Evaluation of Human Resources Distribution Working in Hospitals Affiliated to Kurdistan University of Medical Sciences by Using Gini Index and Lorenz Curve in 2015

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Abstract: Symmetric, proportional and fairly distribution of human resources can be as effective factors on improving the health indicators of a country and is one of the significant factors considered by the health system planners. The aim of this study was to investigate the distribution of human resources in hospitals affiliated to Kurdistan University of Medical Sciences using the Gini index and Lorenz curve in 2015. The present study was an analytical and interventional research. The study population consisted of all hospital beds and all staff working in the job categories employed in hospitals. After collecting the necessary data, the statistical relationship of inequality rate between the variables of human resources and hospital beds and the health indicators was evaluated. In this study, the STATA 13 Software was used to calculate the Gini Index and draw the Lorenz curve. Also, the SPSS 23 Software was employed to evaluate the presence and absence of a statistically significant relationship between the variables. The study findings indicated that the available beds per capita of hospitals affiliated to the university in the affiliated cities is in accordance with the national standard as 1.5 beds per thousand people except in the cities of Dehgolan, Sarvabad and Kamyaran and the ratio is not fitted in other counties. Finally, the Gini coefficient was calculated for the distribution of human resources as follows: Specialist (0.61), general practitioners (0.48), nurses (0.51), midwives (0.40), other health categories (0.45), administrative and financial (0.57), service personnel (0.44) and available beds (052). Although, the distribution of human resources and also hospital beds is not proportional to the population in most cities of Kurdistan Province, however, recruiting and motivating human resources, particularly health care professionals by increasing payment and benefits based on employees' performance and provision of particular recreational facilities can be helpful in achieving the objectives of healthcare reform plan as parameters for adjusting the shortages.

Key words: Human resource distribution, available beds, Lorenz curve, Gini coefficient, Iran

INTRODUCTION

Inequality in health is a general term used to show differences, changes and dissimilarities in individuals or groups access to health facilities. Inequality in health includes those injustices that are unfair or caused due to some mistakes (Mohammadbeigi et al., 2013). Health equity issues are permanent concerns of researchers, planners and policy makers in the field of health (Berndt et al., 2002; Hiroshi et al., 2004; Tofighi et al., 2010). Regardless of different concepts, justice or equality is the axis of service providing system. The focus should be on equitable distribution of services between different social groups (Motevallizadeh and Zakiyani, 2005; Maddox, 1998; Tofighi, 2011). Although, it may seem difficult to respond to issues of health equity, but it deeply influences the policy making, resource allocation and in general, legal principles of the state and society (Berndt et al., 2002; Tofighi, 2011). The quantity of human resources in the health sector of countries is one side of the issue and its distribution in the different regions of a country with respect to demographic, epidemiologic and disease diagnostics characteristics is the other side. Policy making for the distribution of human resources, especially on medical personnel, is among decisions made at state macro level by the states' Ministry of Health

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which has turned the regular documentation of its distribution to a constant concern for policy makers. The overall performance of the health system depends on the presence of optimal number and proper distribution of human resources as well as applying these two issues about other resources of the health sector (Gravelle and Sutton, 1998; Zandiyan *et al.*, 2012).

Symmetric and balanced distribution of human resources can be seen as factors contributing to the enhancement of health indices in a country. There are many problems facing the health system planners and policy makers regarding the distribution of resources in the health and treatment sector which may lead to failure in appropriate distribution of these important and strategic resources (Karimi and Azimi, 2005; Zandiyan *et al.*, 2012). In the human resources issue, the problem of imbalance and unbalance has always been in play. Imbalance in health human resources is an unpleasant and complex phenomenon that such an imbalance can occur in terms of numbers, quality and on distribution (geographical, occupational or professional institutional or gender distribution). It is obvious that training health staff more than the country's estimated need would be the waste of public money. The distribution of physicians in different regions has always been disputed and the issue is different even in the United States. The per capita of physicians to population varies up to double between the states. Japan, Australia and Canada are somehow facing such a distribution problem. In the UK, due to perfectly tuned system, the geographic distribution of physicians is under control. The problem faced in Iran, is not only the increasing number of general practitioners, but also the problem of distribution these physicians in different regions of the country (Shahabi *et al.*, 2010). In Iran, the privileged provinces compared to deprived provinces are up to 3 times more different in terms of physicians per population, ratios of hospital beds, medical laboratories and radiology centers which means the privileged provinces benefit from such facilities 3 times more than deprived provinces (Shahabi *et al.*, 2010). Several factors lead to improper distribution such as socio-economic status inequality, educational system, payment incentives, development of public or private sectors in the provision of health services and the movement toward the health system reforms. In developing countries, one of the main barriers to successful implementation of health policies and reforms is the lack of qualified human resources for providing health care and treatment services (Mostafavi *et al.*, 2015; Olsen *et al.*, 2005).

