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Investigation of Inequality Trend in Distribution of Health Sector Resources in Iran during 2006, 2011 and 2016 Timelines Using Gini Coefficient

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ABSTRACT

Background: Equality in resource distribution is one of the important aspects of effectiveness in achieving the goals of health system. Spending more resources in the health sector will not decline the inequality in the distribution of resources. Generating evidence and adopting evidence-based policies are very essential to reduce inequality in the distribution of health resources in the country. The present study investigates the equality trend in the distribution of health sector resources in Iran using Gini coefficient.

Methods: This is a descriptive-analytical study performed to investigate the equality trend in the distribution of health workers (Behvarz in Persian), general practitioner, pharmacist, pharmacy and fixed beds over 2006, 2011 and 2016 timelines. Data were extracted from the reports of the Iranian Statistics Center database and according to the population and housing censuses. Moreover, the data from the Plan and Budget Organization of the Islamic Republic of Iran (PBO) reports are used. Finally, data analysis was carried out through using Stata $_{14}$ software.

Results: The Gini coefficient for general practitioner distribution has had a constant trend. The Gini coefficient for pharmacists and pharmacies has decreased, i.e. the distribution of these resources is improving. In addition, the Gini coefficient for fixed beds and Behvarz has increased, referring to a relative decrease in equality in the distribution of these resources. There is equality in the geographical distribution of Behvarz in 2006 and 2011; but in 2016, there is a relatively unequal distribution. Concerning beds, pharmacies and general practitioners, it can be claimed that geographical distribution is generally equal. Despite the found trends, with respect to the Gini coefficient, the geographical distribution of pharmacists is estimated quite unequal.

Conclusion: Although the ratio of each variable to population is different in different provinces, it can be claimed that there is a relative equality in the distribution of general practitioners, Behvarz, pharmacies and fixed beds. In addition, health policy makers and decision makers have to consider the extent to which the target community needs each of these resources, in addition to crude distributional equality.

Keywords: Distributional equality, Gini coefficient, Health resources, Lorenz curve

Citation

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Introduction

The study of the allocation of limited resources to unlimited needs is one of the most important definitions of economics science (1). Despite the considerable resources allocated to the country's health sector, there is still a gap between the available resources and the required resources (2). Inequality in the distribution of resources between different regions can be referred to as one of the most important causes of resource loss, so that in some places, we are faced with overcrowded and wasted resources while others are deprived of the minimum facilities (3). Today, unequal distribution of health facilities in the world has become one of the most important concerns of any health system (4).

Equality in resource allocation is one of the important aspects of effectiveness in achieving the goals of the health system, becoming important due to the role of governments in providing public access to health services (3). Justice can be regarded as a principle of eliminating inequalities in the health system (5). Governments should note that, based on the evidence, merely increasing health sector resources will not lead to reduced inequality in resource distribution (6, 7). Inadequate geographical distribution of human resources has been one of the most important inequality sources and various studies have revealed that high workforce density is associated with positive and favorable outcomes even when there are unfavorable socioeconomic factors in the region (8). Inequality in access to health care increases the burden of diseases as well as exacerbating inequalities (9). Different studies indicate the geographical inequalities in the distribution of health resources as well as their impact on geographical inequality in health outcomes (10-12). Although inequalities in the distribution of health resources are not exclusive to developing countries (1.-15), they are more prominent in these countries (16, 17). Thus, the generation of evidence and consequently the adoption of evidence-based policies to decline inequality in the distribution of health resources in the country is necessary (17).

Gini coefficient and Lorenz curve are one of the most common and famous methods to investigate the inequality (4). The Lorenz curve was first created by Max Lorenz in 1905 in order to investigate the distribution of income. The more convex the curve is, the more unequal the distribution will be; and the closer it is to the 45-degree line, the more equitable the distribution will be (18). The Gini coefficient is calculated by dividing the area between the 45-degree line and the Lorenz curve by dividing it to the total area below the 45-degree line. The Gini coefficient has the following features: it is comprehensible; it depends on the unit of measurement and gives the same weight to different people. It also has some disadvantages, the most important of which is that it cannot distinguish different patterns of inequality when intersecting the Lorenz curves. I.e., the two communities may have different shapes of the Lorenz curve while the same Gini coefficient (19, 20).

