



Classification of Health Structural Indicators Using Scalogram Model in Golestan Province, Northern Iran

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Abstract

Background: One of the main and basic pillars of health system promotion is the equitable distribution of health facilities in order to ensure fair access of people in the community to the health services. The goal of this study was to classify the health structural indicators in Golestan Province using Scalogram analysis model.

Method: A descriptive study was conducted in 2010. Data related to indicators in 3 categories of institutional, human resources and rural health and their indicators were collected using statistical yearbook. Data analysis was done using SPSS software and scalogram analysis model.

Results: There is large gap between health structural indicators in cities of Golestan Province. Aq Qala City with 97 score and Azad Shahr City with 41 score were the most and lowest scores respectively from enjoyment of health structural indicators. Generally, 18% of cities were in less developed level and only 27% of cities were developed level.

Conclusion: To achieve a fair and balanced healthcare status in different provinces based on their state of development, plans should be arranged in order to reduce the gap in the access to healthcare facilities.

Keywords: Health, Indicator, Scalogram, Iran

Introduction

Fair distribution of facilities and services is a sign of a robust economy that can be achieved through well-organized and comprehensive strategies and programs at the national level. However, in order to explore the status of regions and identify gaps, certain indicators are to be defined. Studies show that there is a huge gap between different regions of Iran in terms of fair access to services (1). To tackle this inequality, the first step is to categorize regions based on their development status and their access to services, be it economic, social, cultural, or health care (2). Noticeably, the impor-

tance of healthcare system to support physical and mental health of people in the society cannot be neglected. Hence, health indicators should be improved in order to facilitate human and social development and enhance the development level in the society. Overall, equitable distribution of health services and fair access to them by different groups of people in rural and urban areas is considered as a mission of health system (3), as it will ensure relative welfare and a healthier lifestyle for people in the society (4-5). Furthermore, the information analysis related to health problems and

coverage rate of present services and their impacts can help to prioritize health needs (6). As an important component of development, health services should be based on clear programs, policies, and goals (7). To do so, an initial health need assessment is inevitable to identify the real needs of people and obtain the desirable level of health services (8). Studies show that one of the major problems in providing health services in developing countries is lack of health facilities and human resources and wrong distribution of them in rural and urban areas (9). Moreover, the imbalance in supply and demand of health human resources and improper organizing of human resources has caused inefficiency in health services (10). In most developing countries, the required health standards to prevent and control infection diseases are very low. While the goal of health system in these countries is to cover the whole country, the most significant gap is observed between big cities and small cities, as well as rural and urban areas (4, 11). A quick view at health indicators during the last decade in Iran shows that despite the increasing trend of indicators, inequity exists in certain indicators for some regions and provinces of country (12).

In Iran as a developing country, the nationwide rate of welfare and accessibility to facilities is not uniformly distributed and there is a significant difference in terms of social aspects (13). In order to perform spatial analysis and recognition of regional disparities, there are numerous models including the factor analysis, simple population, functional approach, spatial triangle model, numerical taxonomy, and Scalogram model (14-18). One of the important methods in planning is Scalogram model, which was first used by geographers to show functional foundations of urban areas hierarchy (19). Scalogram classifies cities of a region based on the number and the kind of performance despite limited availability of data (20). This method uses a selection of variables that indicate development in a region over a one-year time (21).

Result of a study in Iran showed that there is large gap between rural areas in terms of development indicators using Scalogram model (22). In addition, a research in Isfahan proved a large gap among cities of province in terms of possession of health indicators (23). In another survey, the status of children health in provinces of Iran and its relationship with socioeconomic factors was investigated (13). Furthermore in other study, provinces of Iran were classified according to 35 development indicators (24). Finally, other researchers in a different county such as Portugal classified different regions using economic, educational, cultural and health indicators applying multivariate statistical techniques, factor analysis and cluster analysis (25).

The objective of this study was to use Scalogram model for evaluating health structural indicators in cities of Golestan province and to determine development rate for planning and resource allocation in order to reduce heterogeneity in the cities.