However, the issue of justice in the distribution of human resources is an important and considerable issue in all countries, especially countries with high income. For example in Western Europe countries where the ratio of physicians to population is high, the equity in the geographical distribution of physicians is not better than other countries. On the other hand, despite the low ratio of physicians to population in the UK, the distribution in society is more balanced than other countries in the region (Mostafavi *et al.*, 2015). In the Islamic Republic of Iran, like other countries, the human resources of health system are hardly willing to serve in rural and disadvantaged areas and there are always complaining in the news and newspapers of the shortage of health human resources in rural areas. Therefore, due to the importance of the issue, the distribution policy of human resources, especially the physicians, is a decision that is made at the country macro level by the countries' Ministry of Health. The same is true on the distribution of hospital beds so that in 2008, the number of hospital beds in the country varied from 86-126 beds per hundred thousand population in provinces such as Sistan and Baluchestan, Southern Khorasan and Kerman to 209-249 beds in provinces of Semnan, Tehran and Yazd (Mostafavi *et al.*, 2015; Nishiura *et al.*, 2004).

Surveys and studies conducted by institutions and researchers in different periods of time are indicative of an inequality and imbalance in the distribution of human resources and hospital beds in the health sector of the country. Such a degree of deviation and variation among the provinces of the country regarding the health resources is considerable. In fact, a glance at the health indicators of the country (Iran) in the past decade reflects rapid rising trend of indicators on one hand and the inequality in some indices in different regions and provinces on the other hand (Mostafavi *et al.*, 2015; Movahedi *et al.*, 2008). Therefore, providing a basis for establishing justice in the distribution of human resources is essential. Since in terms of planning management, allocation of human resources by population is very expensive, valuable and important. Also, one of the most important indicators of access to health care is the ratio of the number of specialists per one hundred thousand individuals. In addition, equitable distribution of resources contributes to access to services and establishing justice (Mostafavi *et al.*, 2015; Keley *et al.*, 2012).

Based on available evidence, Kurdistan province along with five other provinces including Qazvin, Ardebil, Kohgiluyeh and Boyer-Ahmad, Sistan-Baluchestan and Hormozgan have the lowest degree of development in

health and treatment issues. In addition, the province of Kurdistan has a very bad status in terms of human resources indices of health sector than to the institutional and structural indicators (Mostafavi *et al.*, 2015; Hamouzadeh *et al.*, 2013). Thus, this study aimed to determine the distribution of human resources working in hospitals affiliated to Kurdistan University of Medical Sciences by using Gini index and Lorenz curve in 2015 to draw the attention of the health policy makers to process of human resources distribution across this province. The Gini coefficient is a number between zero and one and Lorenz curve is equal to the enclosed area between the Lorenz curve and the perfectly equal line of distribution. In fact, the Lorenz curve is one of the important indicators of "distribution of wealth" in the society which shows the relationship between the cumulative proportion of income holders (on horizontal axis) and the cumulative proportion of income received by them (on vertical axis), provided that the income holders are arranged in ascending order of their income. Hence, any point of the lorenz curve represents a share of the total income of the society which has been obtained by the ratio of the population with a certain amount of income or lower (Zandiyan *et al.*, 2012). In general, the lorenz curve includes a horizontal axis as the cumulative frequency of population, a vertical axis as the cumulative frequency of studied variable (including revenues, manpower, expenditures, wealth, etc.) and a line with a 45° angle from the origin which is known as the complete equality line. Based on mathematical principles, the line at 45° from the origin has the feature of equal width and length of each point on the line, according to which it is called the same equity line (Zandiyan *et al.*, 2012; Sullivan and Steven, 2006). The general shape of the lorenz curve is as in Fig. 1.

