Electronic Physician (ISSN: 2008-5842) http://www.ephysician.ir
June 2017, Volume: 9, Issue: 6, Pages: 4584-4589, DOI: http://dx.doi.org/10.19082/4584

Geographic distribution indices of general practitioners, midwives, pediatricians, and gynecologists in the public sector of Iran

Rasoul Honarmand[1], Mostafa Mozhdehifard[2], Zahra Kavosi[3,4]

[1] M.Sc. of Health Management, Health Human Resources Research Center, School of Management & Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran
[2] DDS. Health Management and Economics Research Center, Iran University of Medical Sciences, Tehran, Iran
[3] Ph.D. of Health Management, Associate Professor, Health Policy Research Center, Shiraz University of Medical Sciences, Shiraz, Iran
[4] Ph.D. of Health Management, Associate Professor, Health Human Resources Research Center, School of Management & Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

Type of article: Original

Abstract

Background: Health workforce distribution is so important in access posture, coverage and equity. Following millennium development goals (MDGs), special attention to health workforces in relation with maternal and child health is required.

Objective: The aim of the current study was to determine distribution of maternal and child health related workforces in Iran during 2010-2012, using inequality measures.

Methods: In this cross-sectional study, data about the number of physicians and midwives obtained from Ministry of Health reports and demographic statistics were obtained from the Statistical Center of Iran. Gini coefficient and Robin Hood index were calculated in terms of population ratio, need adjusted index for birth (NAIB) and need adjusted index for mortality (NAIM). For calculations, DAD software version 4.6 was used.

Results: Gini coefficient was reduced for general physicians (GPs) and pediatricians, and had increasing and decreasing trends for gynecologists. For achieving equality within provinces, the number of transferable health workforces was more than 1 person per 10 health workforces.

Conclusion: Health workforce distribution had various trends in Iran. Special attention to deprived provinces is required. Most of the reduction in Gini coefficient is due to the increase in health workforce in developing provinces, and deprived provinces still have serious problems. The health system could achieve better equality by considering deprived provinces and using Gini coefficient and Robin Hood index together.

Keywords: Equality, Human Resource, Gini coefficient, Robin Hood index, Maternal Health

1. Introduction

Health systems are extremely dependent on human resources in order to provide high quality services (1). For delivering health care, particularly in developing countries, the lack of qualified human resources and unequal distribution of health workforces is a main problem (2-4). Furthermore, health workforce distribution is very important in access posture, coverage and equity (5). Growth in inequalities, access problems and costs, forced many countries to improve their policies; especially human resource distributing policies with these facts (6). However, ideal health outcomes are directly dependent on the distribution of the health workforces (6), and evidence shows there are tight relationships between number and quality of health workforces and primary health care services, vaccination coverage and maternal mortality rate (7, 8). Often, there are many inequalities in the distribution of healthcare personnel within countries and between regions and provinces of a country (9-11). It is a

Corresponding author:
Associate Professor Dr. Zahra Kavosi, Health Human Resources Research Center, School of Management & Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.
Tel: +98.9177284865, Email: zhr.kavosi@gmail.com
Received: November 11, 2016, Accepted: March 18, 2017, Published: June 2017
iThenticate screening: February 13, 2017, English editing: April 12, 2017, Quality control: May 14, 2017

considerable problem in developing countries that health-related workforce is condensed in big towns and cities, and rural regions are allocated only 23% and 38% of the country's general practitioners and nurses, and these inequities resist against the changes (12). This problem involved developed countries such as the UK, America, Japan, Australia, Portugal and Canada (5). Also, all the countries in the Organization for Economic Cooperation and Development (OECD), have the problem of unequal distribution of practitioners (13). Analysis of health workforce trends in Iran shows significant growth in the number over the past 30 years (14) and various patterns of equality. Although the number of health workforces increased by policies like growth in the number of universities (15), unfair distribution is seen (16, 17). In a study by Abbasi, Gini coefficient for nurses decreased, hospital beds remained constant and physicians increased during 2000-2008 (18). Also, a study of recruitment licensed physicians' distribution during 2005 – 2009 done by the Iranian Ministry of Health (IMOH), showed equitable distribution in Iran (5). In 2011, hemodialysis bed distribution was studied, and revealed equal status in connection with population needs in Iranian provinces, based on Gini coefficient. However, unequal distribution of nephrologists was reported (19). Inequalities in distribution of health inputs like hospital beds, nurses, and physicians etc. have been studied but evidence regarding maternal and child health related workforces is scarce. According to following millennium development goals (MDGs) in reducing the maternal mortality rate and increasing child health, special attention to relative health workforces is required. In this study, we aimed to show trends of distribution inequality in maternal and child health related workforces in relation with population needs, and calculate redistributive numbers based on Robin Hood index.

