Inequality Analysis of Pharmacist Distribution in Iran

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Research

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Abstract

Introduction: Unequal distribution of resources has always been a concern for health systems in addressing access issues in relation to health services. It might have a devastating effect on health outcomes and in a way incur the direct and indirect costs. The purpose of this study thus is to investigate the trend of pharmacists' distribution in Iran.

Methods: In this retrospective longitudinal study, data were collected for a four-time period; 2007, 2012, 2016 and 2019, from the Statistical Center of Iran and Islamic Republic of Iran Medical Council. The sought indicator was the number of pharmacists per 10,000 population. Gini coefficient and Lorenz curve were used to measure and analyze the inequality using STATA software and ArcGIS software was used to map the pharmacists' distribution.

Results: The results showed that the number of pharmacists in 2007 was 12986 and increased by 69% (21919) in 2019, however the inequality in the distribution of pharmacists has not yet disappeared. Gini coefficient values for 2007, 2012, 2016 and 2019 were 0.26, 0.23, 0.21 and 0.19, respectively. The Gini coefficient decreased by 27% during the study period and from 2007 to 2019, pharmacy per capita increased in all provinces of Iran.

Conclusion: The trend of pharmacist distribution in Iran indicates an overall decrease in the inequality level. However, the inter-provincial distribution of pharmacists is significantly unequal, demanding full attention of national and provincial authorities. The results might also inject plenty of insights into the evidence-based policy making at the ministerial level.

Introduction

Health sector, as a key public sector, is of a substantial role in promoting health, well-being and even the development of societies. Accordingly, it is receiving more attention in both developed as well as developing countries. Competing demands both inside and outside of this sector, particularly for available resources and efficient and effective utilization has always encountered health systems with various challenges (1). Health care is recognized as an essential right in most countries. Health services must be hence accessible to all members of society equally and without discrimination. An important goal of health systems is to provide an equal access to health care (2–4). In the Universal Declaration of Human Rights and Constitution of the Islamic Republic of Iran (Article 29), the enjoyment of a healthy, productive and disease and disability free life has been emphasized as a universal right, and it's the responsibility of incumbent governments (5, 6).

Human resources are considered as the core of health systems in most countries (7). Besides accounting approximately for 65 to 80 percent of health care organizations' expenses (8–10), they play a dominant role in comparison with other resources such as money, time and information and ease the ground for the utmost use of the latter. Therefore, a cautious approach should be adopted as to their efficient and equitable usage. The distribution of manpower, as the intelligent assets, among different regions, is

always contentious as compared to the other resources (11), to some extent that, the generation of a sufficient quantity of human resources in health sector is deemed as one side of the coin and their distribution as the other side (12).

Health services delivery to society requires teamwork among a variety of workforces including specialties from different professions such as medicine, pharmacy and nursing and there is no key role for a particular profession in such a process. The pharmacists play a major role in fulfilling the goals of a curative team, given the importance of medications both in terms of their curative effect and expenses. The primary task of pharmacists is to monitor and ensure the medicine dispensing accuracy to patients and also to provide pharmaceutical consultations to other clinical professions (13). Pharmacist collaboration and alignment with other healthcare professionals is expected to increase the productivity and optimal utilization of health care services. This collaboration could allegedly have some effect in reducing drug-related morbidity and mortality, lowering hospitalization costs due to the inappropriate drug use, decreasing the cost of services, and also increasing patient satisfaction (13–20). As to their critical position as the last person in the patient treatment cycle, the proper distribution of pharmacists can be effective in enhancing the access to patient treatment.

Various indices such as Gini Coefficient, Atkinson Index and Theil Index (21–23) are used to measure the equality in access to health services. Gini coefficient is more commonly used in health studies among different countries (24–30), which is defined by Lorenz Curve. This index was designed by the Italian statistician and sociologist, Corrado Gini, and was initially used to measure inequality and distribution of wealth and income among population (31).