Material and Methods

This study is a descriptive study for system evaluation. Data related to primary indicators (n=30) was taken from the statistical yearbook of 2010 and data related to population of cities as obtained from documentations of Iran Statistical Center. These indicators were selected due to structural nature and availability of statistical data for them. The Scalogram analysis model consisted of four stages applied as it follows:

Stage 1: Indicators selection - In the first stage, proper indicators were selected. To do so, thirty indicators were selected and were categorized under the three main categories of Institutional (n=14), Human Resources/Manpower (n=20), & Rural Health (n=3) indicators. These indicators were selected by the experts and bases on the availability of data related to them (Table 1).

Table 1: Structural indicators extracted from the statistical yearbook of *Golestan* province

Code	Category	Indicator
1	Institutional Indicators	1) Proportion of active treatment centers to every 1000 people, 2) proportion of active treatment centers affiliated of Medical Science University to every 1000 people, 3) proportion of private active treatment centers to every 1000 people, 4) proportion of active beds of treatment centers to every 1000 people, 5) proportion of active beds of treatment centers affiliated of Medical Science University to every 1000 people, 6) proportion of active beds in private treatment centers to every 1000 people, 7) proportion of health centers to every 1000 people, 8) proportion of urban health centers to every 1000 people, 9) proportion of health centers affiliated of Medical Science University to every 1000 people, 10) proportion of private health centers to 1000 people, 11) proportion of laboratory to every 1000 people, 12) proportion of pharmacy to 1000 people, 13) proportion of radiology centers to every 1000 people, 14) proportion of rehabilitation centers to 1000 people
2	Human Resources Indicators	1) Proportion of internist to every 1000 people, 2) proportion of cardiologist to every 1000 people, 3) proportion of pediatricians to every 1000 people, 4) proportion of psychiatrists to every 1000 people, 5) proportion of dermatologist to every 1000 people, 6) proportion of general surgery specialist to every 1000 people, 7) proportion of urologist to every 1000 people, 8) proportion of orthopedist to every 1000 people, 9) proportion of neurologist to every 1000 people, 10) proportion of ENT specialist to every 1000 people, 11) proportion of eye specialist to every 1000 people, 12) proportion of gynecologist to every 1000 people, 13) proportion of anesthesiologist to 1000 people, 14) proportion of radiotherapist to every 1000 people, 15) proportion of pathologist to 10000 people, 16) proportion of dentist to every 1000 people, 17) proportion of pharmacologist to every 10000 people, 18) proportion of paramedical to 1000 people, 19) proportion of infectious diseases specialist to every 10000 people, 20) proportion of general practitioner to every 1000 people
3	Rural Health Indicators	1) Proportion of rural active health house to every 1000 people, 2) proportion of rural active health center to every 1000 people, 3) percentage of villages covered by rural active health house

Stage 2: In this stage, the mean and standard deviation for each indicator is calculated.

Stage 3: Evaluation of indicators and calculating the scores - Numeric value to these indicators were recorded in Scalogram model and in the meantime scorings have been ranked; where score 4, score 2, and score 1 indicate a positive, neutral, and negative status, respectively. Since there were 30 indicators identified, the maximum score to be given with regard to possession of healthcare facilities could be 120, whereas the minimum score could be 30.

Stage 4: Identifying development gaps between cities - For determining developmental gap of health structural indicators among cities, five classes including developed, somewhat developed,

moderately developed, less developed and under developed have considered. To that end, amplitude of changes (R) of scores was determined and then using the Sturges formula, the distance between classes was calculated. The SPSS software was used for the data analysis purpose.

$$i = \frac{R}{1 + 3.3 \log N}$$

Sturges Formula

I= class interval

R= range of classes

N= number of items that should be classified category

After calculating the development gaps, the cities were categorized based on their total score of access to healthcare indicators. Finally, GIS (Geographic Information System) was used to better display the results graphically and spatially.