It is a simple scale to measure income relative inequality that is obtained by calculating the ratio of area between the square diameter and the lorenz curve in comparison with the total area of half a square that the curve is located within. For example in Fig. 1, the ratio of Gini coefficient to the Gini coefficient of total inequality scale as: A/(A+B), can be from zero to one. Smaller values of this index and closer to zero reflects more equitable distribution, while values closer to one will indicate more unequal distribution. Although, the mentioned scale has been initially used to measure income distribution, however, it can be used to evaluate data from any distribution pattern (Zandiyan *et al.*, 2012; Frank, 1998). The Gini coefficient can be calculated using the following formula which is also known as the Brown formula:

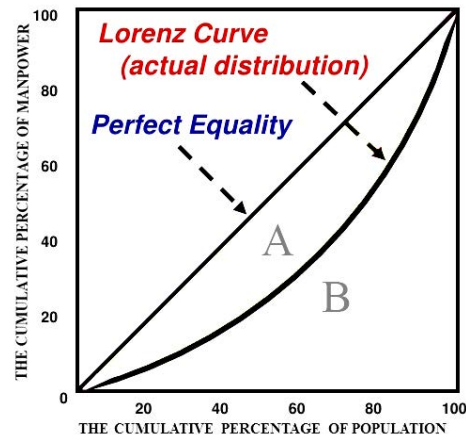$$Gini = 1 - \sum_{i=1}^{n}(x_{i+1} + x_i)(y_{i+1} + y_i)$$

Fig. 1: Lorenz curve

Where:
x_i, i = Human resources and hospital beds in the nth city
I = Cumulative ratio of population variable of the province in total number of cities

It should be noted that the per capita of beds distribution per thousand population is 1.5 beds and the human resources distribution was calculated per ten thousand population.

MATERIALS AND METHODS

The present research was an analytical, applied and intervention study for the planners of health and treatment sector of Kurdistan province. The study population consisted of all hospital beds and specialist physicians, general physicians, nurses, midwives and other job categories working in the health sector of Kurdistan province. The data on the populations of the cities in Kurdistan province and the number of specialist physicians, general physicians, nurses, midwives and other job categories as well as the number of hospital beds in Kurdistan province were collected respectively from Iran Statistics Center and human resources units affiliated to the University. After collecting the required data in the next step, the distribution of human resources was analyzed based on the number of people using the relative inequality indices of the Gini coefficient. Finally, the statistical relationship of the inequality rate of human resources and hospital beds variables with health indices was studied. In this study, the software STATA 13 was used to calculate the Gini Index and draw the lorenz curve. The SPSS 23 Software was also used to assess the presence or absence of a statistically significant relationship between the variables.

RESULTS

Table 1 and 2 shows the per capita of hospital beds and staff working in the different cities of the province. According to this Table 2, the city of Dehgolan has the highest per capita among the cities of Kurdistan province in terms of the following: Specialist physicians (3.23); General physicians (3.23), Midwives (0.92) and other health and treatment fields (0.21). The city of Bijar has the lowest per capita regarding the GPs (0.48), midwifes (0.25), other health and treatment fields (0.07) and service staff (0.11). It is worth noting that the city of Sanandaj has the lowest nurse per capita with 0.07 among the cities of the province.

Figure 2 shows the hospital bed per capita in different cities of the province. Since, the standard distribution of beds in the country is 1.5 bed per thousand people, then, it can be seen according to the chart that the number of beds is proportional to the standard except in cities of Dehgolan, Sarvabad and Kamyaran. Other cities in the province are not in accordance with this standard. Lorenz curves in the occupational categories of specialist, general practitioner, nurse and midwife are shown in Fig. 3-7.