In Iran, the previous studies have shown different and somewhat mixed and inconsistent results in terms of resources distribution, especially human resources. Some studies displayed inequitable status in terms of various resources distribution in such provinces as Ardabil(32), Lorestan (33) and Kermanshah (34). However, there are some pointing to a fairly equal situation on the physician and hospital bed distribution (4, 35–37).

Several studies were carried out on the distribution of physical and human resources in the country, especially on general practitioners and specialists. Nevertheless, the distribution of pharmacists are largely neglected in the literature and very few existing studies are mostly conducted at a provincial level (32, 33, 38) and only one nationwide study (39) included just the pharmacists in the public sector, representing a tiny percentage of whole pharmacists.

Therefore, the purpose of this study was to investigate the distribution of pharmacists in Iran's provinces in both public and private sector in order to provide a clear picture of pharmacists' distribution at the national level in four-time intervals.

Methods

Design

This study was a retrospective longitudinal study in Iran.

Data Collection

The study population consisted of the pharmacists working in the public and private sectors in the 31 provinces as a unit of analysis. Data collected from the Statistical Center of Iran (SCI) and Islamic Republic of Iran Medical Council (IRIMC) database in 2007, 2012, 2016 and 2019 based on available data. Data on the pharmacist staff were collected using the data extraction form, in which the name of each province, along with the data required for the years under study, were collected from the IRIMC's database. Moreover, the population data of four relevant time periods came from the SCI's databases for each province.

Data Analysis

Gini Index and Lorenz curve were used to measure the inequality. Lorenz curve has two axes, the horizontal axis representing the cumulative population frequency and the vertical that of the cumulative variable frequency (in this study the pharmacist). Moreover, the curve has a line 45° from the origin of the coordinate, known as the line of equality. The more the distance from this line, the severe the inequality status (40).

Normally, the numerical Gini coefficient values range from zero to one, zero indicating complete equality and one representing complete inequality. Usually, when Gini value is between 0.2-0, the distribution is relatively equal, and it is relatively unequal when the value lies between 0.35–0.5, whilst it is quite unequal if the value is in between 0.7 – 0.5 (41). In our study, STATA software (version 14) was applied to measure the inequality and draw Lorenz curve of the pharmacists, and ArcGIS (Geographical Information Systems) software (version 10.6) was used to map the pharmacists' distribution. This study was approved by the Ethics Committee of Tehran University of Medical Sciences.

Results

Tehran, Isfahan and East Azarbaijan provinces had the highest number of pharmacists per 10,000 population in 2007, while the lowest ratios were seen in Hormozgan, Chaharmahal and Bakhtiari, Sistan and Baluchistan provinces (Table 1). As such, in 2012, the highest number of pharmacists per 10,000 population belonged to Tehran, Isfahan and East Azarbaijan provinces, 5.15, 2.11 and 2.08, respectively; whilst the lowest number of pharmacists per 10,000 population were in Hormozgan, Sistan and Baluchestan and Kurdistan provinces, 0.39, 0.77 and 0.89.

Table 1
Pharmacist-to-10000 population and rank in the country for 2007-2012-2016-2019