2. Material and Methods

This was a cross-sectional study in which inequality indices (Gini and Robin Hood) of health human resource distribution in Iran were calculated during 2010-2012. Data about the number of general physicians (GPs), midwives, gynecologists and pediatricians who work in the public (governmental) sector were obtained from the human resource office and the treatment deputy of the Iran health ministry report related to 2010 - 2012. Also, demographic statistics were obtained from the Statistical Center of Iran reported in 2012. To access data from the Ministry of Health (MOH) and the Statistical Center of Iran (SCI), researchers with an introduction letter referred to these organizations, and available data was recorded to an extraction data form, designed in the basis of study goals. In this study, we computed Human Resource per 10,000 Population Ratio (HRPR) as an indicator of human resource availability in each province and need adjusted index (NAI). So HRPR, according to the number of GPs, gynecologists, pediatricians, midwives, and population of each province was computed. To calculate NAI initially, in accordance with previous studies (20, 21), two variables including crude mortality rate (CMR) per 10,000 population and crude birth rate (CBR) per 10,000 population were used as indicators of population needs. Then, by dividing HRPR by CMR and CBR, need adjusted index for mortality (NAIM) and need adjusted index for birth (NAIB) was calculated. Then Gini coefficient and Lorenz curve of maternal health-related workforce in relationship with the province population and needs were calculated. The Gini coefficient is a measurement unit of statistical dispersion, usually used to measure the inequality in the distribution of income or wealth in a population. This index is defined as the ratio and has a value between zero and one. The Gini coefficient between 0.2 to 0.35 shows the relative balanced distribution, between 0.35 to 0.5 shows the distribution is relatively unequal and the index between 0.5 to 0.7 means the distribution is very unequal (22). Lorenz curve is as an important indicator for social inequalities in general. On the Lorenz curve, the vertical axis represents the cumulative percentage of income and the horizontal axis represents the cumulative percentage of the population. In the case of "uniform distribution of wealth among members of society", Lorenz curve distribution line shows same income in every person. In a situation in which all the wealth of one person and the rest of society does not have the assets or income, Lorenz curve becomes a "totally unequal distribution line" (22). In a case of inequality, the Robin Hood index was calculated to show how human health resources should be redistributed in the country. The Robin Hood index is associated with Lorenz curve. It is used to the better-known inequality measure of the Gini coefficient in relation to the Lorenz curve. The value of the Robin Hood index approximates the share of total number of human resources that needs to be reallocated. It guides human resource shift from rich provinces to the poor provinces to achieve equality. Its range is from 0 (perfect equality) to 100 (complete inequality) (22). So, in order to calculate the Robin Hood index, "Lorenz curve" was also drawn. For calculation, DAD software version 4.6 was used.

3. Results

Results showed that the ratio of general practitioners, midwives, pediatricians and gynecologists per 10,000 population in the year 2010 was 1.95, 2.21, 0.177 and 0.218, and in the year 2011 was 2.07, 2.2, 0.171 and 0.185. This ratio in the year 2012 raised to 2.05, 2.24, 0.208 and 0.147 respectively. Table 1 displays the distribution of health-related workforces in the provinces of Iran during 2010-1012. This ratio was different within provinces and

