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Trends of geographic distribution of general practitioners in the public health sector of Iran

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Abstract:

BACKGROUND: Proper distribution of general practitioners (GPs) is one of the challenges in all health systems. This study aimed to investigate geographical distribution of GPs in public health sector in Iran between 2010 and 2016.

METHODS: The study is a descriptive–cross-sectional study. The population of provinces was extracted from Iran’s National Statistic Center, while information on GPs was gathered from deputy of statistic and information technology in Ministry of Health and Medical Education. Data analysis was carried out using descriptive statistics, Gini coefficient (GC), and by drawing geographical distribution map of GPs. Data analysis was performed by excel 2013, Stata V.14, and Arc GIS software.

RESULTS: The results of calculating the number of GPs per 100,000 population in Iran showed that, in year 2010, Chaharmahal and Bakhtiari Province had the highest (10.39) and Alborz Province had the lowest (0.66) number of per capita GPs. The highest number of GPs per 100,000 population among Iran’s provinces belonged to Chaharmahal and Bakhtiari (8.97), while the lowest belonged to Tehran (0.28) in year 2016. The GC was 0.31 in year 2010 and 0.283 for 2011. The lowest GC belonged to year 2012 (GC = 0.272), while the largest coefficient belonged to year 2016 (0.356).

CONCLUSIONS: According to the results of this study, the distribution of GPs in public health sector of Iran in between 2010 and 2016 showed inequality. Therefore, along with increasing the number of GPs working in public health sector, it is necessary to pay attention to their distribution. Further studies are needed to investigate inequality of GPs within and between the provinces.

Keywords:

General practitioner, Gini coefficient, health workforces, inequality, public health sector

Introduction

Health is one of the basic human rights in societies and must be distributed equally and without any discrimination among all members of society.^[1] Equity in access to health-care services is one of the most important goals of health-care system. Equity in health care is a multidimensional concept and achieving it is one of the greatest challenges of policymakers in this area. Equity means equal access to all necessary health-care and medical services

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and distribution of medical resources is one of the measures of health-care equity.^[2]

Human resources in health-care sector is one of the bases of health care and medical system.^[3] This is also important because in most countries, people employed in health-care sector make up more than 10% of all government employees.^[4] Physicians are the most important resource in health-care sector who are responsible for effectiveness and performance of health-care and medical sector.^[5] Nonuniform geographical distribution of health-care resources, especially physicians is one of the most

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important reasons for inequality in health care.^[6] Various factors affect scattering and skewed distribution of physicians in different areas. For years, estimating the number of physicians and health-care human resources in each area has preoccupied policymakers in health-care sector. Providing the correct amount of human resources in health care is one of the key factors in improving health-care situation in every country.

Uneven distribution of physicians in different areas has always been a problem and countries such as the USA, Japan, Brazil, China, Australia, Canada, and the U. K have been faced with this problem.^[7,8] For example, the result of studies in Japan shows that, despite increase in total number of physicians between 1996 and 2006, indicators of inequality have also increased after year 2004.^[9] Furthermore, in the reports from Organization for Economic Co-operation and Development countries, these inequalities have been mentioned one of the most important problems.^[10] Iran is no exception in this regard and results of various studies show that geographical distribution of different physician groups in Iran is unbalanced. For example, dispersion coefficient of variability for general practitioners (GPs) in Iran is 252.3% which shows high unbalance in distribution.^[11] Without doubt, this problem becomes more important with increase in medical education in Iran because if such factors are not considered, despite increase in the total number of physicians, some areas will be faced with shortage of human resources, while the number of physicians will become inflated in other areas.^[12,13] The results of a study by Huang *et al.* in Taiwan showed no improvement in distribution of physicians based on Gini coefficient (GC). They also stated that increase in the number of physicians will improve the geographical distribution.^[14] Shin *et al.* in their study of geographical distribution of physicians in Japan and the US reported that distribution of physicians has been unsatisfactory in 2010. Findings of this study also showed that diffusion of physicians in the US is associated with income distribution. This study suggested a political intervention to reverse the maldistribution of physicians in these countries.^[15] The result of the study by Nomura *et al.* also showed that, while the number of pediatrics per capita increased in Japan, there has been inequality in the distribution of pediatrics in rural areas of Japan happened between 1994 and 2004. This study cleared that nonpediatrics practice in pediatrics distributed more equally than pediatrics and substitution between different physician can play an important role in improving access to physician services.^[16]