Province	2007		2012		2016		2019	
	Ratio ¹	Rank ²	Ratio	Rank	Ratio	Rank	Ratio	Rank
Tehran	4.68	1	5.15	1	5.92	1	6.14	1
Isfahan	1.91	2	2.11	2	2.48	2	2.60	3
East Azerbaijan	1.86	3	2.08	3	2.41	4	2.58	4
Alborz	1.86	4	1.87	6	2.26	7	2.21	8
Mazandaran	1.76	5	2.00	4	2.42	3	2.52	5
Razavi Khorasan	1.75	6	2.00	5	2.39	5	2.50	6
Gilan	1.68	7	1.84	7	2.09	8	2.22	7
Qom	1.58	8	1.72	9	1.91	9	1.88	12
Fars	1.53	9	1.82	8	2.38	6	2.61	2
Golestan	1.19	10	1.29	17	1.54	22	1.69	20
Qazvin	1.18	11	1.43	10	1.62	15	1.77	18
Zanjan	1.17	12	1.37	14	1.67	13	1.81	17
Yazd	1.17	13	1.39	12	1.85	10	1.98	10
Semnan	1.15	14	1.39	13	1.60	17	1.63	23
Ardabil	1.08	15	1.40	11	1.74	12	1.95	11
Khuzestan	1.08	16	1.23	19	1.40	25	1.57	24
Hamadan	1.05	17	1.33	15	1.60	18	1.85	14
Kermanshah	1.00	18	1.20	21	1.81	11	2.11	9
West Azerbaijan	0.98	19	1.15	22	1.43	24	1.51	26
Lorestan	0.97	20	1.31	16	1.61	16	1.83	15
Markazi	0.94	21	1.25	18	1.59	19	1.86	13
Kerman	0.88	22	1.05	25	1.47	23	1.67	21
South Khorasan	0.83	23	0.97	27	1.64	14	1.83	16
Bushehr	0.82	24	1.03	26	1.31	27	1.31	27

1. Ratio: pharmacist/population * 10000 2. Rank among provinces

Province	2007		2012		2016		2019	
	Ratio ¹	Rank ²	Ratio	Rank	Ratio	Rank	Ratio	Rank
Kurdistan	0.78	25	0.89	29	0.89	30	1.20	29
Kohgiluyeh and Boyer-Ahmad	0.76	26	1.21	20	1.59	20	1.70	19
North Khorasan	0.74	27	1.07	24	1.39	26	1.55	25
Ilam	0.68	28	1.08	23	1.57	21	1.64	22
Sistan and Baluchestan	0.63	29	0.77	30	0.99	29	1.10	30
Chaharmahal and Bakhtiari	0.62	30	0.90	28	1.13	28	1.31	28
Hormozgan	0.33	31	0.39	31	0.52	31	0.52	31
Mean	1.84	-	2.1	-	2.5	-	2.67	-
1. Ratio: pharmacist/population * 10000 2. Rank among provinces								

In 2016, Tehran, Isfahan and Mazendaran provinces had the highest number of pharmacists per 10,000 population, 5.92, 2.48 and 2.42, and the lowest ratios were in Hormozgan, Sistan and Baluchistan, and Kurdistan provinces, 0.52, 0.99, and 1.12, respectively. Similarly, Tehran, Fars and Isfahan having the highest ratios of 6.14, 2.61 and 2.6, and Hormozgan, Sistan and Baluchestan, and Kurdistan provinces were lowest with the ratios of 0.52, 1.1 and 1.2 in 2019.

As presented in Table 1, nine provinces had steadily rising trends in terms of rank among other provinces, and nine other had a fixed declining trend. Between 2007 and 2019, the five provinces, Tehran, Mazendaran, Razavi Khorasan, Gilan and Hormozgan were ranked 1st, 5th, 6th, 7th and 31st, respectively for the all period.

Additionally, the rank of some provinces was fluctuating significantly inter-provincially during the whole period. For example, the provinces of Kermanshah, Markazi, South Khorasan, Fars, Kohgiluyeh and Boyer-Ahmad, and Ilam were ranked 18th, 21st, 23rd, 9th, 26th and 28th, in 2007, whereas they were in the 9th, 13th, 16th, 2nd, 19th and 22nd positions, in 2019. As such, Golestan, Semnan, Khuzestan, Qazvin and West Azarbaijan provinces were ranked 10th, 14th, 16th, 11th and 19th in 2007, but in 2019 they were ranked 20th, 23rd, 24th, 18th and 26th, respectively.

The findings regarding the distribution of pharmacists per 10,000 individuals per province displayed that most provinces in 2007 had less than 1.5 pharmacists per 10,000 population, whilst in 2019 only five provinces were under this ratio namely; Bushehr, Kurdistan, Sistan and Baluchistan, Chaharmahal and Bakhtiari, and Hormozgan (Fig. 1).