Results

Results related to value of mixed indicators in Scatogram model were ranked after scoring was completed (Table 2). It was seen that three cities including Aq Qala, Gorgan and Gonbad-e-Kavus that scored 97, 95 and 85 respectively, were developed cities (27.27% of cities). Moreover, five cities

including Ramiayn, Kalaleh, Bandar-e- Gaz, Ali Abad, and Kord Kuy with scores of 84, 81, 80, 76, 72 were somewhat developed respectively (45.45% of cities). It was also found out that Minudasht city was moderately developed with the score of 69.

Table2: Status of development in cities of Golestan province according to health structural indicators

Group	Classes distance	Degree of enjoyment	City name	Number	Percent
1	84.36-97	Developed	Aq Qala, Gonbad-e-Kavus, Gorgan	3	27.27
2	71.71-84.35	somedeal developed	Bandar-e-Gaz, Ramiyan, Kord Kuy, Ali Abad, Kalaleh	5	45.45
3	59.06-71.70	moderately developed	Minudasht	1	9.9
4	46.41-59.05	less developed	Bandar-e-Torkaman	1	9.9
5	33.76-46.40	Under developed	Azad Shahr	1	9.9

In this study, Bandar-e- Torkaman city with score of 52 was less developed indicating an unsuitable status of healthcare indicators. Finally, Azad Shahr with a score of 41 was recognized as an under developed city representing undesirable status of healthcare indicators (Table 3).

Generally, among institutional indicators, the highest one belonged to the proportion of active bed per 1000 people. As for human resources indicators, the best indicator was for proportion of paramedics per 1000 people. Finally, among rural health indicators, the best performance belonged to the proportion of active health houses to 1000 people.

On the other hand, among institutional indicators, the lowest one belonged to the proportion of private active treatment centers to every 1000 people. As for human resources indicators, the lowest indicator was for proportion of cardiologist to every 1000 people, as well as proportion of dermatologist to every 1000 people. Finally, among rural health indicators, the lowest performance belonged to the percentage of villages covered by rural active health house.

The development status of healthcare indicators of the cities were displayed schematically in the GIS mode at 5 different levels (Fig. 1).

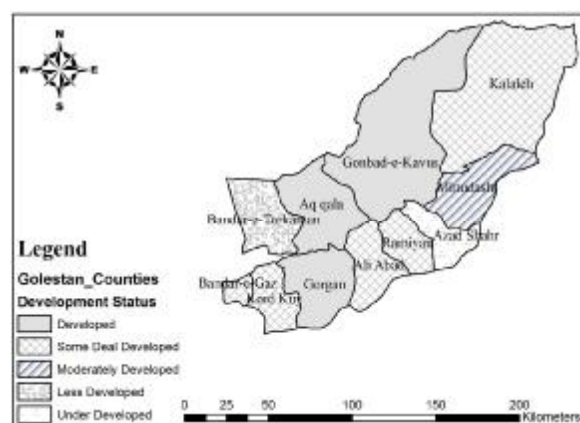


Fig.1: Status of development in cities of Golestan province

As it can be observed in the map, the development distribution of the healthcare institutional indicators for cities of Golestan province shows no geographical or locational relationship. Moreover, nearby Azad Shahr, the developed and somewhat-developed cities are located; whereas Bandar-e-Torkaman (a less developed city) is located nearby two developed cities (Aq Qala and Gorgan), and a somewhat-developed city (Kord Kuy).

Discussion

Aiming to achieve a deeper and more functional perspective, this study investigated the health structural indicators as key health factors in Golestan province. Experiences of regional studies in different countries show that some areas have higher growth and development rates compared to other regions. Hence, if planners can identify the factors affecting the development of the regions through consulting with experienced managers in different sectors of the region and as a result, allocate the existing budget properly (26-27).

Most studies conducted in Iran regarding development using Scalogram model, have been conducted in the fields other than health care. Using the mentioned method in this study together with the comprehensiveness of the used indicators is an advantage. In addition to human discussions, this method is used in regional planning. Given its simplicity, the methodology used helps to identify the differences of resource allocation in the local level and within a region, which would lead to a better and more equitable distribution of facilities (28-31).