Another study in Japan disclosed maldistribution of physicians in this country. This study suggests increased number of generalists as one solution of this problem in Japan. Recruitment of general physicians in deprived

areas is easier than other types of physicians.^[17] The results by Ahmed *et al.* in Bangladesh showed that geographical location, medical and paramedical specializations, health-care providers, population, gender distribution of population, and prevalence of diseases are factors affecting distribution of physicians in different areas. This study also proposed policy intervention to improve distribution of health workforce in Bangladesh.^[18]

Totally, increase the number of physicians will improve the chance of attract them in deprived areas of countries. Also, substitution of other health workers to physicians, can be considered as other solution for improving distribution of physicians.^[19]

Due to the importance of GPs in equal access to health care, and since there have no comprehensive evidence about the distribution of physicians in the public health of Iran, the goal of this study is to investigate the distribution of GPs in Iran between years 2010 and 2016. The results of this study will help policymakers to gain a comprehensive and systemic perspective in this issue and make the necessary decisions for providing the necessary number of GPs in the following years. In other words, these results can provide evidence-based information that can be used for better management and planning of human resources (physicians) and to determine the number of necessary physicians in the future.

Methods

The current study was a descriptive–cross-sectional study. The information investigated belongs to years 2010–2016, therefore making it a retrospective study. The statistical population included all GPs in different Iran provinces during the study period. Data gathering tool was a two-part form. The first part gathers population information (province name, population, and year), and the second part was the information related to physicians (province name, number of distributed GPs, and year). The population information was extracted from Iran's national statistic center. Furthermore, information on GPs was gathered from deputy of statistic and information technology in the Ministry of Health and Medical Education (MOHME). Before analysis data, all required permission were obtained from MOHME. Then, using the gathered information, the per capital index of number of GPs/100,000 population was calculated. Since general population survey was only conducted in years 2011 and 2016 and exact population information for other years is unavailable, population in year 2011 was used for years 2010–2013, while population in year 2016 was used for years 2014–2016. After data gathering, data analysis was carried out using descriptive statistics, GC, and by drawing geographical distribution map of GPs.

Gini coefficient

In this study, to investigate the inequality in distribution of GPs in different provinces, GC was used. GC is one of the most famous inequality indexes which was first used for investigating income inequality.^[20]

However, in recent years, GC has been used numerous times for investigating the geographical inequality in health-care sector.^[21,22]

GC is calculated using 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, \dots, y_n are the number of GPs of provinces sorted from smallest to largest and n is the total number of provinces.

The GC value is between 0 and 1 with 0 meaning complete equality and 1 meaning total inequality in recourse distribution (GPs). The distribution of general physicians in the investigated years was mapped on the geographical map of Iran. This was carried out using five cutoffs in GPs per capita for each 100,000 population. Analysis was carried out using, Microsoft Excel 2013, stata V.13 (StataCorp., College Station, TX, USA), while geographical distribution map of GPs was created using AcrGIS 10.4 software.

Results

The results of calculating the number of GPs per each 100,000 population in Iran showed that, in year 2010, Chaharmahal and Bakhtiari Province had the highest (10.39) and Alborz Province had the lowest (0.66)

number of GPs per capita. For year 2011, the highest and lowest number of GPs per capita belonged to Chaharmahal and Bakhtiari (8.71) and Qom (0.66) Provinces, respectively. In year 2012, the highest and lowest number of GPs per capita belonged to Chaharmahal and Bakhtiari (8.15) and Alborz (1.45) Provinces. In 2013, Ilam with 8.97 GPs/100,000 population had the highest and Qom with 0.78 had the lowest number per capita. In 2014, the highest and lowest number of GPs per 100,000 population belonged to Northern Khorasan (8.46) and Tehran (0.55) Provinces, respectively, while in 2015, the highest and lowest were Chaharmahal and Bakhtiari (9.71) and Tehran (0.43). Finally, in year 2016, the highest number of GPs/100,000 population among Iran’s provinces belonged to Chaharmahal and Bakhtiari (9.97), while the lowest belonged to Tehran (0.28). In total, during the investigated period, Tehran Province with the average of 0.98 GPs/100,000 population in public health sector had the lowest number of physicians. After Tehran, the lowest average number of GPs per capita belongs to Qom (1.13), while Chaharmahal and Bakhtiari Province with the average of 8.53 GPs/100,000 population had the highest number in 2010–2016 period [Table 1].