According to Table 3, the Gini coefficient for the distribution trend of human resources of specialist physicians, general practitioners, nurses, midwives and other health and treatment categories, administrative and

Table 1: Frequency distribution of the population, specialist and general physicians, nurses, midwives and other health staff and available beds in 2015

Name of city	Population estimate in 2015	Specialist physicians	General physicians	Nurses	Midwives	Other health and treatment categories	Administrative and financial	Services and cleaning staff	Other support categories	Available beds
Baneh	136235	18	10	84	28	84	18	64	1	110
Bijar	96309	14	20	70	39	137	11	91	4	100
Dehgolan	64584	2	2	34	7	31	4	24	5	24
Divandareh	84232	9	6	83	17	43	20	43	0	72
Sarvabad	51221	0	4	15	8	31	3	19	3	32
Saghez	216657	39	10	143	38	182	15	108	2	189
Sanandaj	462631	181	63	698	118	479	114	307	34	869
Qorveh	140753	26	12	88	30	83	4	32	0	136
Kamyaran	108931	12	11	72	20	67	8	40	3	72
Marivan	173447	32	30	154	38	163	31	77	2	184
Sum	1535000	333	168	1441	343	1300	228	805	54	1788

Table 2: Per capita distribution of hospital beds and staffing employees of affiliated hospitals of Kurdistan University of Medical Sciences in various job categories in each city

