Original Article

Assessing Development Levels of Kerman City in Terms of Health Indicators Using the Numerical Taxonomy

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Abstract

Introduction: Understanding the development situation is regarded necessary in order to plan to achieve the optimal development. This understanding involves separating study regions from planning areas, evaluating the separate regions via development indicators, and ranking each area in terms of having development blessings. Therefore, this study aimed to stratify Kerman province districts in terms of health indicators using taxonomy models.

Materials & Methods: This descriptive study was conducted on the stratification of 16 Kerman Province districts based on 10 selected health indicators using taxonomy models. The study data were collected by the researcher from statistical center of Iran as well as Kerman University of Medical Sciences. In order to analyze the data, SPSS.19 and Excel 2010 softwares were utilized.

Results: The taxonomy model results revealed Baft district (0.46) and Rigan district (0.96) as the most and least developed districts, respectively. Moreover, 31.25% of the studied cities were moderately developed, 37.5% were less developed and others were the least developed ones.

Conclusions: A relatively large difference can be observed between cities in regard with their health sectors. Most of the cities did not demonstrate satisfactory status concerning healthcare indices. Therefore, formulating plans on how to allocate resources for the health sector in order to improve the health status of the cities demand to be essential for the policy makers.

Keywords: Development; Health Care; Taxonomy

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Introduction

Nowadays development is one of the significant concerns of many countries. In other words, development means satisfying the people's living conditions [1]. To achieve the development, planning is an undeniable necessity. However, the first step to achieve success in planning and development is i real identifying the level of capabilities, limitations, and regional imbalances [2].

Formulation of development strategies in implementing schemes, identifying the strengths, and deficiencies, as well as determining the levels of development of regions based on a set of appropriate indices is an inevitable necessity for effective regional planning. Thereby, the executive level managers have this opportunity to identify the development strategies and provide some programs in accordance with the conditions of the region [3].

Equitable distribution of facilities and the development are the most important properties among the majority of dynamic and healthy economies. The planners, to achieve these goals, have endeavored to reduce inequalities and imbalances through implementing numerous programs of deprivation and expanding all-round positive aspects of the development.

The basic step in this regard involves the development of effective programs consistent with reality, achieving the superior goal of social justice via recognizing the existing condition [4]. Inequality and its dimensions are introduced as the signs of underdevelopment. In fact, in developed countries, high economic and social indices as well as income distribution and facilities are reported relatively fair, whereas in underdeveloped countries, levels of these indicators and their distributions are unfair [5]. Determining the status of the provinces in terms of development planning and the fair distribution of facilities as well as development benefits in the society seems to be essential.

To achieve this, the planners of different societies and communities have made an effort to reduce inequalities via executing multiple programs aimed to eradicate the poverty [6]. The regional studies in different countries indicated that some areas d revealed a better performance compared to other areas of the country, leading to better growth and development. Hence, planners will be able to benefit from the experience of the managers in different parts of the region provided they can identify the factors affecting the proper functioning of the areas and thus, planners can allocate the optimum allocation of funds [7].

Within the different developmental indices, the health indicator is one of the most development indicators of the country, due to its high role in the people's

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health. As a matter of fact, it is introduced as the most important indicator of progress and success in any country. The national development programs largely depend on the objectives of this sector to be achieved [8]. Improving health indicators leads to the human, society and finally country development [9].

In the past decades, a brief look at health indicators in the country revealed the rapid development of indicators on the one hand, and the inequality in some indicators in the regions and different provinces of the country on the other hand [10]. In any case, Iran like other developing countries is necessitated to ameliorate its position within the developed countries of the world and needs paid more attention to the development of the health sector, since improving development in this sector is a prerequisite for the development of other sectors of country [11, 12].

Several studies have been conducted in the field of development, utilization level of educational programs and health services using multiple methods. Noorbakhsh, in ranking the provinces of the country, demonstrated Tehran and Qom provinces as highly developed provinces and Sistan-o-Baluchistan Province as the least developed province [13]. SayehMiri (2011), in a study using numerical taxonomy, concluded that the cities of Ilam, Mehran, DarrehShahr, and Dehloran have developed, whereas the cities of Shirvan, Chardavol, Eivan, and Abdanan were proved to be underdeveloped [14]. In the present study, the selected indicators of health were ranked simultaneously based on the numerical taxonomy.