Sistan and Baluchistan (3.43), Ilam (2.92), and Fars (2.73) Provinces had the largest increase in the number of GPs per capital between years 2010 and 2016, while Hamedan (-1.51), Chaharmahan and Bakhtiari (-1.42), and Bushehr (-1.20) Provinces had the largest decreases in the number of GPs per capita between years 2010 and 2016 [Table 1]. Figure 1 shows the number of GPs/100,000 population in different Iranian Provinces in years 2010 and 2016.

The GC for distribution of GPs in public health sector was 0.31 in year 2010 and 0.283 for 2011. The lowest GC belonged to year 2012 (GC = 0.272), while the largest coefficient belonged to year 2016 (0.356). The average GC

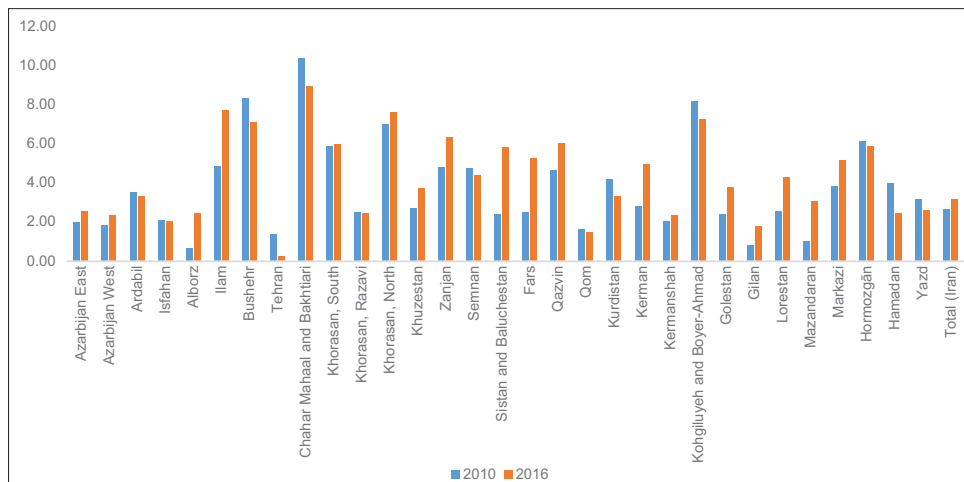


Figure 1: Number of general practitioners/100,000 population in different Iranian provinces in years 2010 and 2016

Table 1: General practitioners per capita (for 100,000 population) based on different Iranian provinces between 2010 and 2016