The results of the study showed that almost one fourth of Golestan cities are categorized as developed cities and the rest are grouped as some-deal developed and less. Among them, Aq Qala and Azad Shahr have the maximum and minimum level of health indicators utilization respectively. The results regarding institutional indicators showed that hospital bed capitation as one of the institutional indicators differs among cities and its distribution compared to other studied indicators is more unbalanced. As for human resources indicators, the proportion of general practitioner to every 1000 people in half of the cities, and the proportion of gynecologist to every 1000 people in about 80 percent of the cities are in an appropriate status. Finally, about the rural health indicators, it is observed that the villagers supported by health houses are only in about 40% of the cities, which is not in adequate. Generally, the results showed that there are gaps in the health structural indicators in Golestan province, which mostly are related to human resources indicators.

The study done by Taghvaei using McGranahan model examined the health care services transmittance in Iran cities; however, the studied indicators didn't have the comprehensiveness of the indicators used in the current study and are limited to only 10 indicators. The results of the referred study showed that only one of the Golestan province cities (Gorgan) can be categorized among developed cities and the remaining areas are categorized as under developed. The mentioned results are different from the results attained from the current study and that might be due to lack of comprehensiveness in the indicators studied by Taghvaei (32).

In the study done by Elyaspour et al. the health structural indicators in North Khorasan province were studied in 2007 by taxonomy method. In this study like the one done by Taghvaei, the number of examined indicators lacked comprehensiveness. They surveyed 16 indicators and identified one of the cities as developed and others as less developed and underdeveloped; however, in Golestan province the status was different. The differences between the mentioned study and the current one can be traced in the differences of the two provinces possessing the studied indicators, the type of the indicators and the research method (33). Amini et al. have studied the countries provinces' health levels based on 35 development indicators in health field using factor analysis and taxonomy method. The results from the stated study showed that Golestan province is not in an appropriate health level. Regarding the development level identified in the present study, the findings of both studies are alike to some extent (24).

The results of a study showed that 76 percent of regional differences are due to unbalanced distribution of 5 indicators including specialists, urban health centers, rural health centers, number of urban sewage branches and health houses in the country's provincial areas. The results from the mentioned study are similar to the present study regarding some indicators. According to stated study, Golestan was categorized among the country's less developed provinces (34). Another study

showed that according to the indicators that are used to determine the needs of different regions, the budget allocation process to Golestan province has been in a balanced condition; however, the findings of the present study are different (35). In a study, entitled "Spatial analysis of health care development indicators in Isfahan" notified the human resources indicator as the most inappropriate one, which is similar to the findings of the current study regarding the human resources indicators in Golestan (23).

The results could be more precise if the indicators distribution were examined in several years, but the available data regarding the studied indicators were not complete. The available data was aperiodic and limited to some years. There are several health structural indicators and it was not possible to use all indicators in this study. Our country lacks a conceptual health indicator framework, so the current study, like other studies, was designed based on the available data in the country's health system. It is clear that one of the most significant steps for carrying out such studies is to explain fundamental indicators. What should be important for the country's policy-makers in health field is that with regard to the health structural indicators, the existing differences among the provinces is much less than the existing differences among the cities of a province.

In conclusion, this study showed that there are gaps in the health structural indicators in Golestan province. It has offered an appropriate method in order to identify the development level of Golestan province regarding health structural indicators. With respect to the results, which emphasize on inequality of development level among the region's cities in health sector, the provincial and state policy-makers need to pay attention to this issue in allocating health facilities and plans should be arranged in order to reduce the gap in the access to healthcare facilities.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission,

redundancy, etc) have been completely observed by the authors.

