Original Article

Measuring Equity of Geographical Distribution of Specialist Physicians in Iran's Health System

Abstract

Background: Equitable distribution of health care sector resources is one of the most important goals of health systems in all countries. The purpose of this study is to measure equity of geographical distribution of active specialist physicians in Iran's health system. **Methods:** The present study was a descriptive-cross-sectional. The statistical population included: all active specialist physicians working in the public, private, social insurance organization, military, charity, and the other health service providers in Iran in 2019. Studied demographic data were collected from Iran's national statistic center. Also, information of specialist physicians was obtained from several databases. Finally, duplicated records were removed, and the number of specialist physicians extracted. Data analysis was performed using Stata V.16 and ArcGIS 10.4 software. **Results:** The results showed that the number of specialist physicians per 100,000 population who worked in Iran's health system was 46.81. The provinces of Tehran had the highest and Sistan and Baluchestan had the lowest number of specialist physicians. Also, 52.63% of active specialist physicians provide health services in four provinces, whereas these provinces are 37.13% of the country's population. Total Gini coefficient of the distribution of active physicians in Iran in 2019 was 0.23. **Conclusions:** Distribution of specialist physician was different but somewhat equitable in the provinces. However, in some provinces, the ratio of specialist physicians to the population was still low. Therefore, when the number of specialist physicians increased, their distribution should be considered concurrently.

Keywords: *Equity, geographical distribution, health system, Iran, specialist physicians*

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Introduction

Health is one of the most important human rights that all people should have equal access to it according to need and without discrimination. Achieving this goal requires physical and human resources in the health sector such as physicians, nurses, hospital beds, and appropriate medical equipment.[1] In addition, equal access and equitable distribution of health sector resources is one of the most significant goals of health systems in all countries and has become one of the main challenges of health policy makers.[2]

Human resources are one of the most key components of health systems. To achieve the essential changes in the health outcomes of the community, it is necessary that health policy makers plan to ensure about the distribution of sufficient manpower at the right time and place and to provide adequate access to health services.[3] Unequal distribution of human resources in the health sector reduces access to health services in disadvantaged areas. There are two types of inadequate distribution of physicians: first is inappropriate geographical distribution due to the presence of a large number of physicians in urban areas and the shortage of physicians in sparsely populated areas. second is the insufficient distribution of expertise among physicians because in some specialized fields, the number of physicians is much less than in other fields and in some fields the number of specialists is too high.[4]

According to the World Health Organization, although half of the world's population lives in sparsely populated areas far from provincial capitals, less than a quarter of all physicians live in these regions.[5] Also based on some studies, Iran is facing a shortage of health specialized staffs[6] due to the extended geographical size of the country especially concentration of physicians in urban areas and the shortage of specialized physicians in low-populated parts and small towns.

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Results of a study in Iran showed that distribution of specialists appears to be imbalanced and 50% of them were located in three provinces of Tehran, Khorasan Razavi, and Isfahan.[7] As well as, the lack of specialized doctors in distant areas with the greater need of people to the medical services is another major concern.[8]

Numerous factors such as economic and social inequality status, education system, wage incentives, development of the private or public sector in the provision of health services and the low rate of effort toward health system reforms cause inadequate distribution of physicians.[9-11] What we usually found in similar reports and articles was the total number of trained specialists or the number of registers and license holders, for example, the number of physicians with a medical system number. So, this data was different from the real number of active specialist physicians in the country due to decline in manpower such as: migration, death, retirement, unemployment, employment of physicians in unrelated fields, etc., has not been seen. In this study, active physician means the number of physicians who work professionally in careers related to health system. Therefore, purpose of this study is to measure equality in the geographical distribution of physicians active in the Iranian health system. We expect that the results of this study provide appropriate policy solutions to solve the problems and inequalities in the distribution of physicians and help to health policy and decision makers in Iran's health sector.

Methods

The present study was a descriptive cross sectional. The statistical population included: all active specialist physicians working in the public, private, social insurance organization, military, charity, and other health service providers in Iran in 2019.