Numerical taxonomy is used to evaluate similarities between taxonomic units as well as ranking those elements as taxonomic groups. In this method, a set series will be divided into more or less homogeneous subsets and other options will be deleted. Then, among the remaining homogeneous sets, the options will be ranked using Multiple Attribute Decision-making (MADM) Methods. The distinctive feature of numerical taxonomy involves measuring the target of homogeneous various topics based on their distances to each other. [15]. Recognizing the inequalities and imbalances within the different geographical areas leads to assessing current situation of country, province, city and, therefore, understanding the existing differences and the policy making process to reduce inequalities [16].

This study, using the numerical taxonomy model, intended to examine the condition of health indicators in Kerman province as well as to determine the level of development and deprivation in these areas.

Materials and Methods

In this descriptive applied study, the health level of counties of Kerman has been investigated using the numerical taxonomy based on health indicators in 2011.

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Therefore, the geographic scope of the study is Kerman, where its statistical population consists of 16 counties (Zarand, Baft, Bam, Bardsir, Fahraj, Faryab, Jiroft, Kahnuoj, Kerman, Normashir, Rabar, Rafsanjan, Ravar, Rigan, Shahrebabak and Sirjan).

After evaluating the literature review and expert opinions, 10 indicators were considered as health indicators including active medical institutions to thousand populations ratio (I1), number of beds in active medical institutions to thousand populations ratio (I2), healthcare institutions to thousand populations ratio (I3), public healthcare institutions to active healthcare institutions ratio (I4), daily healthcare institutions to active healthcare institutions ratio (I5), circadian healthcare institutions to active healthcare institutions ratio (I6), the number of laboratories to thousand populations ratio (I7), the number of pharmacies to thousand populations ratio (I8), radiology centers to thousand populations ratio (I9), and rehabilitation centers to thousand populations ratio (I10).

The study data were collected using a data collection form developed by the researchers including questions on the counties' names, number of active medical institutions, available beds, number of healthcare institutions, number of public healthcare institutions, number of daily healthcare institutions, number of circadian healthcare institutions, number of laboratories, number of pharmacies, radiology centers, rehabilitation centers, and city population.

The data were also collected from the Center of Statistics and Kerman University of Medical Sciences. After completing the forms, the rank of city development was calculated using the numerical taxonomy through Excel 2010 and SPSS softwares (Ver 19) respectively.

Analysis method of taxonomy is regarded as one of the common methods concerning the development level evaluation of the areas or points, and categorizing them as homogeneous sets recommended in 1968 by UNESCO in order to assess the development level of the countries. In this method, normally one of the parts of the studied region is selected, based on which other areas will be rated. Therefore, the distance between each zone of the area is determined from the ideal point. Steps of the numerical taxonomy analysis are shown in figure 1 [17, 18].