| Name of city	Baneh	Bijar	Dehgolan	Divandareh	Sarvabad	Saghez	Sanandaj	Qorveh	Kamyaran	Marivan	Sum
Available bed	1.24	0.96	2.69	1.17	1.60	1.15	0.53	1.03	1.51	0.94	0.86
Specialist physicians per capita	0.76	0.69	3.23	0.94	0	0.56	0.26	0.54	0.91	0.54	0.46
General physicians per capita	1.36	0.48	3.23	1.40	1.28	2.17	0.73	1.17	0.99	0.58	0.91
Nurses per capita	0.16	0.14	0.19	0.10	0.34	0.15	0.07	0.16	0.15	0.11	0.11
Midwifes per capita	0.49	0.25	0.92	0.50	0.64	0.57	0.39	0.47	0.54	0.46	0.45
Other categories of health categories per capita	0.16	0.07	0.21	0.20	0.17	0.12	0.10	0.17	0.16	0.11	0.12
Administrative and financial per capita	0.76	0.88	1.61	0.42	1.71	1.44	0.41	3.52	1.36	0.56	0.67
Service staff per capita	0.21	0.11	0.27	0.20	0.27	0.20	0.15	0.44	0.27	0.23	0.19
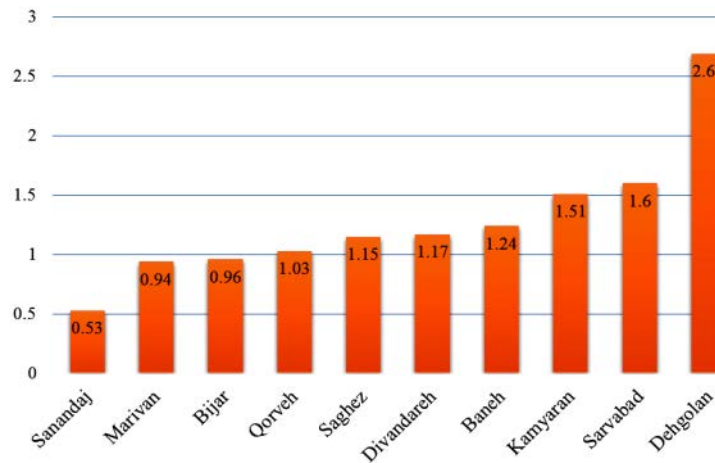
Fig. 2: Per capita of hospital bed for each city in the province of Kurdistan in 2015
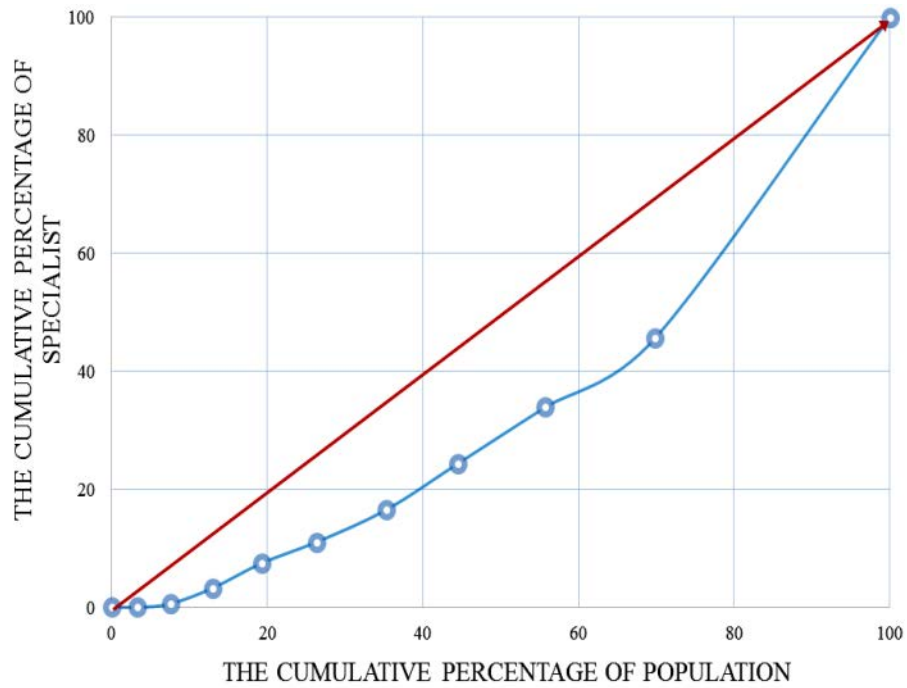
Fig. 3: Lorenz curve of specialists' distribution working in hospitals affiliated to Kurdistan University of Medical Sciences to population of the province cities in 2015
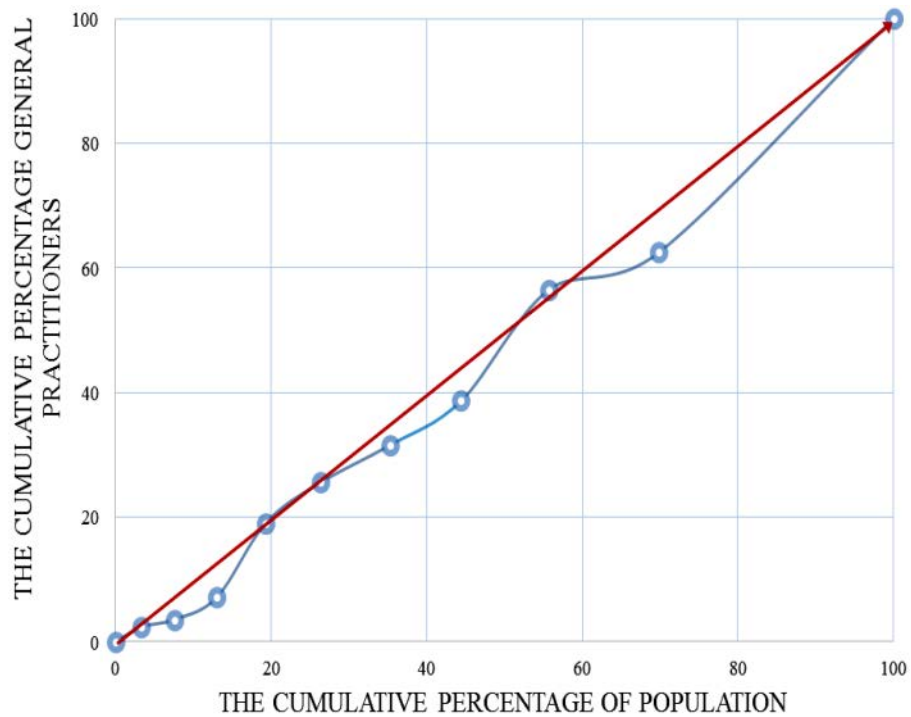