We used different national data centers in current study. Studied demographic data was collected from Iran's national statistic center. Also, Information of specialist physicians was obtained from several databases including: Iran's Ministry of Health and Medical Education (Health Human Resources Research Center and Health database center), the national survey of specialists who are active in hospitals, and the national registry of Continuing Medical Education (CME). Finally, after merging data of three independent sources mentioned above, duplicate records were removed, and the number of specialist physicians extracted. Then, the index of specialist physicians per 100,000 population was calculated for different provinces.

Statistical methods

We used Lorenz curve and Gini Coefficient (GC) to measurement of equity of distribution of specialist physicians in Iran's provinces. Lorenz curve, for the first time was introduced by Max Otto Lorenz, which

was the most important graphical tool for describing the amount of concentration in society, such as wealth, and economists use it to measure economic inequality. This curve displays the cumulative percentage of the population on the horizontal axis and the cumulative percentage of the studied variable (e.g., specialist doctors) on the vertical axis. The diagonal line is called the line of equality because it shows a completely equal distribution, so the greater distance of the Lorenz curve from this line, shows the greater the inequality, and the tangent of the Lorenz curve to the diagonal line means complete equality.[12]

GC is one of the famous indexes of inequality that was initially applied to study of income inequality.[12] But in recent years, it has been used in many cases to examine inequality in the geographical distribution of health resources.[13] GC is calculated by the following equation:

$$G = \frac{1}{n}\left\{ n+1-2\left[\frac{\sum_{i=1}^{n}(n+1-i)y_i}{\sum_{i=1}^{n}y_i} \right] \right\}$$

where y_1, y_2,…, y_n are the number of SPs of provinces sorted from the smallest to the largest and n is the total number of provinces. GC score is ranged between 0 and 1. 0 score means completed equality and 1 score means completed inequality in the distribution of resources (here specialist physician).

Data analysis was performed using Stata V.16 and Excel software and per capita geographical distribution map of specialist physicians was drawn by ArcGIS 10.4 software. The distribution of specialist physicians was displayed on the map of Iran.

Results

The results showed that the number of specialist physicians per 100,000 population who worked in Iran's health system was 46.81. The provinces of Tehran (87.97), Yazd (60.96), and Isfahan (56.24) had the highest and Sistan and Baluchestan (19.60), Hormozgan (24.83), and North Khorasan (25.26) had the lowest number of specialist physicians [Figure 1].

The distribution of active physicians in different provinces of the country was shown in Figure 2. Most of the provinces had 20–40 specialist physicians per 100,000 population.

52.63% of active specialist physicians provided services in four provinces including Tehran (31.19), Isfahan (7.70), Khorasan Razavi (7.37), and Fars (6.37). While these provinces are 37.13% of the country's population [Figure 3].
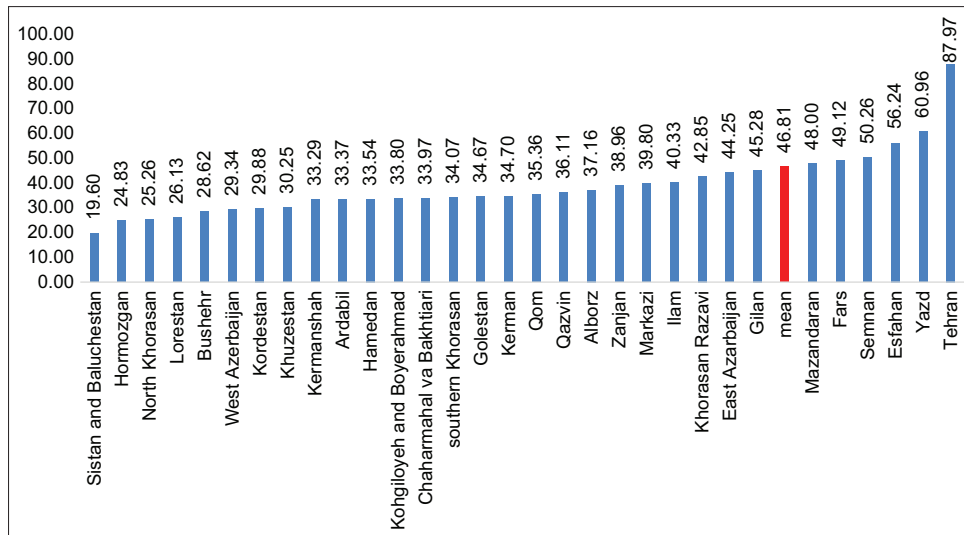
Figure 1: Number of specialist physician per 100 000 population in different Iranian provinces in 2019