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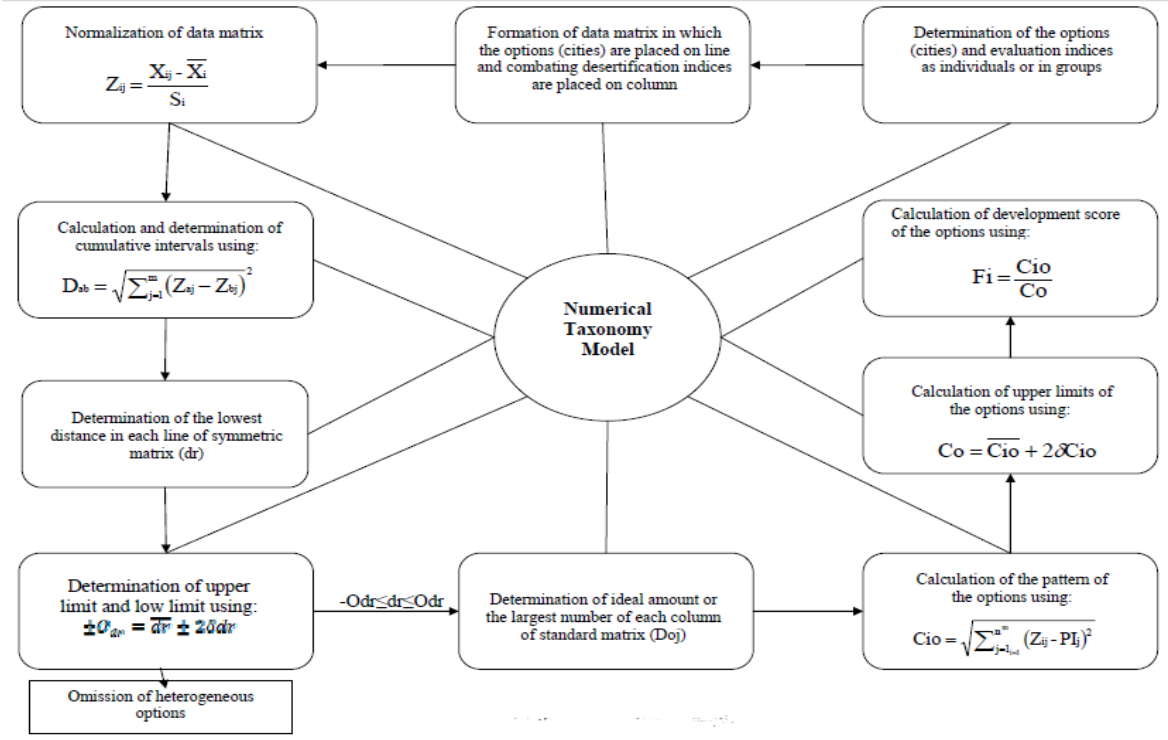


Fig 1: Steps of numerical taxonomy analysis

Results

In the first stage of the study, matrix taxonomy indicators were formed based on the Kerman cities (Table 1).

Table 1: Matrix of Development Indicators

Cities	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
Zarand	0.0133	1.246	0.1525	0.1739	0.0928	0.0663	0.0199	0.0464	0.8261	0.8261
Baft	0.0132	1.619	0.158	0.1667	0.1449	0.1053	0.0263	0.0527	0.8333	0.8333
Bam	0.0051	0.163	0.0511	0.1	0.0256	0.0665	0.0256	0.0153	1	0.9
Bardsir	0.0136	0.434	0.1492	0.2727	0.1085	0.0542	0.0136	0.0271	1	0.7273
Fahraj	0	0	0.0588	0.25	0	0.0147	0	0	1	0.75
Faryab	0	0	0.1162	0	0.0291	0.1162	0	0	1	1
Jiroft	0.0055	1.982	0.077	0.0357	0.0907	0.0935	0.0082	0.0137	0.9286	0.9643
Kahnoj	0.003	0.271	0.1025	0.1176	0.0573	0.1327	0.009	0.003	1	0.9118
Kerman	0.0166	2.581	0.0844	0.377	0.0775	0.1675	0.0567	0.0554	0.5246	0.623
Normashir	0	0	0.0859	0	0	0.0343	0	0	1	1
Rabar	0	0	0.3198	0	0	0.0582	0	0	1	1

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Cities	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
Rafsanjan	0.0093	1.485	0.1547	0.34	0.0773	0.1052	0.0278	0.0248	0.76	0.66
Ravar	0.0248	0.694	0.273	0	0.0993	0.0745	0.0248	0.0496	1	1
Rigan	0	0	0.0452	0.3333	0	0.0301	0	0	1	0.6667
Shahrebabak	0.0111	0.751	0.1547	0.1429	0.0884	0.0774	0.0111	0.0221	1	0.8571
Sirjan	0.0075	0.978	0.0747	0.25	0.0672	0.0859	0.0336	0.0448	0.7	0.75

In the second step of the numerical taxonomy, standardizing the data matrix, each of the matrix elements were changed to a standard one in order to remove the effect of different units and replace the scale unit. As it was illustrated in Table 2, data matrix was turned into the standard matrix.

