



## Inequality in the Distribution of Physicians in the South of Iran

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### Abstract

**Introduction:** The estimated human resources needed in the health care sector, especially physicians, have been discussed over the years. Supplying the targeted medical human resources is the key to improvement of health care in a country. The aim of this study was to determine the equity in distribution of physicians in the south of Iran before and after adjusting the needs.

**Methods:** In this study, data were gathered from the Statistics Center of Iran and Ministry of Health for the number of population and physicians, respectively. Birth and mortality rates were used for adjusting the needs. We calculated Gini and Robin Hood indices using the Excel 2013 software. In order to display the distribution of variables in graphical form, we used GIS software as well.

**Results:** Gini coefficients for general and specialized physicians in 2011 were 0.18 and 0.31, while they were 0.13 and 0.38, respectively, in 2014. The equity in distribution of GPs was better than specialists during the study period. The results revealed a worse status after adjusting needs.

**Conclusion:** Because the health sector is affiliated to human resources, especially physicians, paying attention to their balance based on the people's needs is essential. Therefore, the Ministry of Health should put it as one of its goals. Accurate estimation of the required human resources can help to reduce the cost of health care systems as well as those of households.

**Keywords:** Inequality, Human resources for health, Gini coefficient, Needs assessment, Physicians

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### Introduction

Despite the obvious centrality of health personnel, planning, producing and managing human resources for health (HRH) remain the least developed aspect of health systems' policy and development in many countries. According to the WHO report, the world was faced global shortage of 2.4 million doctors, nurses and midwives (in 2006) (1, 2). Equity is recognized as one of the main goals of the health sectors (3). It does not refer to provision of equal services for different needs, but it means providing different services for different needs (4). In the context of equity and resource allocation, Sheridan et al. (2011) indicated differences in health, well-being and longevity in all countries

because of different social circumstances leading to inequity. The health system can achieve equity through commitment to health equity and evidence-informed action by people at all levels (5).

The health sector is mainly dependent on human resources and spends a large portion of its expenditure for them more than any other sector. The unequal distribution of physicians was observed in the early 20th century, and still persists in most countries; the number of specialists is more than GPs, while the workload of GPs is more because of the diversity of diseases (6, 7). Horev et al. has demonstrated that despite the high income inequity, physician supply leads to lower mortality, longer life expectancy, and better birth outcome(8). According to the concepts

of equity, distribution of physicians must meet public health needs and leads to an adequate level of access to health care services (9). Many studies pointed out the importance of equity and human resources. For example, Wiseman et al. (2017) stated that policies designed to address the misdistribution of health workers should pay attention to the distribution based on the 'needs' within a country in addition to informed robust analyses of the current per capita distribution of health workers (2). Liu et al. (2016) indicated that the basic condition to achieve the equity in health is equitable allocation; also, governments should intervene to achieve utility and effectiveness (10).

Iran is rich in terms of human resources, especially in the health sector. Every year, many college graduates enter the workplace. Given the magnitude of the health sector services and importance of their goals to achieve better health by all people, social equality requires proper division of labor, proper use of human resource, maximum staff deployment and setting up the required human resource. Therefore, if there is a lack of attention to the nature of the sector, we will suffer the waste of resources and negative its impact on public health (11). The current study investigated the distribution of physicians (GPs, specialist) in the south of Iran using inequality indicators in 2011 and 2014. Also, we aimed to determine the need for distribution of specialists and GPs, because of their importance in the early diagnosis and prevention of diseases, which results in high economic savings for the health sector as well as households.

## Methods

This study carried out in Fars province (south of Iran). Census data on population by district and the number of GPs and specialist that worked in public sector in 2011 and 2014 were obtained from the Iranian Statistical Center (ISC) and the Ministry of Health, respectively.

In the present study, we calculated the level of inequality in the distribution of physicians in the south of Iran and the number of physicians who must be relocated in order to achieve equity. Inequality in all cases was estimated both before and after adjustment for people's health needs.