Fig. 4: Lorenz curve of GPs distribution working in hospitals affiliated to Kurdistan University of Medical Sciences to population of the province cities in 2015
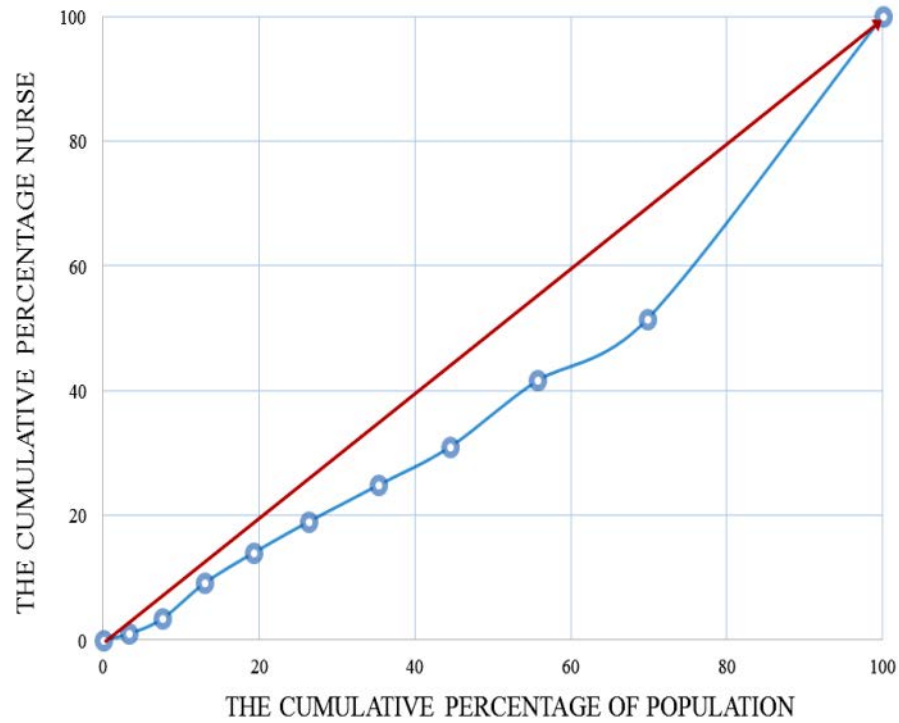
Fig. 5: Lorenz curve of nurses' distribution working in hospitals affiliated to Kurdistan University of Medical Sciences to population of the province cities in 2015
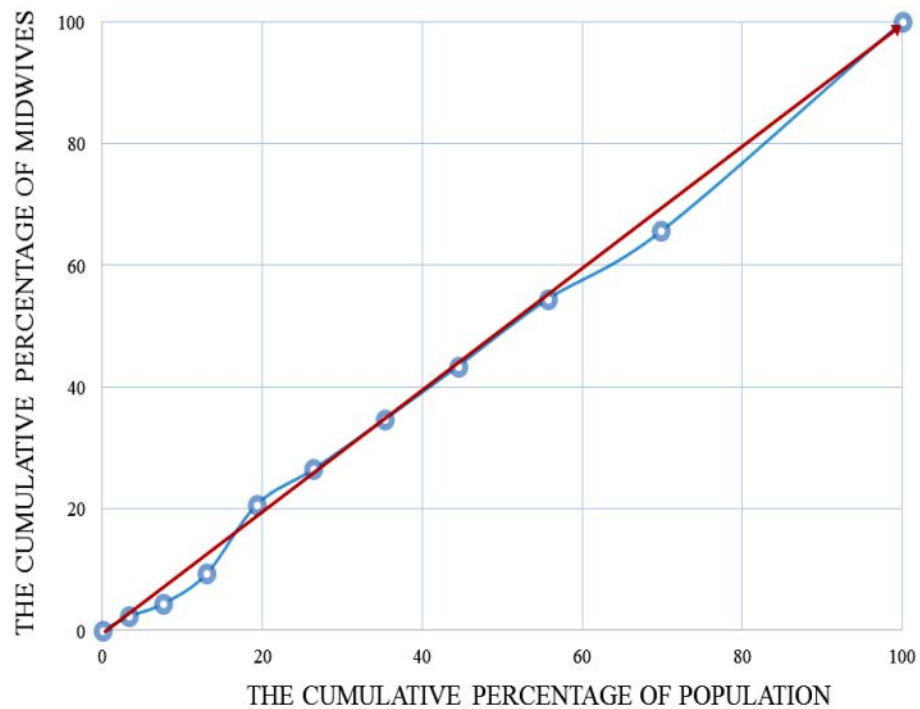