Table 2: Matrix of standardized development indicators

Cities	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
Zarand	0.7585	0.5934	0.3107	0.1053	0.7224	-0.3491	0.2411	1.1325	-0.5898	-0.1184
Baft	0.7461	1.0516	0.3825	0.0505	1.8644	0.6347	0.6452	1.4253	-0.5393	-0.064
Bam	-0.3486	-0.7359	-1.008	-0.4538	-0.754	-0.3451	0.5967	-0.3202	0.6212	0.4371
Bardsir	0.7995	-0.404	0.2675	0.8527	1.0664	-0.6528	-0.1557	0.2308	0.6212	-0.8612
Fahraj	-1.0433	-0.9367	-0.9083	0.6808	-1.3151	-1.6493	-1.006	-1.0372	0.6212	-0.6903
Faryab	-1.0433	-0.9367	-0.1612	-1.2101	-0.6773	0.9088	-1.006	-1.0372	0.6212	1.1888
Jiroft	-0.2961	1.4969	-0.6715	-0.94	0.6766	0.3359	-0.4888	-0.3945	0.1238	0.9203
Kahnoj	-0.6336	-0.6036	-0.3393	-0.3203	-0.0574	1.3236	-0.4388	-0.8963	0.6212	0.5256
Kerman	1.2137	2.2321	-0.5747	1.6417	0.3863	2.2003	2.5519	1.5511	-2.6891	-1.6453
Normashir	-1.0433	-0.9367	-0.556	-1.2101	-1.3151	-1.1542	-1.006	-1.0372	0.6212	1.1888
Rabar	-1.0433	-0.9367	2.4876	-1.2101	-1.3151	-0.5544	-1.006	-1.0372	0.6212	1.1888
Rafsanjan	0.2179	0.8863	0.3393	1.3615	0.3827	0.6309	0.7398	0.1199	-1.0499	-1.3668
Ravar	2.329	-0.0837	1.8781	-1.2101	0.8639	-0.1437	0.5499	1.2832	0.6212	1.1888
Rigan	-1.0433	-0.9367	-1.0847	1.3111	-1.3151	-1.26	-1.006	-1.0372	0.6212	-1.3167
Shahrebabak	0.4583	-0.0143	0.3394	-0.1296	0.6254	-0.0706	-0.3132	-0.004	0.6212	0.115
Sirjan	-0.0281	0.2647	-0.7012	0.6808	0.1609	0.1452	1.1019	1.0584	-1.4677	-0.6903
Max	2.329	2.2321	2.4876	1.6417	1.8644	2.2003	2.5519	1.5511	0.6212	1.1888

The third step, related to calculating the distances and distance matrix (composite), the distance of each city was compared to other cities (two by two) and then, Dab formula calculated the composite distances based on the sets of indicators. It should be

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noted that matrix composite distances were symmetrical and its diagonal elements were zero (Table 3).