A number of studies have determined the distribution of human resources by adjusting the needs. They used variables like crude birth rate (CBR) or crude mortality rate (CMR) for adjusting the needs (8, 12-14). We used both of the variables. Data on the number of mortality and birth rate were gathered from Ministry of Health, as well. As already mentioned,

we used two variables as indicators of needs: crude mortality rate (CMR) per 1000 population and crude birth rate (CBR).

The CMR (CBR) was calculated by dividing the number of mortality (birth) by 1000 population. We calculated the number of GPs and specialists per 1000 population ratio and the need-adjusted index (NAI). The NAI was calculated by dividing the number of GPs/specialists by CMR/CBR (NAIM/ NAIB). Finally, we compared the distribution of physicians before and after adjusting the needs. Several indices have been used for measuring inequality. Here, we calculated Gini and Robin Hood indices before and after adjusting needs using Excel 2007 software. Using GIS software, we showed the density of physicians in the south of Iran in 2014. It provided a good visual display for policymakers. Managers and policymakers can use the GIS software as a managerial dashboard so that they can understand resource distribution with a glance and take optimum decisions. In the following part, calculation of the indicators will be explained.

**Gini coefficient:** It is an indicator for measuring income inequality. It not only measures the inequality in income, but also in wealth and any variable like health resources. It is related to the area of the Lorenz curve, ranging from zero and one. Zero represents perfect equality (everyone has an equal distribution of the variables), and one represents maximum inequality (15-18). We used the following formula to calculate the Gini coefficient.

$$\text{Gini} = 1 - \sum_{i=1}^n (Y_{i+1} + Y_i)(X_{i+1} - X_i)$$

$Y_i$ : cumulative proportion of physicians (GPs / specialists) in the  $i$  th district

$X_i$ : cumulative proportion of population in the  $i$  th district

$n$ : total number of districts

**Robin Hood index:** Although the Gini coefficient is one of the most popular indices measuring inequity, because of inability to properly interpret it, other indices, such as Robin Hood, were used. The Robin Hood index indicates that what ratio of the resources should be redistributed to have an equal distribution of resources. The main advantage of this index is its obvious interpretation of public health policies (19, 20). Robin Hood index, also well-known as the Pietra ratio, points to the maximum vertical distance of the Lorenz curve from the line of equality. The maximum value of this index shows greater inequity (21). The following formula is used to calculate the Robin Hood index.

$$H = \frac{1}{2} \sum_{i=1}^N \left| \frac{E_i}{E_t} - \frac{A_i}{A_t} \right|$$

$E_i$ : The number of physicians (GPs /specialists) in the  $i$ th district

$E_t$ : Total number of physicians (GPs /specialists) in the  $i$ th district

$A_i$ : The population of  $i$ th district

$A_t$ : Total number of population

## Results

The density of physicians per 1000 people in the south of Iran in 2014 showed in Table 1. We mapped the density of general and specialists physicians per 1000 people by using GIS software In Figure 1 and Figure 2 respectively. Specialist to population ratio decreased in the south of Iran from 2011 (0.19) to 2014 (0.17). There was a variation in the distribution of GPs during 2011 and 2014. The Gini coefficient before adjusting the needs for GPs in the south of Iran was 0.18 during 2011, while it was 0.13 for 2014. After adjusting for mortality, it was found to be 0.20, while after adjusting for birth rates it was 0.21 in 2011. The

comparable figures were 0.14 and 0.14, respectively, in 2014 (Table 2).

When the Robin Hood index for the year 2011 is taken into account, 124 general practitioners should be reallocated in order to achieve equality in their distribution. The corresponding figure after adjusting for mortality was 145 general practitioners, while after adjustment for birth rates the number was 155 (Table 2).