Province	General practitioners per 100,000 population							Average (2010-2016)	Difference between 2010 and 2016
	2010	2011	2012	2013	2014	2015	2016		
Eastern Azerbaijan	2.01	1.96	2.63	1.64	2.66	1.79	2.56	2.18	0.54
Western Azerbaijan	1.85	1.95	2.17	1.85	3.09	3.28	2.36	2.38	0.51
Ardebil	3.52	3.76	3.44	3.68	4.64	4.33	3.31	3.82	-0.22
Isfahan	2.09	1.82	1.91	1.82	1.76	2.28	2.03	1.96	-0.06
Alborz	0.66	1.58	1.45	1.28	1.92	2.03	2.47	1.65	1.81
Ilam	4.84	5.38	7.53	8.97	7.58	6.89	7.76	7.00	2.91
Bushehr	8.33	7.26	8.13	7.26	6.02	7.56	7.13	7.36	-1.19
Tehran	1.41	1.58	1.56	1.20	0.55	0.43	0.28	0.98	-1.13
Chaharmahal and Bakhtiari	10.39	8.71	8.15	7.93	5.91	9.71	8.97	8.53	-1.42
Southern Khorasan	5.89	5.58	6.64	5.74	4.94	7.02	5.98	5.97	0.10
Razavi Khorasan	2.52	2.20	1.67	2.14	1.90	2.36	2.47	2.18	-0.05
Northern Khorasan	7.03	6.34	7.26	5.42	8.46	5.79	7.65	6.85	0.62
Khuzestan	2.74	2.47	2.21	2.25	2.53	2.02	3.74	2.57	1.00
Zanjan	4.82	3.54	3.84	3.64	3.97	3.88	6.34	4.30	1.51
Semnan	4.75	4.12	4.75	3.33	4.27	3.70	4.41	4.19	-0.34
Sistan and Baluchistan	2.41	3.75	3.08	3.20	3.32	5.01	5.84	3.83	3.43
Fars	2.52	2.81	2.96	3.55	3.30	4.53	5.26	3.58	2.73
Qzvin	4.66	4.41	4.49	3.16	6.20	4.95	6.05	4.87	1.38
Qom	1.65	0.61	1.56	0.78	1.08	0.77	1.47	1.13	-0.18
Kurdistan	4.22	5.02	2.68	4.15	3.87	3.68	3.31	3.84	-0.91
Kerman	2.82	3.57	3.67	3.74	3.32	4.80	4.99	3.86	2.17
Kermanshah	2.06	1.80	2.67	2.62	3.02	3.12	2.36	2.52	0.30
Kohkilouyeh and Boyer-ahmad	8.20	7.14	7.59	6.83	6.73	6.03	7.29	7.10	-0.91
Golestan	2.42	3.21	3.43	2.98	4.17	4.23	3.80	3.48	1.38
Gilan	0.81	1.05	1.69	1.33	0.91	1.94	1.78	1.36	0.97
Lorestan	2.57	1.88	2.85	2.34	3.58	2.67	4.32	2.89	1.75
Mazandaran	1.04	1.56	2.11	1.92	2.38	1.98	3.08	2.02	2.03
Markazi	3.82	3.68	3.11	3.75	3.50	4.90	5.18	3.99	1.36
Hormozgan	6.15	6.46	6.53	6.15	6.92	6.25	5.91	6.34	-0.24
Hamedan	3.98	3.18	3.24	2.79	3.51	3.51	2.47	3.24	-1.51
Yazd	3.16	3.07	3.72	1.86	2.90	3.07	2.63	2.92	-0.53
Total	2.68	2.71	2.79	2.61	2.75	2.96	3.19	2.82	0.51

for distribution of GPs during the investigated period was 0.303. In general, GC showed in increasing trend which shows that inequality in the distribution of GPs increases over the years [Table 2].

Distribution trends for general practitioners in Iran

According to the findings, the number of GPs per capita in Iran in 2010 was 2.679 which showed a small amount of increase by 2012, while the GC for distribution of GPs shows a decreasing trend (increase in distribution equality). In 2013, the number of GPs per capita in public health sector decreased and then showed an increasing trend till 2016, but the GC for GP distribution after 2013 has an increasing trend which means increase in distribution inequality [Figure 2].

According to the distribution map of GPs, northern provinces such as Mazandaran, Alborz, Tehran, Gilan, and also western Azerbaijan had <2 GP per 100,000

Table 2: Gini coefficient for distribution of general practitioners in public health sector in Iran between 2010 and 2016

Years	GC	SE	LB	UB
2010	0.310	0.041	0.225	0.394
2011	0.283	0.030	0.222	0.344
2012	0.272	0.029	0.213	0.332
2013	0.300	0.035	0.228	0.372
2014	0.335	0.075	0.181	0.488
2015	0.352	0.081	0.187	0.518
2016	0.356	0.093	0.166	0.546
Total (2010-2016)	0.303	0.049	0.203	0.404

SE=Standard error, LB=Lower bound, UB=Upper bound, GC=Gini coefficient

population in 2010, while most other provinces had per capita distribution of 2–4/100,000 population and Semnan, Zanjan, Kurdistan, Ilam, and Southern Khorasan had between 4 and 6 GPs per capita. Northern and Southern Khorasan had per capital distribution between 6 and 8, while Chaharmahal and Bakhtiari, Kohkilouyeh

and Boyer-Ahmad, and Bushehr Provinces had more than 8 GPs per capita in year 2010. In the following years, the number of GPs per capital had improved in most provinces, and in 2016, the majority of provinces had between 4 and 6 GPs/100,000 population [Figure 3].