Fig. 6: Lorenz curve of midwifes' distribution working in hospitals affiliated to Kurdistan University of Medical Sciences to population of the province cities in 2015
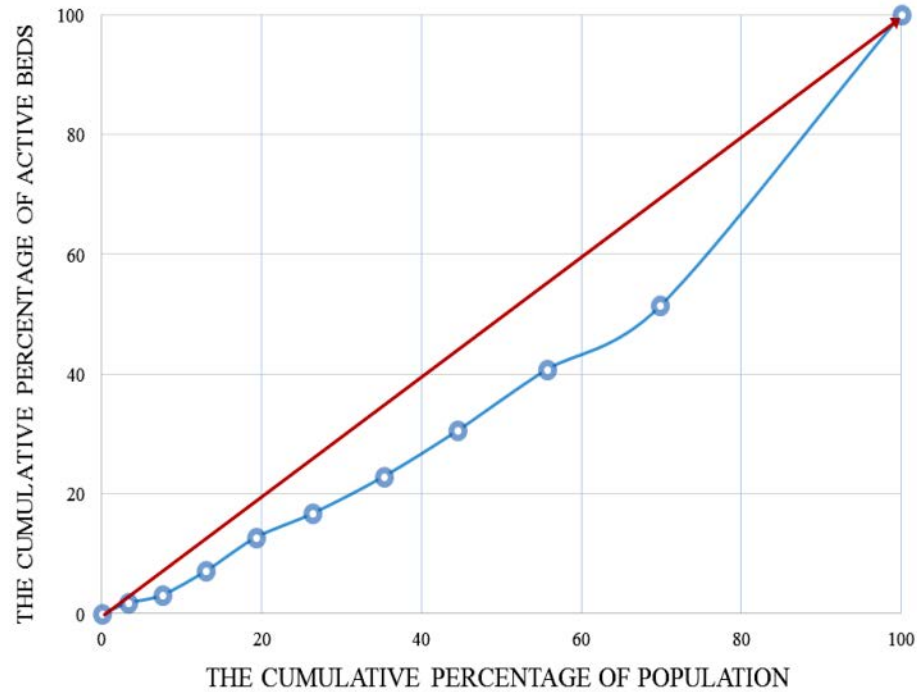
Fig. 7: Lorenz curve of available beds distribution in hospitals affiliated to Kurdistan University of Medical Sciences to population of the province cities in 2015

Table 3: Gini coefficient of manpower employed in Kurdistan province in 2015

Manpower job categories	Gini coefficient
Specialist physicians	0.61
General physicians	0.48
Nurses	0.51
Midwives	0.40
Other health and treatment categories	0.45
Administrative and financial	0.57
Services and cleaning staff	0.44
Available beds	0.52

financial, service forces and finally the available bed were calculated, respectively as 0.61, 0.48, 0.51, 0.40, 0.45, 0.57, 0.44 and 0.52. The highest and lowest Gini coefficients are related to specialist physicians and midwifes, respectively.