Figure 2: The distribution of active specialist physicians in different Iranian provinces in 2019

Internal medicine, Obstetrics and Gynecology, and Pediatrics had the highest and Geriatrics, Sports medicine, and Occupational Medicine had the lowest number of specialist physicians per 100,000 population. Also, in the most field of Specialty, Tehran had the most and Sistan and Baluchestan had the least active physicians [Table 1].

The total GC of the distribution of active physicians in Iran in 2019 was 0.23 [Figure 4]. The highest level of inequality was related to Neurology (GC = 0.19), Internal medicine (GC = 0.20), and Radiology (GC = 0.20). Also, the lowest level of inequality was related to Geriatrics (GC = 0.82), Sports medicine (GC = 0.65), and occupational medicine (GC = 0.55) [Table 1].

Discussion

Physicians are one of the most important factors in resource allocation management due to their key role in the effectiveness and efficiency of health services.[14] When physicians are not sufficiently available in the community, minor health problems can develop and lead to serious and chronic diseases.[10] Because of the limitation of these resources and the complexity of health dimensions in today's societies, proper management and distribution of these resources has a great position.[15] In this study, the distribution of active physicians was examined in the public and non-governmental sector of provinces of Iran in 2019.

Table 1: Frequency distribution and Gini coefficient of active physicians by specialty in Iran in 2019