Table 3: Composite intervals Matrix of Kerman province

	Zarand	Baft	Bam	Bardsir	Fahraj	Faryab	Jiroft	Kahnoj	Kerman	Normashir	Rabar	Rafsanjan	Ravar	Rigan	Shahrebabak	Sirjan	The shortest distance
Zarand	0	1.66	3.35	2.18	4.62	4.53	2.98	3.72	4.99	4.72	5.07	2.47	3.24	4.81	1.93	2.12	1.66
Baft	1.66	0	4.36	3.02	5.92	5.22	3.3	4.21	4.52	5.89	6.03	2.81	3.49	6.03	2.76	2.74	1.66
Bam	3.35	4.36	0	3.27	2.86	2.65	3.08	2.29	6.8	2.43	4.16	4.07	4.72	3.31	2.47	3.37	2.29
Bardsir	2.18	3.02	3.27	0	3.76	4.49	3.74	3.5	6.14	4.59	5.01	2.87	3.92	3.78	1.67	3.2	1.67
Fahraj	4.62	5.92	2.86	3.76	0	3.82	4.54	3.72	8.07	2.73	4.45	4.76	6.46	0.99	3.71	4.6	0.99
Faryab	4.53	5.22	2.65	4.49	3.82	0	3.16	1.56	8.04	2.2	3.09	5.17	5.25	4.31	3.14	4.94	1.56
Jiroft	2.98	3.3	3.08	3.74	4.54	3.16	0	2.68	6.37	3.71	4.72	3.94	4.52	4.92	2.4	3.78	2.4
Kahnoj	3.72	4.21	2.29	3.5	3.72	1.56	2.68	0	6.85	3.1	3.87	3.96	4.89	3.94	2.33	3.97	1.56
Kerman	4.99	4.52	6.8	6.14	8.07	8.04	6.37	6.85	0	8.7	9.03	3.78	7.04	7.8	6.28	3.92	3.78
Normashir	4.72	5.89	2.43	4.59	2.73	2.2	3.71	3.1	8.7	0	3.1	5.67	5.62	3.6	3.57	5.16	2.2
Rabar	5.07	6.03	4.16	5.01	4.45	3.09	4.72	3.87	9.03	3.1	0	5.84	5.02	5.09	3.95	5.97	3.09
Rafsanjan	2.47	2.81	4.07	2.87	4.76	5.17	3.94	3.96	3.78	5.67	5.84	0	5.09	4.54	3.12	1.98	1.98
Ravar	3.24	3.49	4.72	3.92	6.46	5.25	4.52	4.89	7.04	5.62	5.02	5.09	0	6.88	3.26	4.97	3.24
Rigan	4.81	6.03	3.31	3.78	0.99	4.31	4.92	3.94	7.8	3.6	5.09	4.54	6.88	0	4	4.56	0.99
Shahrebabak	1.93	2.76	2.47	1.67	3.71	3.14	2.4	2.33	6.28	3.57	3.95	3.12	3.26	4	0	3.23	1.67
Sirjan	2.12	2.74	3.37	3.2	4.6	4.94	3.78	3.97	3.92	5.16	5.97	1.98	4.97	4.56	3.23	0	1.98

In the fourth stage, in order to verify the homogeneous cities, high level, L1, and low level, L2 calculated using least of matrix of composite intervals (Table 4).

Table 4: Matrix of composite intervals (L1 and L2)

mean	2.04	**L1**	**L2**
Standard deviation	0.77	3.58	0.5

At the last stage, an indicator was demanded in order to rank the cities according to the development degree. Therefore, the cities were compared to each other, and ranked according to their distances. Moreover, we determined the highest score of each variable as basic model and compared all cities with basic model. The distances of each city from the model city was calculated in terms of each indicator, which represented composite distances between each city and the model city, shown as Cio (Table 5).

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Table 5: Ranking of Kerman cities and the development degree

city	grade	Cio	Fi
Baft	1	4.46	0.46
Ravar	2	4.94	0.51
Zarand	3	5.36	0.55
Rafsanjan	4	5.5	0.56
Kerman	5	5.64	0.58
Shahrebabak	6	5.9	0.61
Bardsir	7	6.07	0.62
Sirjan	8	6.15	0.63
Jiroft	9	6.5	0.67
Kahnoj	10	6.96	0.71
Bam	11	7.34	0.75
Faryab	12	8	0.82
Ravar	13	8.16	0.84
Normashir	14	8.92	0.91
Fahraj	15	9.04	0.93
Rigan	16	9.06	0.93

Based on the taxonomy model, Baft city was the most highly-developed city (0.46) and Rigan city was the least underdeveloped city based on the development degree (0.93) (Table 5). Moreover, 31.25% of the studied cities were moderately developed, 37.5% were less developed and others were the least developed ones (Table 6).

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Table 6: The development of the studied cities

Development status	city	Frequency (percent)	Fi (Range of Development)
Highly developed	-	0	**0-0.2**
moderate to high Development	-	0	**0.21-0.4**
moderately developed	Baft - Ravar - Zarand - Rafsanjan - Kerman	5(31.25%)	**0.41-0.6**
less developed	Shahrebabak - Bardsir - Sirjan - Jiroft - Kahnoj - Bam	6(37.5%)	**0.61-0.8**
the least developed	Faryab - Ravar - Normashir - Fahraj - Rigan	5(31.25%)	**0.81-1**

Discussion

According to the development degree-based taxonomy, Baft city was the most highly-developed city (0.46%) and Rigan city was the least developed one (0.93%). As it was demonstrated, a large gap can be observed in utilizing health structural indicators among the cities of Kerman Province.