The present study investigates the inequality in the distribution of health resources in Iran using Gini coefficient. Previous studies have either locally addressed the distribution of health resources for one province (21-24) or selected limited resources for review (25-27), or despite the comprehensiveness in the selection of the studied sources and indicators, they have evaluated timelines for a limited time (28, 29). In addition to the relative comprehensiveness of the data and the selection of the studied indices, this study has employed the maximum possible timelines based on the data available in the population and housing censuses.

Materials and Methods

Variables and Data

This is a descriptive-analytical study aimed at investigating the equality trend in the distribution of human resources of Behvarz, general practitioner, pharmacist, as well as the pharmacy and fixed bed resources as indicators of 3 major parts of the health system, i.e. health, treatment and education in 2006, 2011, and 2016 timelines. Medicine was performed in 2006, 2011 and 2016.

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Moreover, these indicators were selected as those with less defective data. General practitioner, pharmacist and fixed beds are the cases existing in the provincial medical universities' service delivery structure and pharmacy refers to all pharmacies including university, private pharmacies, etc. and the hospital beds in the present study refer to the fixed beds. The data were collected from the Iranian Statistical Center's website based on population and housing census reports for 2006, 2011 and 2016 as well as the data from the Plan and Budget Organization of the Islamic Republic of Iran (31). These data are freely available to the public. Moreover, it seems that data of Iranian Statistical Center are related to governmental sector. In 2006, Due to the lack of Alborz province, the data from 30 provinces were investigated. Moreover, the data of 31 provinces in 2011 and 2016 were analyzed.

Data Analysis

The inequality in the distribution of variables was assessed both numerically and using Gini coefficient and visually using Lorenz curve. All analyzes were carried out in Stata 14 software and installation of DASP (Distributive Analysis Stata Package) plugin. The more convex the Lorenz curve is, the more unequal the distribution will be; and the closer it is to the 45-degree line, the more equitable the distribution will be (18). The Gini coefficient is also a number between zero and one whose formula is $1 - \sum(Y_{i+1} + Y_i)(X_{i+1} - X_i)$, where Y_i is the cumulative percentage of human resources and X_i refers to the cumulative percentage of the population. The closer the Gini coefficient is to zero, the more equitable the distribution will be; and the closer it is to one, the more unequal the distribution will be. In case that the Gini coefficient is between 0.25 and 0.35, the distribution is relatively equal and if it is between 0.35 and 0.5 the distribution is relatively unequal; however, if it is between 0.5 and 0.7, the distribution is quite unequal (32). To calculate equality in the distribution of variables of bed, pharmacist, pharmacy and physician (GP), the total population of each province was considered since all population use them. Whereas, to calculate equality in the distribution of Behvarz, just the rural population of each province was considered since only the rural population used the services provided by Behvarz.

The authors declare that they have complied with the principles of the Helsinki Declaration.

Results

The population of Iran in 2006, 2011 and 2016 respectively was 70495728, 75149669 and 79926270. In all three periods, Ilam province had the lowest population and Tehran province had the highest population. It is noteworthy that the population reported from Tehran in 2006 is actually the combination of Tehran and Alborz provinces. In 2016, the lowest and highest rural population belonged to Semnan and Khorasan Razavi provinces, respectively' nevertheless, in 2011 and 2006 these provinces were Qom and Khorasan Razavi. The values of each of the variables of Behvarz, bed, pharmacist, pharmacy and general practitioner in the years 2006, 2011 and 2016 are presented in diagrams one to five.

According to the results, Gini coefficient of general practitioners has had an almost constant trend and in the years 2006, 2011 and 2016 it has been 0.243, 0.226 and 0.23, respectively. The Gini coefficient value for pharmacists and pharmacies decreased, i.e. the trend is improving, increased from 0.3 and 0.143 to 0.21 and 0.125, respectively. However, the Gini coefficient has increased from 0.107 and 0.17 to 0.147 and 0.19, respectively, indicating a declining trend (Table 1).