| Field of Specialty	Number	Per capita	Minimum		Maximum		Gini coefficient
			Province	Per capita	Province	Per capita	
Neurology	963	1.2	North Khorasan	0.23	Tehran	1.83	0.19
Internal medicine	4727	5.91	Sistan and Baluchestan	2.52	Tehran	9.88	0.2
Cardiology	1946	2.43	Hormozgan	1.13	Tehran	4.35	0.2
Radiology	2349	2.94	Hormozgan	1.41	Tehran	5.26	0.2
Urology	987	1.23	Sistan and Baluchestan	0.43	Tehran	1.99	0.21
Emergency Medicine	819	1.02	Western Azerbaijan	0.31	Yazd	2.2	0.21
Infectious disease	827	1.03	Alborz	0.52	Tehran	1.73	0.22
Pediatric	3791	4.74	Sistan and Baluchestan	1.66	Tehran	8.55	0.23
Pathology	1700	2.13	Sistan and Baluchestan	0.83	Tehran	3.89	0.24
Obstetrics and Gynecology	4223	5.28	Sistan and Baluchestan	2.31	Tehran	10.49	0.25
Anesthesiology	2844	3.56	Hormozgan	1.24	Tehran	7.08	0.25
Orthopedics	1592	1.99	Sistan and Baluchestan	0.58	Tehran	3.76	0.26
General surgery	2924	3.66	Sistan and Baluchestan	1.37	Tehran	7.73	0.26
Psychiatry	1556	1.95	West Azerbaijan	0.7	Tehran	3.66	0.26
Social Medicine	311	0.39	Khuzestan	0.08	Semnan	1	0.26
Ophthalmology	1707	2.14	Bushehr	0.77	Tehran	4.19	0.27
Nose and Throat and Head and Neck Surgery	1314	1.64	Sistan and Baluchestan	0.36	Tehran	3.32	0.27
Neurosurgery	615	0.77	Sistan and Baluchestan	0.25	Tehran	1.68	0.28
Dermatology	1032	1.29	Sistan and Baluchestan	0.36	Tehran	2.8	0.31
Radiotherapy	257	0.32	Semnan	0	Tehran	0.71	0.33
Nuclear medicine	180	0.23	Kohgiloyeh and Boyerahmad	0	Tehran	0.51	0.36
Physical medicine and rehabilitation	348	0.44	Ilam	0	Fars	1.01	0.39
Forensic Medicine	252	0.32	Kohgiloyeh and Boyerahmad	0	Tehran	0.84	0.41
Occupational Medicine	141	0.18	-		Semnan	0.71	0.55
Sports medicine	65	0.08	-	0	Tehran	0.29	0.65
Geriatrics	10	0.01	-	0	-	-	0.82
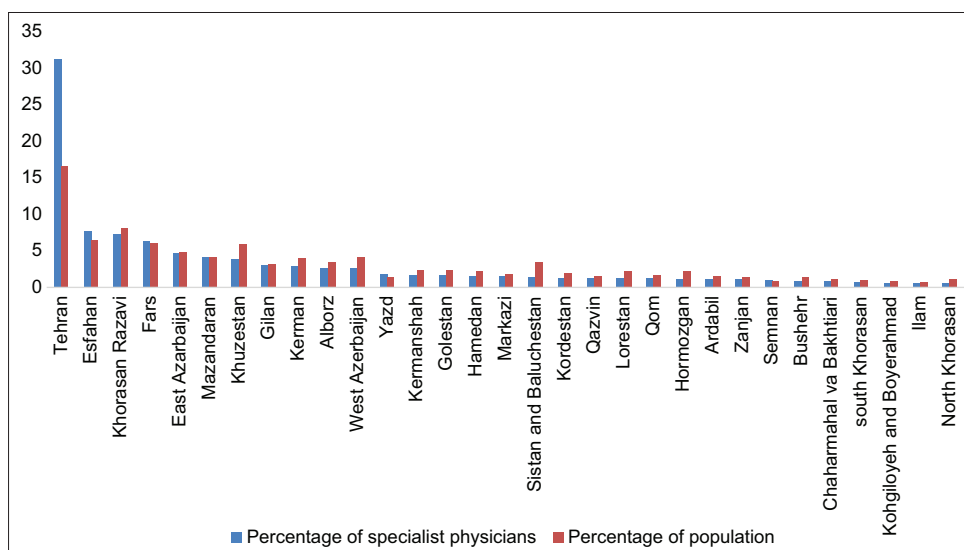
Figure 3: Percentage of population and active specialist physicians in Iran in 2019

The results showed that the total number of active physicians in Iran was 37,416 and per 100,000 population, there were 46.81 of specialist physicians. The distribution of specialist physicians has not been same among different provinces, and some provinces had lower per capita. Also, provinces of Tehran, Yazd and Isfahan had the highest and Sistan and Baluchestan, Hormozgan and North Khorasan had the lowest number of specialist physicians per capita. Moreover, Internal medicine, Obstetrics and Gynecology, and Pediatrics had the highest and Geriatrics, Sports medicine, and Occupational Medicine had the lowest number of specialist physicians per 100,000 population. In
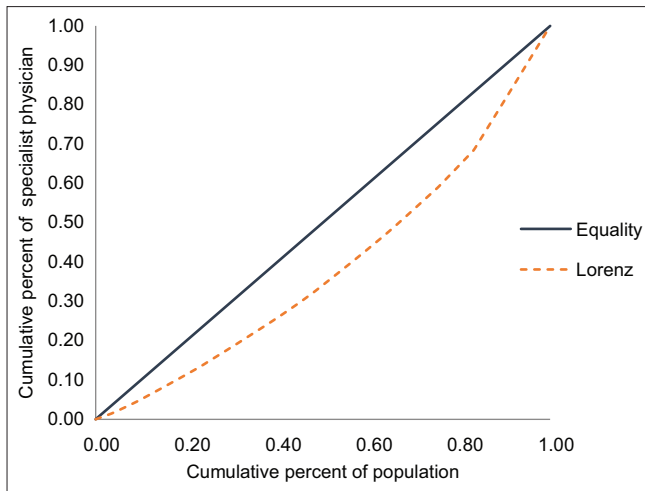
Figure 4: Lorenz curve of distribution of active specialist physicians in Iran in 2019