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References

1. Bahadori M, Sadeghifar J, Hamouzadeh P, Hakimzadeh SM, Nejati M (2011). Assessing Hospital Performance in Iran. *AMJ*, 4(4):175-9.
2. Mousavi M, Hekmatnia H (2005). Factor analysis and modulation index in determining factors affected on human development of areas in Iran. *Geography and Development*, 4(2):87-95.
3. Hasanipour H (2010). Why the health system in Iran is lower than 98 countries around the world?. Available from: <http://www.mehrnews.com/fa/newsdetail.aspx?NewsID=1062425>.
4. Nastaran M (2001). Analysis and measuring degree of concentration and distribution of health indices in Isfahan. *Journal of The Faculty of Literature and Humanities*, 27(1):145-62.
5. Sejdic E, Djurovic I, Stankovic LJ (2008). Quantitative performance analysis of scalogram as instantaneous frequency estimator. *Iee Transactions on Signal Processing* 56(8):3837-45.
6. Graham H (2004). Social determinants and their unequal distribution: clarifying policy understandings. *Milbank Quarterly*, 82(1):101-24.
7. Subramanian S, Naimoli J, Matsubayashi T, Peters DH (2011). Do we have the right models for scaling up health services to achieve the Millennium Development Goals? *BMC Health Serv Res*, 11:336.
8. Bahadori M, Teimourzadeh E, Farzaneh A, Nejati M (2011). Prioritizing research needs: insights from a healthcare organization in Iran. *APP*, 2(3):135-40.
9. O'Donnell O (2007). Access to health care in developing countries: breaking down demand side barriers. *Cad Saude Publica*, 23(12):2820-34.

10. Ulschak FL (1990). *Human resource development: The theory and practice of need assessment*. Reston, Virginia, pp:111-131.
11. Peters DH, Garg A, Bloom G, Walker DG, Brieger WR, Rahman MH (2008). Poverty and access to health care in developing countries. *Ann N Y Acad Sci*, 1136:161-71.
12. Movahedi M, Hajarizadeh B, Rahimi A, Arshinchi M, Amirhosseini K, Motlagh M (2008). Trend and geographical inequality pattern of main health indicators in rural population of Iran. *Hakim Medical Journal*, 10(4):1-10.
13. Farhadian M, Mahjoub H, Sadri G, Aliabadi M (2010). Ranking Health Status of Children in Iran's Provinces and Assessing its Relation with Socio-Economic Indicators. *Hakim Medical Journal*, 13(2):38-44.
14. Arce OEA, De Marco NE, Santillan MR (2009). Principal component and principal coordinates: a comparative study based on an application to numerical taxonomy. *Lilloa*, 46(1-2):10-33.
15. Ravesh MHS, Ahmadi H, Zehtabian GR, Khoram MR (2009). Development of the Numerical Taxonomy Model to Assess Desertification: An Example of Modeling Intensity in Central Iran. *PAS*, 92(2):213-27.
16. Kampke T, Radermacher FJ (2005). *Equity analysis by functional approach. Data Analysis and Decision Support*. Springer, pp:241-8.
17. Chang H-S, Liao C-H (2011). Exploring an integrated method for measuring the relative spatial equity in public facilities in the context of urban parks. *Cities*, 28(5):361-71.
18. Luks A, Komenda S, Svoboda J (1982). Monte Carlo verification of the scalogram model. *Acta Univ Palacki Olomuc Fac Med*, 102:227-44.
19. Griffiths S (2005). *Historical space and the practice of "spatial history": the spatio-functional transformation of Sheffield 1770-1850*". University College London, UK, pp:656-67.
20. Wohlwill JF (1960). A study of the development of the number concept by scalogram analysis. *The Journal of Genetic Psychology*, 97:345-77.
21. Kofsky E (1966). A scalogram study of classificatory development. *Child Dev*, 37(1):191-204.
22. Taghvaei M, Tabatabaee S (2006). Survey of the development indicators in rural areas of the country provinces using of Scalogram method. *Journal of Agricultural Economic and Development*, 14(4):109-41.
23. Zarabi A, Mohammadi J, Rakhshanasab H(2008). Spatial analysis of development indicators of health care. *Social Welfare*, 7(3):213-34.
24. Amini N, Yadollahi H, Ainanlou S (2006). Ranking of health in country provinces. *Social Welfare*, 5(4):27-48.
25. Soares JO, Marques MML, Monteiro CMF (2003). A multivariate methodology to uncover regional disparities: A contribution to improve European Union and governmental decisions. *EJOR*, 145(1):121-35.
26. Rietveld P (1989). Infrastructure and regional development. *The Annals of Regional Science*, 23(4):255-74.
27. Zvulun E (1978). *Multidimensional scalogram analysis: The method and its application*. Jossey-Bass San Francisco, pp:96-125.
28. Mehregan M, Nazarian A (2011). Rating of economic services in Lorestan province by using Scalogram. *AMAYESH*, 4(12):1-13.
29. Momeni M (2010). Analysis of inequality and spatial inequality of development in Isfahan province. *Geography and Development*, 1(1):35-42.
30. Momeni M, Khatami M (2010). Geographical analysis of spatial inequalities and imbalances in the development of Yazd Province. *Journal of Geography and Environmental Studies*, 2(4):15-25.
31. Zebardast E (2006). Evaluation methods to determine the level of the hierarchy of settlements based on the approach of urban functions in rural development. *JHZ*, 13:52-63.
32. Taghvaei M, Shahivandi A (2010). Transmittance of health services in Iran. *Social Welfare*, 10(39):39-54.
33. Elyaspour B, Elyaspour D, Hejazi A (2011). Rate of health indicators development in North Khorasan province by taxonomy method. *University of Medical Sciences Journal of North Khorasan*, 3(1):23-8.
34. Sepherdoust M (2011). Factors Affecting the Development from the Viewpoint of Health Indicators. *JHIM*, 8(2):1-8.
35. Yousefi M, Arab M, Sari A, Olyaeemanesh A (2010). Methods of Resource Allocation Based on Needs in Health Systems, and Exploring the Current Iranian Resource Allocation System. *Hakim Medical Journal*, 13(2):80-90.