According to the results, it can be claimed that there is equality in the geographical distribution of Behvarz, bed and pharmacy in 2006, 2011 and 2016 since their Gini coefficient is less than 0.25. Concerning general practitioners and pharmacists, it can be aid that the geographical distribution is relatively equal because their Gini coefficient is close to 0.25 (Table 1). In order to visualize the Gini coefficient, the Lorenz curve for each of the variables of Behvarz, bed, pharmacist, pharmacy and general practitioner in 2006, 2011 and 2016 is presented in Fig. 3.

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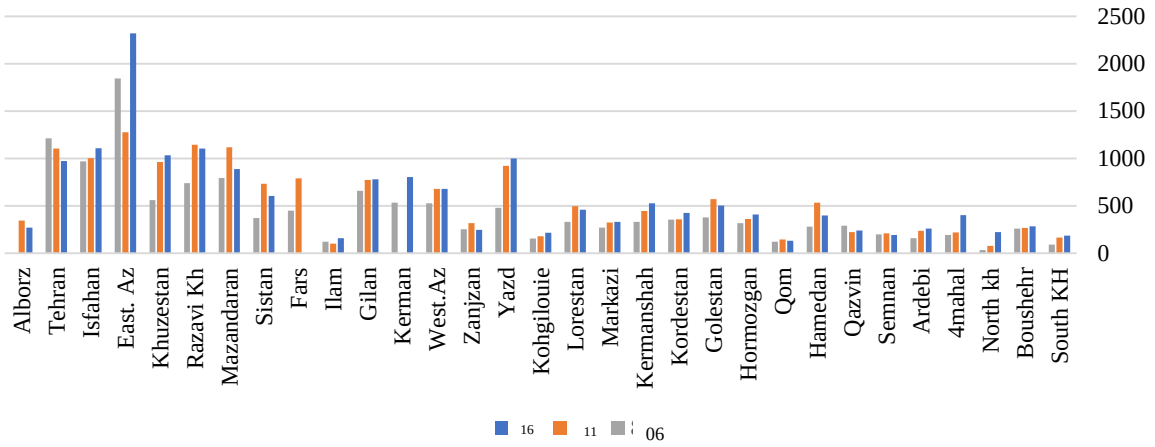