The results of ghazanfarpour's study revealed that among the cities of Kerman province, the over-concentration rate was related to Kerman city, the above-concentration rate belonged to Rafsanjan, the med-concentration rate was obtained by Baam, Jiroft, and Sirjan, and the under-concentration rate was reported for Zarand, Kahnouj, Shahrbabak, Bardsir, Anbarabaad, Ravar, Southren Roudbar, Fahraj, Anar, Rigan, Manoujan, Ghaleh Ganj, and Kouhbanan[19].

In another study conducted by Taghvae and Mosayebi, Kerman city with index of 0.89 was the most highly developed city of the province, whereas the Kuhbanan city with index of 0.11was demonstrated as the least developed city in the province [20].

The results of Mahani and colleague's study in kerman province, based on the human Development Index shows that Rafsanjan in 2001 and Sirjan in 2007, have won the first place. In these years, Ravar and Baft cities were demonstrated to have the lowest human development index. The low size of this index can be related to the lack of resources, not lack of proper use of resources [21].

In the present study, Ravar and Baft cities were moderately developed. These cities have great distances to center of Kerman province. However, so far the results of various studies conducted in Kerman shows less development of cities in Kerman province with greater distance-specially in

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south of province- to center, and more attention is required to be paid to the southern cities of the province. In a study conducted by Taghvaei, the same results were found in all cities of the country, where far provinces than Tehran got the lowest score of development in comparison to other provinces [22]. Nastaran and Zarabi results in Isfahan province showed that cities with great distances to center of province had the worst situations in comparison to other cities [8]. Moreover, results of Valyaspour study showed that in North Khorasan province, cities with less distances to central city of province had better situations in terms of development indicators in health [11].While it can be said that developed cities in terms of structural indicators of health cannot lead to the high quality of health care services. In other words, less developed regions are facing with problems related to quantity of infrastructures and quality problems in health services are largely based on method of resources organizing, Characteristics of the service and other related factors.

As a result, implementing the facility allocation policy could pave a way in order to provide more availability of facilities. The strengths of such studies entails outlining the conditions, regional facilities and capabilities and then performing the regional planning based on the development level of these regions. As the results indicated, 31.25% of the studied cities were moderately-developed, 37.5% were less developed and others were the least developed.

In the study of taghvae and mosayebi, 25% of Kerman cities were posited in a poor class, 37.5% were of the deprived class, 25% belonged to the middle class and others were developed and very developed [20].

The results of a study carried out by Hamozadeh and colleagues [23], in ranking the cities of West Azerbaijan Province in terms of utilizing health indicators, demonstrated that three cities of Mahabad, Naghadeh, and Urmia were considered as highly developed cities and two cities of Khoy and Bukan were known as relatively developed cities. Takab, Maku and MianDoab were considered as moderately developed cities and five cities of Salmas, ShahinDej, Sardasht, Oshnavieh, and Chalderan were reported to be less developed. Bahadori et al.[24], investigated the cities of Golestan province, and reported a big difference between the highest and the lowest levels of development. The difference in the studied cities was largely due to the differences in access to health indicators. However, the differences among different regions can be related to such items such as the kind of geographic location (socio - economic development, etc.), being away from the provincial capital, the level in which the society was located (stages of development economic growth in the mentioned society), the performance of healthcare organizations in the region, and the trust level of local people to these

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organization, the infrastructure facilities, the decentralization policy in the region, the policies for human resources distribution at the Golestan University of Medical Sciences as well as the inability of the relevant units on the competence and skill of the personnel. Furthermore, the results of the resources distribution, based on the model used, could be applied as the default model in assessing the levels of access, justice in the resources distribution, and finally the possibility of development planning in this sector.

Conclusion

Indicators of the health sector like any other indicators in the third world countries were not equally distributed among the regions and geographical areas. Iran is not an exception and the development gap index was observed in different cities. Therefore, to achieve a fair and balanced situation of the health development in the province, making some attempts are recommended according to the of development state of cities in the field of healthcare and evidence-based planning in order to reduce the gap in regard with the allocation of health facilities among these cities.

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