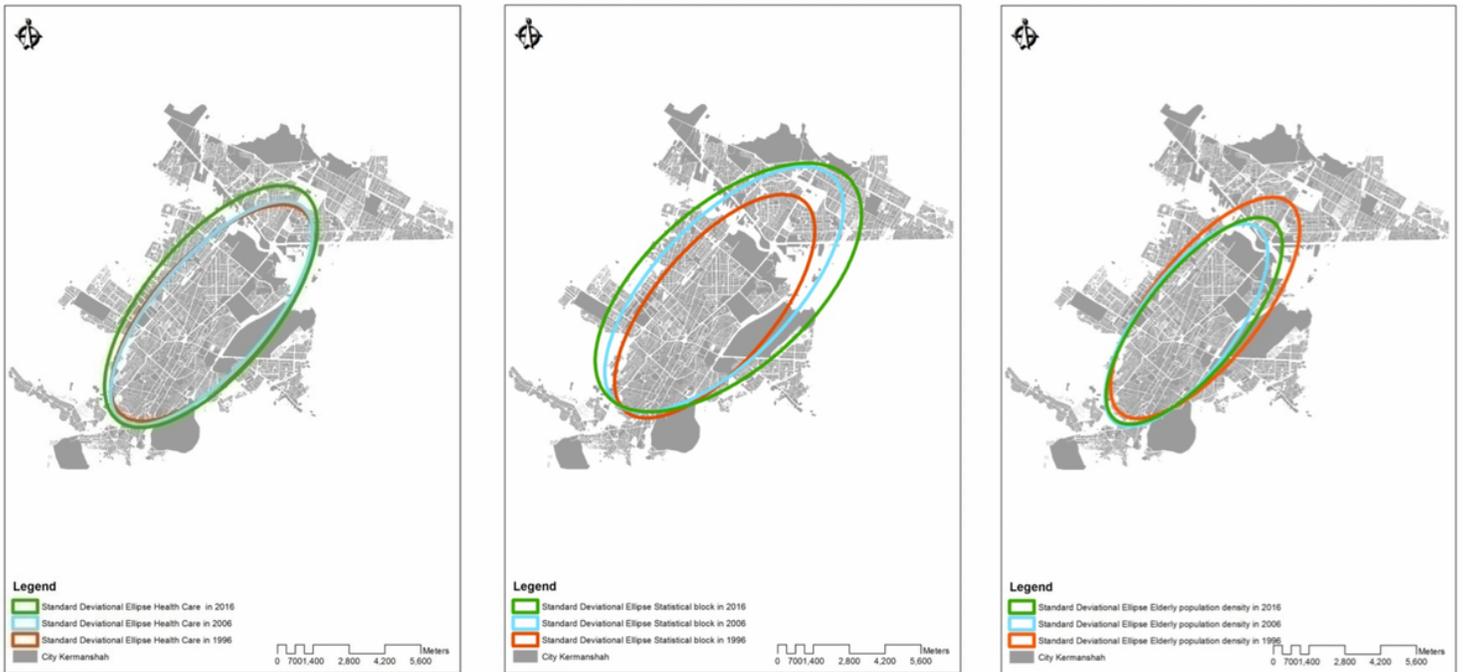
Figure 1

Status of access to HCC and elderly population of Kermanshah in the years 2016-2006-1996



**Figure 2**

Coverage and spatial distribution of HCC during the period of 1996-2016



**Figure 3**

The expansion trend of HCC, city, and the elderly population using SDE over the period 1996-2006-1996