Figure 1. Number of practitioners in 2006, 2011, 2016

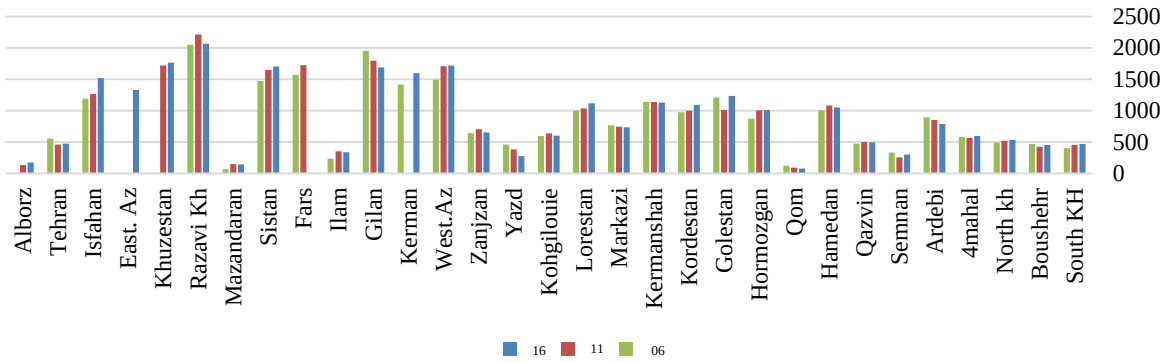


Figure 2. Number of Behvarz in 2006, 2011, 2016

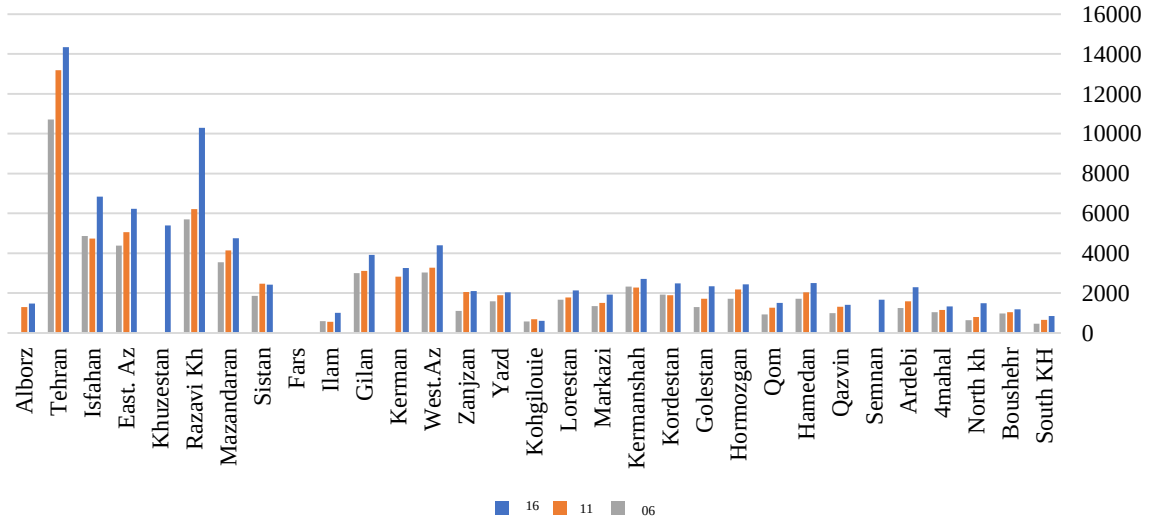


Figure 3. Number of beds in 2006, 2011, 2016

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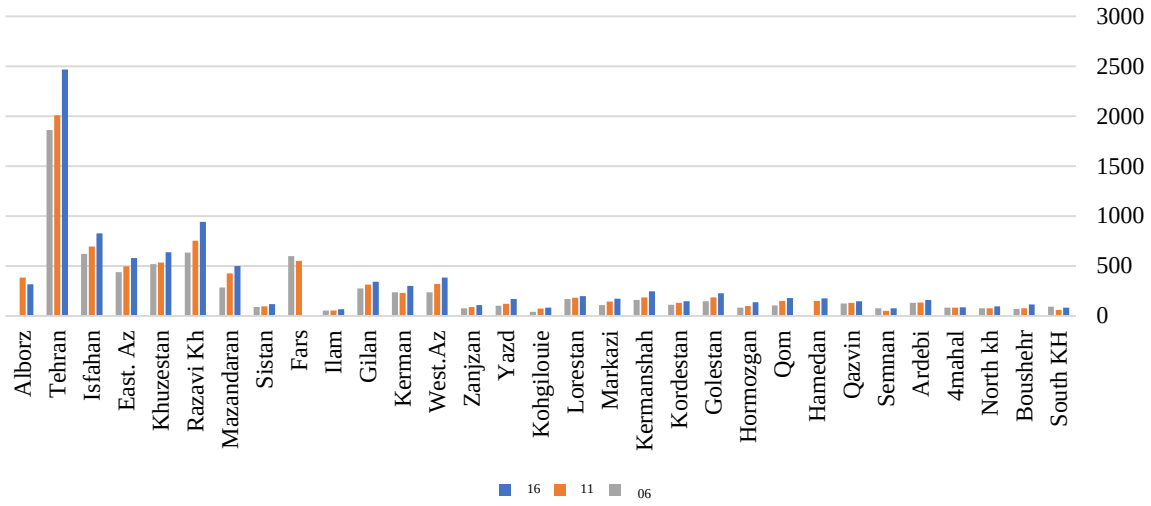