Table3: Scores of mixed indicators by scalogram analysis in cities of *Golestan* province

Indicators	Institutional indicators														Human resources indicators														Rural health indicators			Total scores										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20	1	2	3				
Indicator Number* City																																										
Azad Shahr	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4	1	2	41		
Aq Qala	2	2	1	4	4	1	4	4	4	4	4	1	1	4	2	1	4	4	1	4	4	1	4	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	1	4	1	97
Bandar-e-Gaz	4	4	1	4	4	1	4	4	2	4	2	4	4	2	4	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	4	4	1	1	80	
Bndar-e-Torkaman	1	1	1	1	2	1	1	1	1	1	4	2	2	1	4	1	1	4	1	1	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	52
Ramiyan	4	4	1	1	1	1	4	4	4	1	2	4	4	1	1	1	1	1	1	1	1	1	1	1	1	4	2	1	1	4	4	4	4	1	4	4	4	4	84			
Ali Abad	1	1	1	2	2	1	2	4	1	4	4	2	2	1	4		4	4	1	4	1	4	1	1	1	1	1	1	1	1	1	2	1	1	1	4	1	4	76			
Kord Kuy	2	2	1	4	4	1	2	4	1	2	4	2	1	4	2	1	2	1	1	4	1	1	1	1	1	1	1	1	1	1	4	4	4	4	1	2	1	1	1	72		
Kalale	2	2	1	1	2	1	4	1	4	1	4	1	4	4	2	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	2	1	4	1	4	1	4	4	81			
Gorgan	1	1	2	2	1	4	1	1	1	4	1	1	4	4	4		4	4	4	4	4	4	4	4		4	1	1	1	1	2	4	1	4	1	2	1	4	95			
Gonbad – e-Kavus	4	1	4	4	2	4	1	1	1	2	1	1	4	4	2		2	2	1	2	1	4	2	1	1	4	4	2	4	1	2	1	4	1	1	1	4	85				
Minudasht	2	2	1	2	2	1	4	2	4	1	2	4	1	2	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	2	1	4	1	1	4	4	4	69				

* Indicator Number: The number displayed in the “Indicator number” is the unique number assigned to each indicator of the main 3 categories in Table 1 (Institutional, Human Resources, & Rural Health)