a study conducted in 2017 by Mosadeghrad *et al*.,[16] there were 21.45 specialist physicians per 100,000 population in public hospitals and Internal medicine and dermatology had the most and the least specialist physicians respectively. The study of Taati-Keley *et al*.[17] showed that per 100,000 people, there were 14.2 specialist physicians in Iran's public hospitals and the highest and lowest per capita specialist physicians were in Yazd and Sistan and Baluchestan provinces, respectively. The results of these two mentioned studies were consistent with the present study. Per capita was different between the specialist physicians in the present study and the stated studies. Because in two mentioned studies, physicians specialized in the public sector have been only studied, while in the present study all physicians active in the governmental and nongovernmental sectors have been considered. The number of specialist doctors has also increased over time. The results showed that the GC of the distribution of specialist physicians was 0.23 and it was relatively fair. As well as, distribution of physician specialists in Neurology, Internal medicine and Radiology had less inequity, while in Geriatrics, Sports medicine and Occupational Medicine had more inequity. A study by Mosadeghrad *et al*.[16] Showed that the distribution of specialist physicians working in the public sector was fair. Also, study of Shahabi *et al*.[18] showed that inequality in the distribution of specialists in the country has decreased over 10 years of study. The results of these two studies are consistent with the present study. The study of Ono *et al*.[19] showed that the GC of distribution of ophthalmologists in Japan was 0.35. A similar study by Nishiura *et al*.[20] in Thailand revealed that the GC of physician distribution was 0.43 and approximately 40% of physicians were concentrated in Bangkok. Also, studies by Mosadeghrad, Ünal, Hazarika, and Toyabe have described the distribution of physicians as unfair in different countries.[21-23]

In current study, the number of specialists in the provinces was varied but relatively fair. In some provinces, the number of physicians was lower than average. It seems that the main reasons are the lack of adequate living facilities, insufficient wages and special geographical conditions of the province. A study by Meliala *et al*. showed that there were large differences in the ratio of specialist physicians to population in the Indonesian provinces. The more affluent provinces had a higher per capita specialists than the deprived provinces, and the role of financial incentives in the disproportionate distribution of specialist physicians was increasing. In general, greater concentration of both public and private health resources in one region will lead to a higher absorption of physicians in that area.[24] A study indicated that the most important factors affecting the density of specialist physicians were the number of public hospital beds, the number of private hospital beds and the population.[25] So, overcrowding of physicians and the lack of adequate providers may lead to induced demand and impose high costs on the health system. In addition, oversupply of health services along with absence of quality management mechanisms will lead to an increase in medical errors.

To reduce inequality in the distribution of specialist physicians, the Ministry of Health and Medical Education has implemented some policies including: sending specialist physicians to public hospitals to fulfil their legal obligations, prohibiting university early graduated from fulfilling their legal obligations in Tehran and Large cities, paying special sums for the services provided by specialist doctors in deprived areas, not sending specialist doctors to regions with benefits. These policies have improved equity in the distribution of specialist physicians. Comparison of the results of the present study to studies conducted in the last 10 years showed that distribution of specialist physicians has become fairer.[17,26]

The limitations of the present study included: the timewasting process of data collection and the lack of cooperation of some military hospitals in providing information about specialist physicians; Due to the small number of specialist physicians working in those hospitals, it had little effect on our study.

Conclusions

The number of specialists in Iran has increased over the past decade, but an increase in the number of physicians does not necessarily mean a fair distribution. According to the findings of this study, although per capita specialists vary from province to province, it has been somewhat fair. However, in some provinces, the ratio of specialist physicians to the population is still low. Therefore, in addition to increasing the number of specialist physicians, their distribution should also be considered. It is suggested that health policy makers pay attention to training and distribution of specialist physicians based on the needs and indicators of health care in different geographical areas.

Conflicts of interest

There are no conflicts of interest.

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