Figure 4. Number of pharmacies in 2006, 2011, 2016

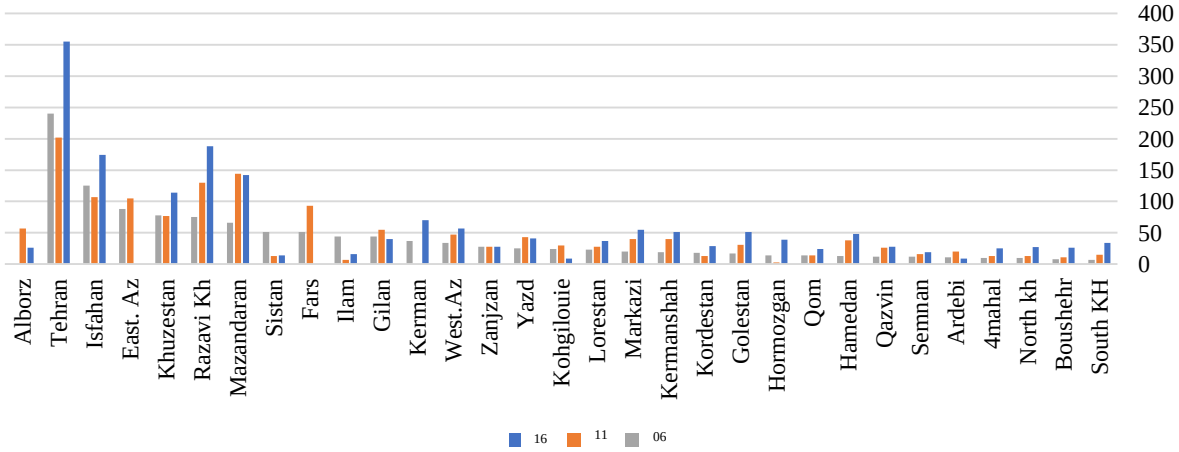


Figure 1. Number of pharmacists in 2006, 2011, 2016

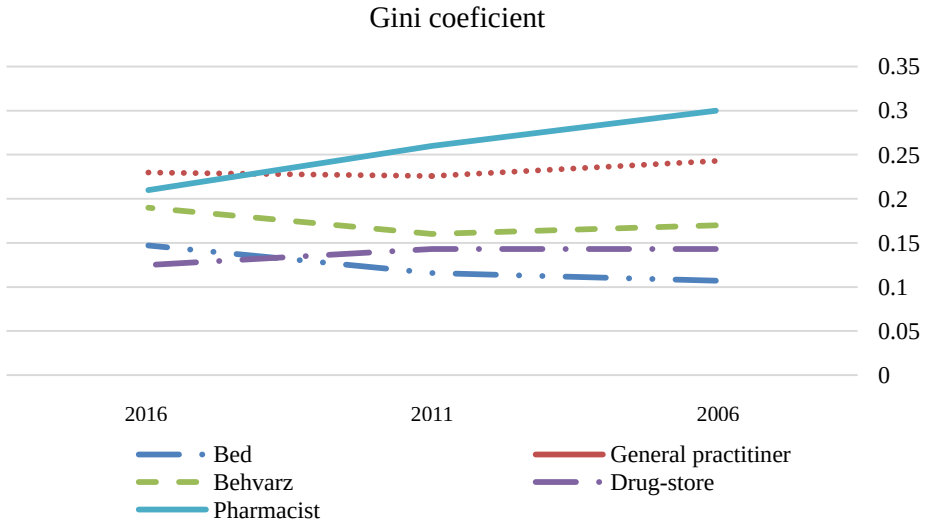


Figure 6. The trend of variations of Gini coefficient for each variable in the studied years

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Table 1. Gini coefficient value for each variable in 2006, 2011 and 2016

Variable	2006	2011	2016
Behvarz	0.17	0.16	0.19
Bed	0.107	0.116	0.147
Pharmacist	0.3	0.26	0.21
Pharmacy	0.143	0.143	0.125
General practitioner	0.243	0.226	0.23