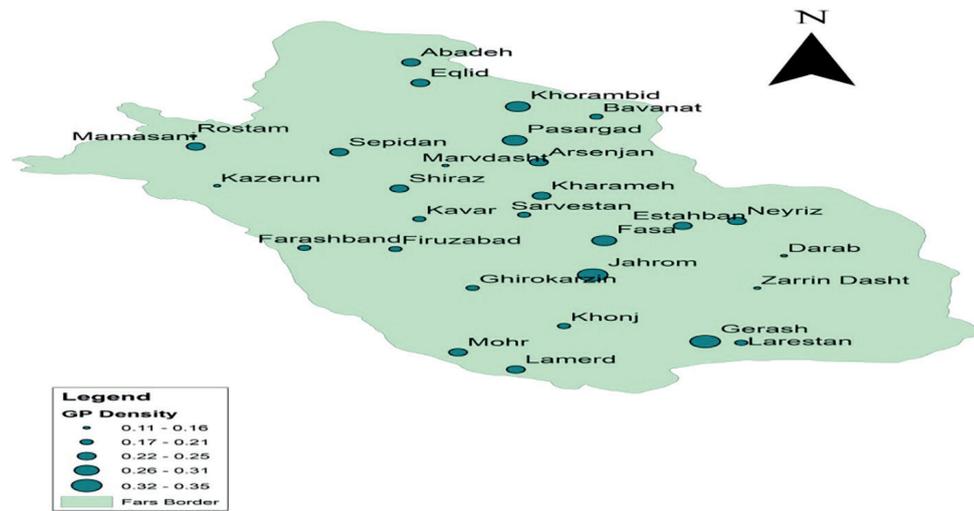
As to the number of GPs for the year 2014, the Robin Hood index was 9.12, indicating that 95 physicians had to be reallocated in order to achieve an equitable distribution. It was 11 and 10 after adjustment for birth and mortality rates, respectively, in 2014 (Table 2). The trend of inequality indicators for GPs showed that in 2014 equality in distribution of them was better than in 2011 (Figure 3).

There was a variation in the distribution of specialists during 2011 and 2014, too. The Gini coefficient before adjusting the needs for them

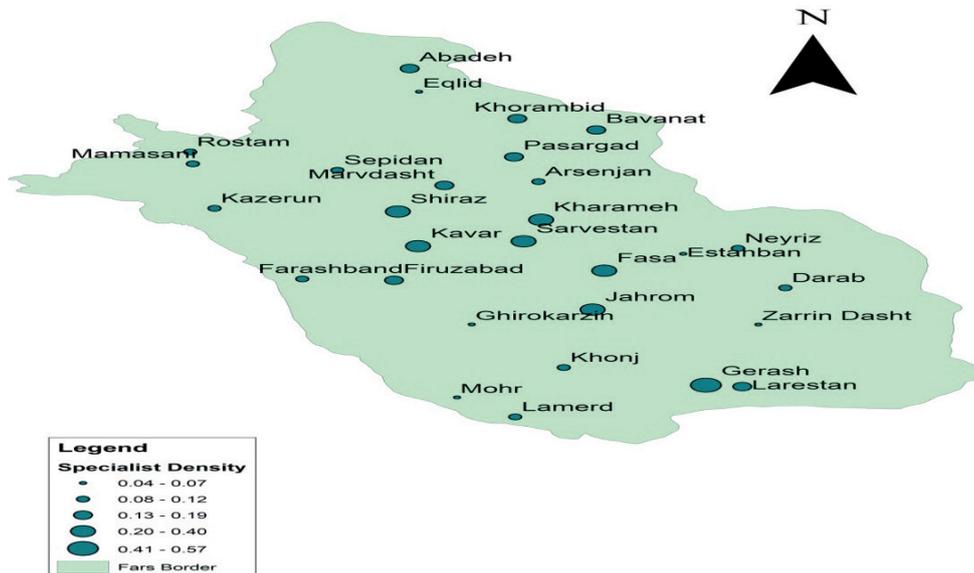
**Table 1:** Density of physicians per 1000 people in the south of Iran in 2014