Discussion

Distribution of human resources in health-care sector, especially physicians, greatly affects disease prevention, health improvement in the society, and important indexes such as infant mortality.^[23] Most countries are greatly limited when it comes to human resources in

health-care sector and these people have the main role in providing various health-care services in the health-care systems. Given the limitations of human resources and the complexity of health dimensions in today's societies, proper management and distribution of available resources is immensely important.^[24] In this study, the distribution of GPs in public health sector in different provinces of Iran was investigated between years 2010 and 2016. The results showed that the distribution of GPs was not equal in different provinces with some areas having lower per capita number of GPs. The results also showed that, in some provinces such as Tehran, Qom, Kurdistan, Hamedan, and Yazd, the number of

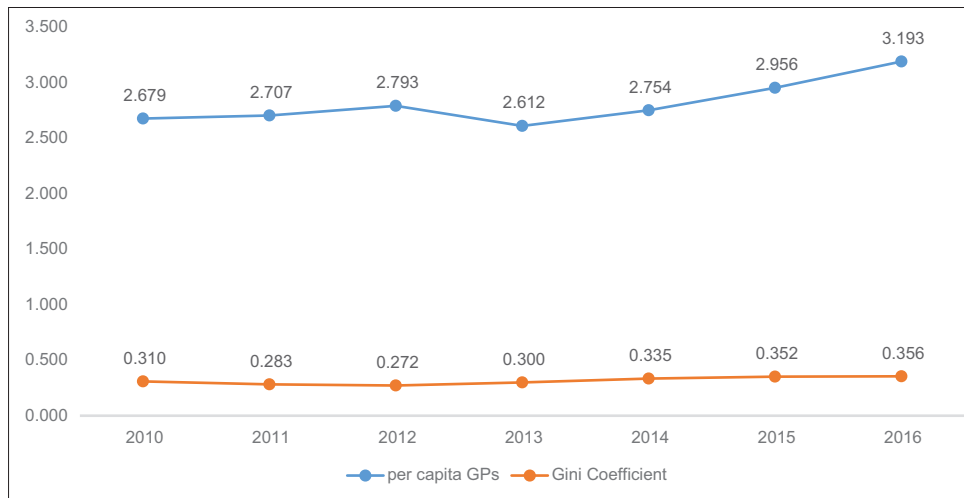


Figure 2: Distributional trends for per capita general practitioners (per 100,000 population) and Gini coefficient in Iran between 2010 and 2016