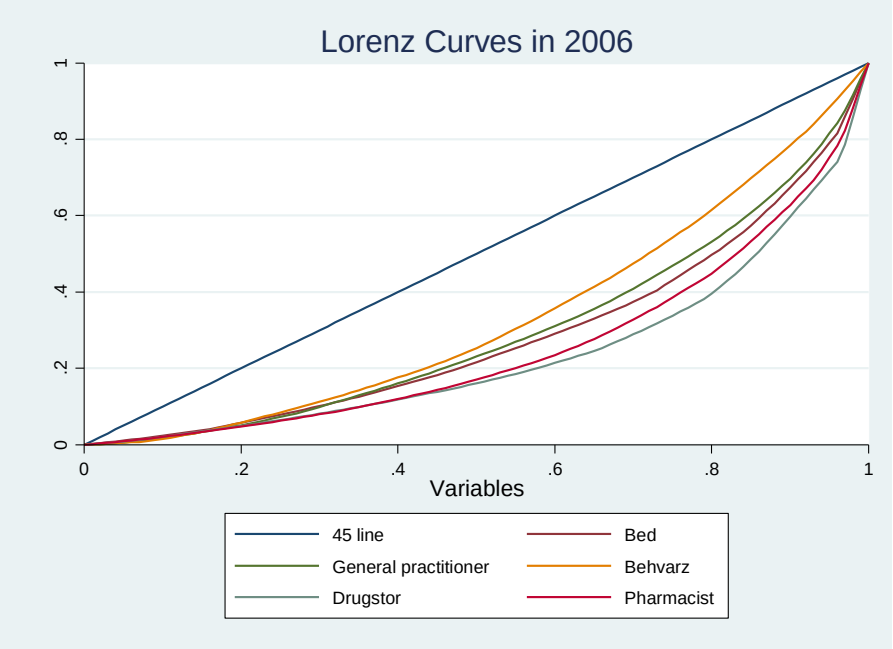


Figure 7. Lorenz curve for various variables in 2006

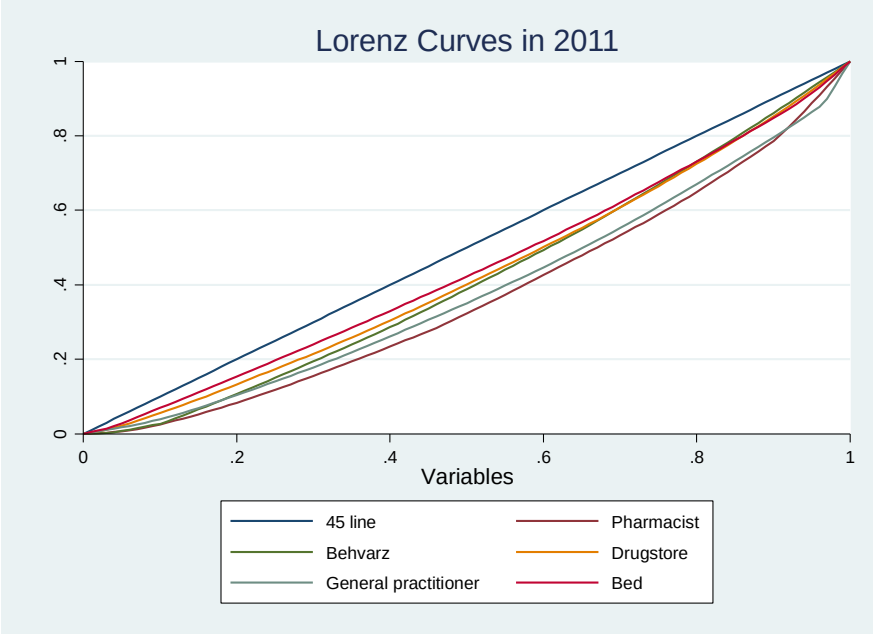


Figure 8. Lorenz curve for various variables in 2011

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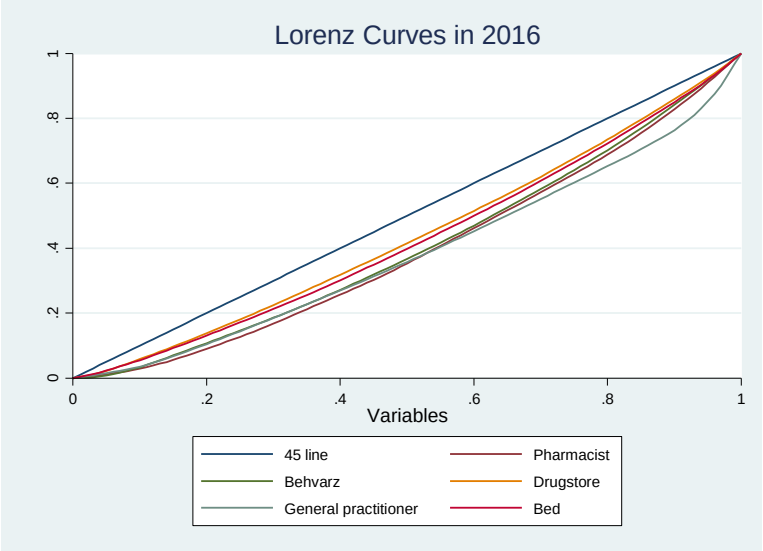


Figure 9. Lorenz curve for various variables in 2016

Discussion

In general, the results of this study based on data from the Iranian Statistical Center and the Plan and Budget Organization reveal that in general, there is a relative equality in the studied variables based on distribution by population. However, the trend for variables of bed and Behvarz has been towards inequality. Nevertheless, the results of this study alone are not sufficient. For better policymaking in the area of workforce distribution, more accurate data are required from within the provinces, i.e. towns and villages in order to show whether there is equal distribution across provinces or there are more resources at the centers of provinces. For example, in a study, Meshkani et al (25) investigated the equality in distribution of pharmacies in Kerman province during 2006 to 2011 with the help of Gini coefficient. The results of their study suggested that the distribution of pharmacies in Kerman province was not equal. Furthermore, the results of the present study show that there is equality in the geographical distribution of pharmacists and that the status of distributional equality has improved over time. These results are in line with those of a study by Rezaei et al. (22) in Kermanshah province. In their study, it was shown that despite the lack of equality in the geographical distribution of pharmacists, the status of distributional equality is improving over time. The results of these two studies may lead to the conclusion that the trend of distribution of pharmacists in the country and in the provinces is improving. Moreover, it can be concluded that although there is relative equality in the distribution of pharmacists among provinces, there is no equality within provinces (cities in provinces). The results of this study are in contrast to those of Zhang's study (13). In his study, the results suggest that the trend of hospitalization concentration index in hospitals in eastern China varies and ranges from - 0.05 to 0.02 whose value has decreased over time. The difference between the results of Zhang's study and the present study may be due to differences in indicators, health systems differences, cultural issues, etc.