Districts	Pop	sp density	GPs density
Abadeh	101,765	0.18	0.24
Arsanjan	42,987	0.09	0.23
Estahban	68,583	0.07	0.22
Eghlid	97,399	0.07	0.22
Bavanat	50,180	0.14	0.20
Pasargad	32,652	0.15	0.31
Jahrom	216,938	0.37	0.34
Kharameh	63,824	0.09	0.24
Khorambid	52,083	0.17	0.27
Khonj	42,632	0.09	0.21
Darab	196,244	0.10	0.14
Rostam	48,558	0.00	0.14
ZarinDasht	71,968	0.04	0.11
Sepidan	92,655	0.11	0.24
Sarvestan	42,008	0.24	0.19
Shiraz	1,762,649	0.25	0.23
Farashband	44,318	0.11	0.18
Fasa	210,530	0.27	0.28
Firoozabad	124,083	0.16	0.20
Ghir&Karzin	67,415	0.04	0.18
Kazeroun	263,984	0.09	0.16
Kovar	80,672	0.00	0.21
Garash	48,769	0.55	0.35
Larestan	235,145	0.15	0.20
Lamard	86,973	0.10	0.23
Marvdasht	318,695	0.13	0.15
Mamasani	120,626	0.17	0.22
Mohr	61,903	0.05	0.23
Neyriz	117,894	0.11	0.25
Total	4,764,131	0.17	0.22

Pop: population; SP: Specialists; GPs: General Practitioner; Density: Number of physicians per 1000 population



**Figure 1:** Density of general practitioners per 1000 population in south of Iran in 2014 (Smaller circles have lower densities while larger circles show the higher densities of physicians)



**Figure 2:** Density of specialists per 1000 people in the south of Iran in 2014 (Smaller circles have lower densities while larger circles show the higher densities of physicians)

**Table 2:** Inequality indicators of the distribution of physicians in the south of Iran

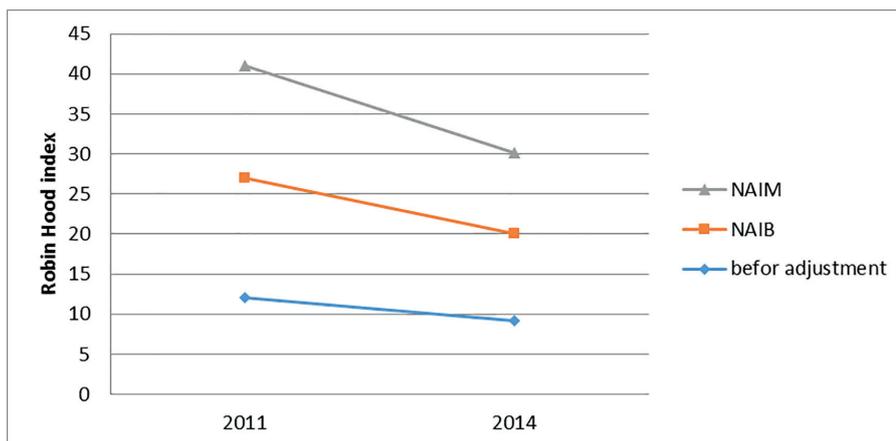
	Year	Gini			Robin Hood		
		Before adjustment	NAIB	NAIM	Before adjustment	NAIB	NAIM
GPs	2011	0.18	0.21	0.2	12	15	14
	2014	0.13	0.1421	0.1425	9.12	11	10
Specialist	2011	0.31	0.32	0.32	24	23.4	23
	2014	0.38	0.37	0.39	27	26	27

NAIM: Needs-adjusted index for mortality; NAIB: Needs-adjusted index for birth

was 0.31 during 2011, while it was 0.38 for 2014. After adjusting for mortality (NAIM), it was found to be 0.32 in 2011, while it was 0.39 in 2014. The corresponding figures for birth rates (NAIB) were 0.30 and 0.37, respectively (Table 2).