DISCUSSION

Balanced and proportionate distribution of resources, especially human resources as well as hospital beds in the health and treatment sector is among the factors leading to improved health indicators and thereby, would increase equity and social justice (Mostafavi *et al.*, 2015). This study was conducted to determine the distribution of human resources working in hospitals affiliated to Kurdistan University of Medical Sciences using the Gini index and lorenz curve in 2015. Evaluation the manpower

employed and through determining the Gini coefficient and per capita of hospital beds, an image of the human resources distribution and available beds in the hospitals affiliated to the university with highest referring rates was provided to draw the attention of decision makers and policy makers of health sector to the treatment needs of the residents of the province. Based on the study findings, the value of the Gini coefficient for the staff working in the province varies from 0.40 for midwifes to 0.61 for the specialists.

At first glance, the province status seems somewhat acceptable in terms of some occupations, such as general practitioner and midwife, but data analysis related to the cities of the province suggested that in some cities, Sanandaj and Sarvabad, the standard is much lower than the provincial average. However, it should be noted that Sarvabad hospital in Sanandaj has been recently become operational (2015) and its human resources, particularly the specialists, are increasing. In a study conducted by Mostafavi *et al.* (2015), the Gini coefficient in various medical specialties is in fluctuation from 0.37-0.88 for anesthesiology and brain surgery. At first glance, the province situation in terms of some specialties such as pediatrics, anesthesiology and internal medicine seems somewhat acceptable, but evaluating the data related to the province cities showed that in some cities including

Piranshar, Shahindezh, Takab, Qareh Ziaeddin and Poldasht, even the number of specialists in four specialties of pediatrics, anesthesiology, gynecology and surgery was much lower than the provincial average. Some of the main causes included insufficient number of physicians across the province, lack of appropriate facilities for living inadequate salaries and special geographical situation of the province, especially locating in the border area which may have inhibited the dynamic urban growth and lack of adequate attention of government to the development of the province cities (Mostafavi *et al.*, 2015).

Also, the per capita distribution of hospital beds and staff employed in hospitals affiliated to Kurdistan University of Medical Sciences in different job categories according to each city showed that the rate of the following was much lower than the provincial average: General practitioners in cities of Bijar and Marivan; nurses in Sanandaj and Divandarreh; midwives, other health and treatment categories and service personnel and cleaners in cities of Bijar and Sanandaj; administrative and financial in Sanandaj, Divandarreh and Marivan. Since the standard distribution of beds in the country is 1.5 bed per thousand people, thus, it can be seen in the graph that the number of beds is proportional to the standard except for Dehgolan, Sarvabad and Kamyaran; other cities in the province are in accordance with this standard. However, an insufficient number of hospital beds is not specific to this province as Zandian *et al.* (2012) reported in their study that the distribution of hospital beds in Ardabil province has been unsatisfactory during the study period (Zandiyan *et al.*, 2012). In their study, Tofighi *et al.* (2010) concluded that according to the position and area of each province and volume distribution, the number of specialists working in public hospitals as well as available beds reflect different distribution in every province.

Mostafavi *et al.* (2015) concluded in their study that the distributions of specialist physicians and hospital beds are not proportional to the population of the province of West Azerbaijan. They believed that some of the possible reasons may include non-equipping these cities with hospitals by proper number of beds, special geographical conditions, lack of adequate welfare facilities and The Kurd people whose language is difficult to be spoken by the majority of specialist physicians and other medical staff. The results of Alla-Eddini *et al.* (2004) suggested that about three-quarters of physicians in Iran accept to serve in deprived and remote areas under certain circumstances. The most important of these conditions include the rate of income and the type of employment. The low rate specialists' distribution in deprived and poor provinces can be considered somewhat due such factors. Limitation of study could mentioned non-considering the beds in other public hospitals as well as private hospitals.

CONCLUSION

The study findings showed that the per capita of available beds of hospitals affiliated to university in the studied cities with the national standard is equal to 1.5 bed per thousand people. The rate is consistent with the standard except in the cities of Dehgolan, Sarvabad and Kamyaran and other counties did not fit. Although, the distribution of human resources and hospital beds is not proportional to the population of in most cities of Kurdistan province, but attracting and motivating human resources, particularly health care professionals by increasing payment and benefits based on employees performance and provision of particular recreational facilities can contribute to achievement the objectives of healthcare reform plan as parameters for adjusting the shortages.

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