In their study, Goudarzi et al (33) investigated the distribution of general practitioners in Iran by means of Gini coefficient and Atkinson index. Conducted between 2006 and 2011, this study showed that the distribution status of general practitioners was equal. Moreover, they employed the need index in this study, in which in both states of before and after adjusting the indices to the need index, the distributional equality is established. It is noteworthy that, after adjusting the need, the status of the distributional equality

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has worsened, although equality remains. The results of their study are also in line with the present study, both of which point to the existence of distributional equality among general practitioners. Furthermore, another study examined the geographical inequality of primary care physicians in the UK and Japan in which the inequality status in the UK was better than that in Japan. The Gini coefficient was 0.08 for the UK and 0.17 for Japan and the difference is in the type of their health systems (34).

The results of Omrani Khou's study (35) have revealed that although the distribution of hemodialysis beds is based on population's needs, the distribution of health care staff is not similar to that of hemodialysis beds, and this can affect equal performance and accessibility. The results of this study are also consistent with those of the present study; however, there are some differences. For instance, in Omrani Khou's study, the distribution of hemodialysis beds has been studied, but in the present study, all fixed beds have been examined. In addition, in Omrani Khou's study, all health care staff has been considered, while the present study separately considers indices of Behvarz, general practitioner and pharmacist. Moreover, in a study using Lorenz curve, Gini coefficient, and Hoover index, Lotfi et al (32) addressed human resources, health centers, and hospital beds. Gini coefficient for each index was 0.138, 0.2 and 0.15, respectively. Hence, in their study, there was equality in the distribution of health sector resources. In a study performed in China, the researchers concluded that in western China, hospital bed inequality was worse (36).