When the Robin Hood index for specialists for the

year 2011 was calculated, we found that 204 of them should be reallocated in order to achieve equality in their distribution. The comparable figure after adjusting for mortality was 200 specialists, while after adjustment for birth rates the number was 193 (Table 2).



**Figure 3:** Trends in the Robin Hood index for the distribution of general practitioners in the south of Iran for the years 2011 and 2014 (NAIM=Need Adjusted Index for Mortality, NAIB=Need Adjusted Index for Birth)

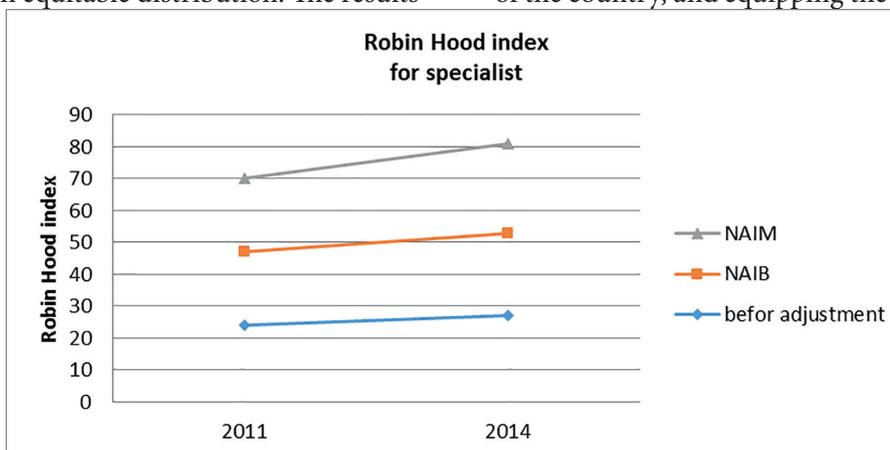
As to the number of specialists for the year 2014, the Robin Hood index was 27, indicating that 240 physicians had to be reallocated in order to achieve an equitable distribution. It was 26 and 27 after adjustment for birth and mortality rates respectively (Table 2). The trend of inequality indicators for specialists showed that in 2014 equality in distribution of them was worse than in 2011 (Figure 4).

**Discussion**

General practitioners were equitably distributed in the south of Iran but the distribution for specialist was inequitable. This becomes apparent when the relative inequality indices are calculated. In order to achieve an equal distribution of GPs and specialists in all districts in the south of Iran by redistributing the existing physicians, on average, 10% and 26% of GPs and specialists should be relocated from relatively over-served to relatively under-served districts in 2014, respectively. After the adjustment for needs (mortality and birth), a larger proportion of physicians (GPs & SP) should be redistributed in order to achieve an equitable distribution. The results

of the current study showed that when we considered the crude mortality rates and crude birth rates as the need criteria, the distribution of human resources was not equitable. In the current study, the GIS software was used to show the density of different medical groups. The density of physicians is higher in large cities, particularly capital of provinces.

Taati et al. (2012) noted the following factors which affect the reduction of the dispersion of specialists and make it more homogeneous: not dispatching specialists to hospitals that are not affiliated tot Ministry of Health and Medical Education (MoHME) and main cities of large provinces to do their mandatory services, using managerial measures such as prohibition of doing mandatory services in Tehran and other large cities, using extra payments in deprived areas, conditioning licensing on doing mandatory services in deprived areas, not sending physicians to privileged areas, identifying underprivileged cities in each province, mandating using graduates that have been sent to each university by MoHME, building new hospitals in different parts of the country, and equipping the current centers and



**Figure 4:** Trends in the Robin Hood index for the distribution of specialists in the south of Iran for the years 2011 and 2014 (NAIM=Need Adjusted Index for Mortality, NAIB=Need Adjusted Index for Birth).