Table 2
Trend of pharmacists' distribution between 2007 and 2019

	2007	2012	2016	2019	Growth rate 2007–2019 (%)
Total Population	70,495,416	75,149,669	78,769,121	82,084,000	16.44
Number of pharmacists	12986	15759	19681	21919	68.79
Pharmacist Per 10000 Population	1.84	2.10	2.50	2.67	45.11
Gini Coefficient *	0.26	0.23	0.21	0.19	-26.92
* The closer to zero, the more equitable distribution					

Overall, the results indicated that the number of pharmacists in 2007 was 12986, increased by 69% and reached 21919 in 2019. Pharmacist per 10,000 people ratio, across the country, demonstrated a growing trend over the study years, with a change of 45%. The Gini coefficients obtained in 2007, 2012, 2016 and 2019 were 0.26, 0.23, 0.21 and 0.19, respectively (Table 2). Furthermore, Fig. 2 illustrates Lorenz curve trend and shows that this trend is closer to the equilibrium line over the four targeted intervals.

Discussion

This study seeks to investigate the inequality in the distribution of pharmacists in Iran, using Gini coefficient and Lorenz curve, as the role of medications and pharmacists in treatment process is not ignorable.

As the results revealed, there was still a fair inequality in the distribution of pharmacists among the provinces in the country. However, the trend of inequality was descending over the 13 years period; in other words, the distribution of pharmacists has relatively become more equitable. As to the ratio of pharmacist per 10,000 populations, Tehran province came overall the first among all provinces in the given period; whereas Hormozgan province was the last (31st). Kermanshah, Markazi, South Khorasan, Fars, Kohgiluyeh and Boyer-Ahmad, and Ilam provinces gradually found better rank among the all provinces in terms of the distribution; whilst, Golestan, Semnan, Khuzestan, Qazvin and West Azarbaijan became worse.

National Comparisons

During the period under study, inequality of pharmacist distribution has generally decreased which probably might be due to the improved conditions of inter-provincial transport, the level of welfare; and an increase in the admission rate of students(42, 43). The relevant Gini coefficient also reduced from 0.26 in 2007 to 0.19 in 2019. However, there exist few provincial contradictory evidence. For instance, Gini

coefficient of the pharmacists in Ardabil province ranged from 0.62, 2002 to 0.65 in 2010 (32). Another study on the pharmacists' distribution in Kermanshah province(38), showed the coefficient ranging from just from 0.43 in 2007 to 0.44 in 2012. As such, according to another study upon the counties of Lorestan province manifested that the values of Gini coefficient for pharmacists varied from 0.37 to 0.39 from 2007 to 2015 (33).

Perhaps these inconsistencies might be because the latter studies have been only conducted in only one province. In a way, the status of pharmacists' distribution within the provinces is normally less equal than that of the inter-provincial distribution. It should be noted, however, that in some studies, including the study of Taghvaei and Shahivandi (44), the all three were considered as less developed provinces, which may explain their high Gini coefficients.

In 2015, a study on the distribution of pharmacists reported that the Gini coefficient was 0.71, denoting a completely unequal distribution (39). The findings of that study are inconsistent with the findings of our study and this can be due to the source of the collected data. The former study depended on data extracted from Statistical yearbook of the SCI's, which was just related to the pharmacists in the public sector. Meanwhile the data in our current study were obtained from the IRIMC and all pharmacists in the both public and private sectors forces were involved (45).

With respect to the pharmacists' distribution, the central provinces are better-off than the borderland provinces, and this was in line with previous studies (39, 46). This divergence could be justified in the light of governmental concern, living standards, per capita income, industrial infrastructure, development and welfare (47–49); and therefore more willingness to work in the central provinces.