One of the notable findings of the present study is that despite the number of hospital beds in the country increased over 2006 to 2016 (Fig. 3), its Gini coefficient increased (Table 1). This finding suggests that in spite of the dramatically increased hospital beds, the distribution of beds has not been equal to the population distribution, indicating that hospital beds may have increased in areas with a previously good bed-to-population ratio that did not need an extra bed. This has also been true for the distribution of Behvarz.

The distribution of disease and mortality seem to be different in different provinces; thus, people's needs in these provinces and from province to province vary, too. Accordingly, the distribution of human resources and health sector resources has to be appropriate and based on patients' needs, i.e., in addition to the population index for the distribution of human resources, the need index must also be considered. Therefore, despite the results of this study show the equality of the studied variables by population, further studies are still required to consider the need indices for equality assessment. However, since inadequate distribution of resources in health sector has always been a global concern (22), in Iran, measures like sending medical and paramedical forces to deprived areas, banning graduates from spending their in-service work in large cities such as Tehran, special financial rewards for physicians serving in deprived areas, etc. have been taken to promote equality in the distribution of human resources. The results of this study and other studies generally suggest that there is equality in the distribution of resources in health sector (18, 33, 37).

Conclusion

The results show that despite the observed difficulties, equality in the distribution of health sector resources is generally established based on Gini coefficient and Lorenz curve. Meanwhile, Gini coefficient for general practitioners in the studied period has been almost constant; equality in the area of pharmacists and pharmacy has improved; however, the distribution of hospital beds and Behvarz has become somewhat more uneven over the studied years (Fig. 1 and Table 1). Nevertheless, it is recommended that health policy makers and decision makers do not just rely on the crude distributional equality; since different provinces may need different services and some provinces may need more services. Hence, further studies in the current study are required to incorporate the need index of data analysis. In addition, given the results of some other studies indicating some inequalities in the distribution of health resources across the studied provinces, more

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detailed investigations about the distribution of health resources within the provinces are required.

Data deficiency is considered the most important restriction in the present study. At first, it was attempted to use the number of referrals to health centers as well as the number of inpatients as need indices in the research to provide a more complete conclusion and analysis of the trend of Gini coefficient variation in the studied variables; but the need index was excluded from the study due to data deficiency. In addition, although the available data were derived from national censuses, they appear to contain many shortcomings; however, they were used in this study since they are one of the few official sources in this field. Furthermore, the defects in the data of other variables finally led to their elimination from the variables studied in this study. Although Iranian Statistical Center, in addition to the 5-year censuses, also samples and collects data on the studied variables every year, the provincial data's large deficiencies in these annual statistics led to the exclusion of these annual data from this study and we just sufficed to 5-year statistics. To provide more detailed analyses, it is better to disseminate the data in more accurate geographical breakdowns and to have accurate data on all towns and villages of provinces so that the Gini coefficient can be measured within each province and distinguish the equal provinces from unequal ones. Nevertheless, the lack of sufficient data in this regard has barred the way for more detailed analysis. Thus, it is recommended that the data available on the Iranian Statistical Center website be collected in a better and more accurate manner. It is also recommended to revise the categorization of data published at the Iranian Statistical Center and publish the data in a format as easy as possible for researchers to use them. For instance, The World Bank publishes its data on the most up-to-date open data standards on its website. Data in other similar cases is expected to be published as open data.

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Conflicts of Interest

The authors declared no conflict of interests.

Author's contributions

Bouzarjomehri H and Mokhtaripayam M designed research; Mokhtaripayam M and Chivaee D conducted research; Bouzarjomehri H analyzed data; Mokhtaripayam M and Hadian Shiva E wrote manuscript. All authors read and approved the final manuscript.

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