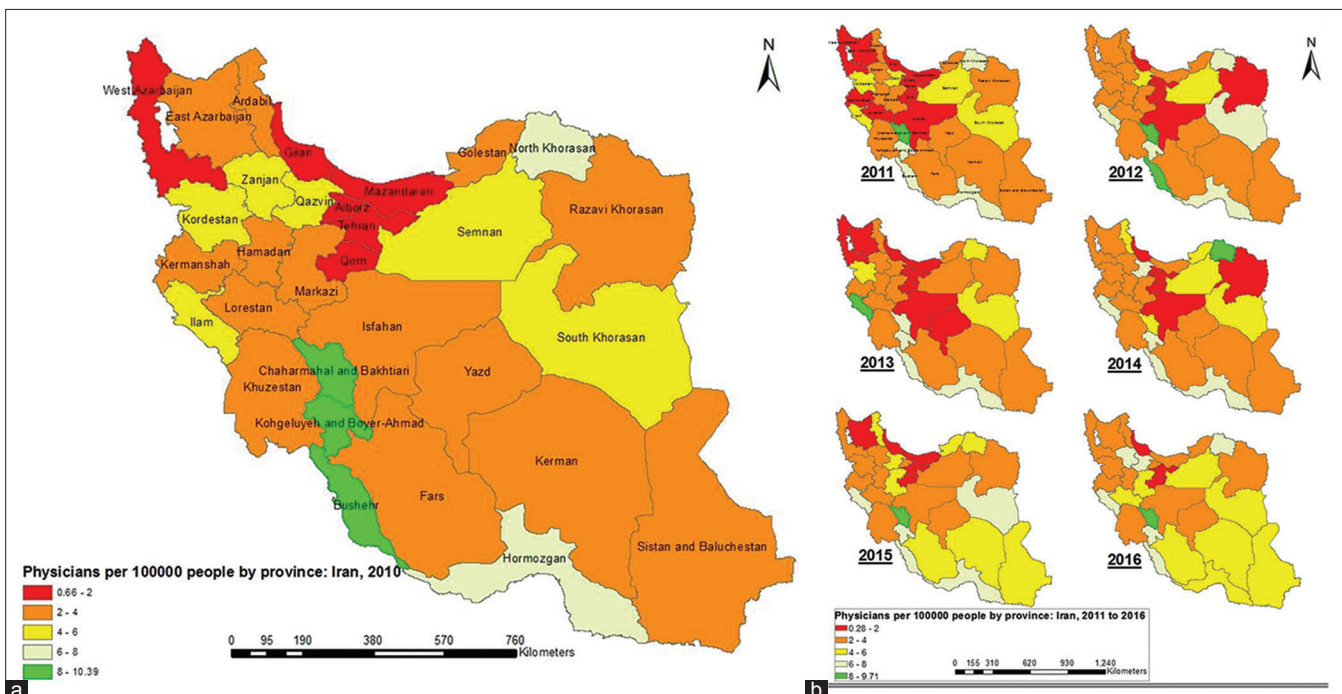


Figure 3: (a and b) Distribution of general practitioners per 100,000 population in different Iranian provinces between 2010 and 2016

GPs per capita had decreased during the investigated period. Chaharmahal and Bakhtiari Province had the highest average number of GPs per capital among Iran's provinces and with the exception of year 2014 had the highest per capita GPs each year as well. On the other hand, Semnan Province had medium access to GPs compared to other provinces, while Sistan and Baluchistan Province had a low number of GPs per capita in the first years of the investigated period. Ghazanfari *et al.* in their study showed that Semnan Province in year 2007 and Chaharmahan and Bakhtiari Province in year 2013 had the best situation, while Sistan and Baluchistan Province had the worst situation in both years when it came to access to health-care human resources.^[25] According to the findings of GC, there was inequality in the distribution of GPs in Iran's public health sector (GC approx. 0.3). In years 2001, 2002, and 2003, City of Semnan had the highest number of specialist physicians per capital in public health sector in Iran while Golestan province had the lowest number of specialists per capita in these 3 years. In year 2004, Kohkilouyeh and Boyer-Ahmad and Isfahan had the highest and lowest number of specialists per capita, respectively, while in year 2005, Semnan and Sistan and Baluchistan and in year 2006 Southern Khorasan and Sistan and Baluchistan had the highest and lowest number of specialists per capita. According to these findings, the distribution of specialists and hospital beds in public health sector was acceptable and there was a direct relation between the distributions of these two resources.^[26] However, other evidences show that, with an increase in the specialization and education of human resources in health-care sector, inequality in their distribution increases.^[22,27]

The most important finding of this study is that the number of GPs per capita in the investigated years had increased, while the inequality in geographical distribution of GPs also increased. Imbalance development of Iran's provinces could affect to unequal distribution of GPs. Usually, developed provinces attract more human resources than less developed ones. Moreover, recruitment and retain physicians in deprived areas is difficult for MOHME. It seems that these factors are important in fluctuation of distribution general physicians in Iran. The study by Rezaei *et al.* shows lower inequality in 3 years of 2001, 2006, and 2011. According to this study, increase in the number of available human resources does not necessarily decreases the inequality in distribution which is similar to the results seen in our study.^[28] Various factors might affect the distribution of GPs. For example, one study showed that distribution of GPs is affected by factors such as time, distribution of psychologists, specialists, and pharmacologists.^[29] Larger cities such as Tehran also have better accommodations and larger private health-care sector due to increased demand for medical services and easier hiring of physicians, which can lead to smaller per capital distribution of health-care resources in public health care.

On the other hand, the majority of GPs employed in public health-care sector are working in health and medicine network and health-care centers of rural areas; this means that the number of GPs in public health care in more rural parts of the country increases, leading to higher number of GPs per capita.