The results also showed that metropolitan provinces such as Tehran, Isfahan and East Azarbaijan had the highest number of pharmacists per 10,000 population, while the lowest numbers of pharmacists were in Hormozgan, Chaharmahal and Bakhtiari, and Sistan and Baluchestan. This seems natural as the former includes more hospitals, health care facilities, amenities as well as well-known universities and the latter of low attractiveness for the pharmacists to serve in these areas (50–53). Similarly, the distribution of human resources and outcome indicators, maternal and neonatal mortality rates, in Hormozgan and, Sistan and Baluchestan were also found poor (54, 55) which might be because of their deprived access to health care resources, both institutional and human resources (56). Granting university admission priority to local students, more financial incentives and facilitated licensure of new pharmacies in those areas might result in a fairly reduced inequality in these provinces.

Interestingly, over the years under review, the number of pharmacists per 10,000 people increased in all provinces, and all provinces (except for Hormozgan) had more than one pharmacists per 10,000. This might point to the fact that more focus has been on increasing the number of pharmacists' manpower rather than their proportional distribution based on the needs and populations.

International Comparisons

Various studies have been conducted on the distribution of health sector manpower, but few regarding pharmacists, in other countries. In Poland, Rójs examined the equality in the distribution of human resources in health sector and found out that the Gini coefficient was 0.11 in 2010 and reached 0.09 in 2017, suggesting relatively good equality(57). In 2015, a study in Cameroon demonstrated that the Gini coefficient for pharmacists was 0.57 (26). One study in Ethiopia reported that the Gini Index for pharmacy personnel in 2000 and 2015 were 0.492 and 0.409 respectively (58). The differences in the health system among different countries could be accounted for the inconsistency between the results of previous studies and the present study. Overall, many countries are now facing with the challenge of unequal distribution of health workforce.

Limitation

Whilst the data in this study were obtained from the IRIMC, the most complete source of human resource distribution data encompassing both public and private workforces, it should be noted that these data may also include inactive pharmacists.

Conclusion

The effective involvement of pharmacists in the cycle of providing health care is critical to any health system. Thus, the proper distribution of this group is invaluable to policy makers. This study manifested that the distribution of pharmacists in the country improved over the study period so that the underdeveloped provinces attracted more percentages of pharmacists than in 2007. However, the growth rate in all provinces wasn't even and some provinces are still facing shortages of pharmacists, which needs to be reviewed and addressed by policy makers.

Likewise, it should be mentioned that increasing the number of pharmacists does not mean improving the quality of services by pharmacists, and this needs further research. This increase may also be a normal trend due to an increase in the number of pharmacy schools and also the growth of students' admission rates. Also, further studies are needed to evaluate the distribution of pharmacist in the counties level, as there seem to be more inequality. It is recommended to prioritize the provinces suffering from pharmacists' shortages to be replenished. Since the equitable distribution of resources has a direct impact on the health of the society, policymakers should make use of up-to-date and scientific evidence based on actual need assessment in order to allocate human resources efficiently and avoid waste of resources.

Abbreviations

SCI

Statistical Center of Iran; IRIMC:Islamic Republic of Iran Medical Council; GIS:Geographical Information Systems

Declarations

Ethics approval and consent to participate

Ethical clearance is obtained from Tehran University of Medical Sciences (TUMS) Ethics committee (IR.TUMS.REC.1395.2491). All data was obtained from related organizations' websites (Accessible to all researchers).

Consent for publication:

Not applicable

Competing interests

The authors declare no competing interests.

Availability of data and materials

The original dataset is available from the corresponding author upon the request.

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Authors' contributions

MG prepared the first draft of the manuscript. EJP supervised the process and revised the entire manuscript. HD and SE provided technical comments on the analysis. All authors read and approved the final manuscript.

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Figures

Figure 1

Pharmacists distribution status in the years 2007, 2012, 2016 and 2019.

Figure 2

Lorenz Curve of pharmacists' distribution for the years 2007, 2012, 2016 and 2019.