transportation expansion, both land and air roads (22). Mobaraki et al. (2013) investigated the equity in distribution of human resources in Iran University of Medical Sciences. The Gini coefficient and Robin Hood index were 0.16 and 0.11, respectively. Based on the results, while authorization to employ human resources was equitable, to achieve equity they should be redistributed (23). Masatoshi Matsumoto et al. (2010) investigated the density of physician's distribution in Japan and the United State. The Gini coefficient for population was the same in both countries, while the Gini coefficient for income was lower in the US. The association between physician to population ratio and income was more intensive in the US. The results revealed that although the number of physicians has increased, its distribution based on the population was not equal. According to the analysis, the equitable distribution of physicians requires governmental interventions (24). In the current study, the Gini coefficient and Robin Hood were calculated after adjusting for birth and mortality rates. Results revealed that in 2014, after adjusting based on birth rate, 11% of GPs and 26% of specialists should have been redistributed, while after adjusting based on the mortality rate, 10% and 27% should have been redistributed to achieve equity in access to medical groups, respectively.

### Conclusion

Health Reform Plan was implemented by MoHME in 2012. Supporting physicians to stay in deprived areas was one of the goals of the program. As the result of the study showed, it was successful to some extent, but it still needs the attention of our government in this regard.

Unequal distribution of facilities and resources, which results in lack of motivation to attend in deprived areas, is among the reasons that can be mentioned as the reasons of inequity in the distribution of human resources in the current study. Physicians who are working in deprived areas have lower incomes and also their work condition is harder than others because of dealing with patients with poor economic conditions, low health literacy, and so on.. Therefore, physicians prefer to work in more populated areas where people have a better lifestyle and treat their disease in time. Also, the payment method is an important factor; health sector should allocate its budget in a way that adequate resources are simultaneously provided for public health and satisfy the physicians with payments mechanisms. The following factors can be mentioned as the causes of unequal distribution of skilled human resources,

especially for physicians. The policy makers should focus on these factors to find solutions.

1. Reduced admission of new medical students
2. Working in other unrelated fields other than medical, due to the high opportunity cost of working in medical fields
3. Lack of out-sourcing the activities which can be performed by other medical fields
4. Adopting policies that limit the training of medical students by the MoHME and Public Health and Treatment Commission of the Parliament.
5. Inadequate payments and benefits (high income is the main incentive of physicians)
6. Inappropriate work conditions (working in deprived areas, inadequate facilities, shortage of essential medicines and supplies, lack of appropriate welfare facilities, specific geographical and cultural contexts, different dialects and accents).
7. Distance from the capital (because of better facilities and more financial achievements compared to deprived areas, the density of physicians is higher in the capital, which results in an inequitable distribution of human resources).
8. Inappropriate distribution of facilities and equipment
9. Attractiveness of working non-medical jobs as well as better job opportunities in larger cities
10. Lack of a support package for families of medical groups
11. Migration of skilled staff from poor to rich countries as well as from public to private sector (within country)
12. Unmet budget in universities
13. Specialization (obstacles to enter other jobs, income differences between different specialists, differences in working hours, and so on)
14. Ignoring gender issues in training medical students (marriage status, tasks in the family, working conditions, etc. affects the female physician's activities).

The present study had some strengths as well as weaknesses. The main weakness of this study was lack of considering those who were working in the private sector and their impact on achieving equity in the current study. However, one of the strengths of this study was that it could direct the policymakers and managers to identify the challenges of maldistribution and think of solutions.

The current study investigated the access to human resources based on mortality and birth rates. The authors suggest that, before defining the adjustment indicators, the goals and contexts of the study should be considered, so the results can be

applied in policy making, planning, and allocating the optimum resources. Results of studies on distribution of dentists based on the DMFT (decayed, missed, filled teeth) revealed that distribution of specialists based on the types of the diseases in the society, distribution of complementary resources (e.g. hospital and physician, bed and nurse), geographical distribution of different resources, and examination of the distribution of resources using the GIS are strong instruments for managers to make effective decisions. Besides, distribution of resources can be investigated using different methods, such as trend, ratio, correlation and regression analysis and simulation method and results can be compared.

**Conflict of Interest:** None declared.

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