According to a review study, four groups of factors affect the distribution of physicians. First, demographic and geographical factors such as population, age and gender distribution, and climate; second is the regional and national health factors such as number of hospitals, health-care centers, and health-care indexes; third is the economic, social, and political factors such as economic growth, culture, and religious beliefs; and fourth is personal and motivational factors in physicians such as age, gender, and payment systems.^[30]

According to a similar study, Chaharmahal and Bakhtiari and Mazandaran Provinces had the highest and Southern Khorasan Province had the lowest number of physicians (GP and specialists) per capita in Iran. The GC for distribution in GPs and specialists based on population in various areas of Iran was lower than 0.2 in different time periods until year 2011 which shows low inequality in distribution of these resources. However, inequality based on hospitalized patients was high.^[31] Therefore, these results show that, although population can be a good criterion for investigating the distribution of human resources in different provinces and geographical areas, other factors such as age and gender structure of the population, mortality rate, number of hospitalizations, prevalence of various diseases, and similar factors must also be taken under consideration.

Based on various evidences, it is possible to conclude that inequality in health care is high and in provinces such as Tehran and Kermanshah, there are large inequalities in distribution of GPs.^[27,28] The study by Mobaraki *et al.* showed lower inequality in distribution of resources in public sector in medical science universities.^[8] One of the possible reasons for this difference is that they considered all human resources working in public sector. Since there are a large number of available personnel in other areas of health care such as in medical staff and midwives and they also receive lower wages compared to physicians, medical science universities probably have fewer limitations when it comes to hiring these personnel.

A study in Portugal showed that the number of physicians (GPs and specialists) per capita in 1970 was 9.4 per 100,000 population, which increased to 35.7 in year 2007. Investigating inequalities in Portugal showed that GC for physicians, GPs, and specialists in years 1996 and

2007 were higher than 0.4 and inequality in specialists was higher than GPs. The inequality also showed no decrease between these years.^[10] In previous decades, Japan also implemented policies aimed to increase the number of physicians but still failed to fix the inequality in their distribution.^[32] In Albania, the distribution of GPs based on population was not equal while this inequality was lower when based on mortality and consultation rates.^[33] Investigating the inequalities in health-care sector in the United States shows that distribution of physicians in different states is not equal and in general inequality is lowest in Western states and highest in southern states.^[34]

Providing incentives for physicians can help improve their distribution in deprived and rural areas. These incentives can include financial incentives, scholarships for students from deprived and rural areas, and priority for further education for physicians working in these areas. Regulatory policies in health-care market can also help reduce inequality.^[35] Therefore, these incentives can increase the hiring of physicians in deprived and rural areas while implementing proper policies can help reduce inequality in health care and therefore help prevent disease and improve health situation in these areas.

This study attempted to measure inequality in distribution of GPs in public health sector of Iran with different approaches to provide a comprehensive analysis about inequality in distribution of this human resources. Descriptive analysis (per capita GPs) used to show how GPs were distributed based on population among Iran's provinces during studied period. Furthermore, ArcGIS used to show inequality in distribution of GPs across different provinces of Iran. GC was calculated to complete analysis of inequality distribution of GPs. Trends of GPs distribution also were investigated during studied period to show changes of in per capita GPs and inequality in distribution of GPs. In our study, due to lack of access to data on physicians working in urban and rural areas, breaking down the inequality results for rural and urban areas was not possible. Some evidences show that generally, distribution of human resources in health-care sector had higher inequality in rural areas compared to urban areas.^[1] Place of residence also affects the results of inequality in health care such as infant mortality rates.^[36]

Data about a number of physicians in different cities of each province and also data on physicians working in private health sector were not available. Therefore, it was not possible to investigate the distribution of human resources inside different provinces and in private sector. It is suggested that future studies study the distribution of human resources in rural and urban

areas and at national and provincial scales. It is also better to consider private sector when investigating possible inequalities.

Conclusions

According to the results of this study, the distribution of GPs in public health sector of Iran in between 2010 and 2016 showed inequality. Despite the increase in the number of physicians per capita in general and in different provinces, the inequality in their distribution did not decrease. Therefore, along with increasing the number of GPs working in public health sector, it is necessary to pay attention to their distribution. Monitoring the distribution of GPs and redistribution of them according to population number and health needs is a possible solution to improve the equality in access to GPs. It is also suggested that better attention is paid to distribution of physicians within provinces and that resource distribution takes into consideration the regional needs and health indexes of each geographical area. Another suggestion is to create a general and codified plan for distribution of human resources in health-care sector.

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Conflicts of interest

There are no conflicts of interest to declare.

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