became different in the period of study. The highest ratio of general practitioners and midwives was in Chaharmahal Bakhtiari province, with a rate of 7.63 and 4.59 per 10,000 population. The highest ratio of pediatricians and gynecologists was in Yazd province (0.74 per 10,000) and Ilam province (0.81 per 10,000), respectively (Table1). Table 2 shows the Robin Hood index and Gini coefficient in terms of population, NAIM and NAIB, during the years 2010-2012. Gini coefficient was variable in the period of this study and demonstrated various trends in increasing and decreasing. Highest and lowest value of Gini coefficient was related to Gini coefficient of gynecologists in terms of NAIB in 2011 and in terms of population in 2012. This coefficient for GPs and pediatricians decreased, and for midwives increased during 2010-2012. Noticeable increase was observed for gynecologists in 2010 and 2011 and then it decreased in 2012. Highest value of Gini coefficient of GPs was based on NAIB in 2010, for midwives based on NAIB in 2011, and for gynecologists and pediatricians in terms of NAIB in 2010 and 2011 respectively. Likewise, the Robin Hood index had variable amounts, highest and lowest of this index was for gynecologists in accordance with population in 2011 and 2012 (34.7% and 10.2%), which was equal with the relocation of 476 and 113 specialists respectively. Highest amount of reallocation in GPs was 2,430 practitioners in 2010, for midwives 2,303 persons in 2012, for pediatricians 280 specialists in 2010 and for gynecologists was 460 specialists in 2011. All of them were in terms of NAIB. For achieving equality within provinces, the number of transferable health workforces was more than 1 person per 10 health workforces. This number was decreased in GPs, pediatricians and gynecologists and it was constant for midwives in the period of this study (Table 3).

Table 1. Distribution of health-related workforces in the provinces of Iran, years 2010-2012

Index	HRPR for midwives			HRPR for Gynecologists			HRPR for pediatricians			HRPR for GPs		
Year	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
East Azarbayjan	1.93	2.39	2.63	0.38	0.04*	0.13	0.22	0.09*	0.17	2.74	3.45	2.14
West Azarbayjan	1.84	2.53	2.62	0.22	0.09	0.19	0.15	0.17	0.19	1.95	3.55	2.17
Ardebil	1.94	2.7	2.59	0.21	0.08	0.14	0.15	0.18	0.18	2.63	3.72	1.85
Isfahan	2.0	1.87	2.04	0.12	0.06	0.15	0.18	0.22	0.23	1.92	4.09	2.17
Alborz	N/A	1.15*	1.11	N/A	0.04*	0.11	N/A	0.09*	0.09*	N/A	1.71	0.88*
Ilam	3.74**	2.31	2.87	0.11	0.81**	0.14	0.2	0.27	0.29	2.86	4.36	2.62
Bushehr	3.11	2.92	2.86	0.23	0.08	0.15	0.15	0.19	0.21	3.13	4.6	2.45
Tehran	1.3	1.24	1.0*	N/A	0.28	0.15	N/A	0.17	0.25	0.97*	1.21*	1.13
Chaharmahal Bakhtiari	3.01	4.37**	4.59**	0.1*	0.05	0.18	0.11	0.24	0.25	6.14**	7.63**	5.19**
South Khorasan	2.65	1.6	1.75	0.15	0.06	0.14	0.25	0.27	0.27	1.81	4.23	2.26
Razavi Khorasan	2.17	2.19	2.33	0.45	0.12	0.12	0.38	0.15	0.16	1.38	3.25	1.77
North Khorasan	2.8	3.03	3.03	0.2	0.22	0.08*	0.17	0.12	0.13	1.1	3.08	2.29
Khuzestan	2.41	2.52	2.49	0.12	0.05	0.11	0.13	0.14	0.16	2.05	2.56	1.9
Zanjan	2.41	2.22	2.5	0.26	0.04*	0.22	0.29	0.3	0.31	2.5	5.02	2.93
Semnan	3.29	3.16	3.41	0.29	0.69	0.43**	0.47	0.48**	0.6*	3.19	6.68	2.85
Sistan Baluchestan	2.42	1.69	1.87	0.1*	0.07	0.1	0.09*	0.11	0.11	2.06	3.11	2.1
Fars	2.52	1.95	2.05	0.4	0.4	0.08*	0.14	0.14	0.2	N/A	3.53	2.11
Qazvin	1.87	1.36	1.48	0.29	0.15	0.13	0.31	0.24	0.24	2.26	3.38	1.91
Qom	1.2	1.83	1.91	0.22	0.12	0.16	0.17	0.12	0.29	1.12	2.92	1.13
Kordestan	3.08	1.96	1.91	0.16	0.2	0.13	0.18	0.16	0.18	2.41	3.03	0.185
Kerman	2.3	2.8	2.46	0.1*	0.1	0.12	0.09*	0.09*	0.16	2.14	3.91	2.44
Kermanshah	3.34	2.19	2.47	0.23	0.23	0.15	0.16	0.16	0.15	2.19	3.56	2.16
Kohgiluyeh	3.1	2.6	2.95	0.19	0.75	0.26	0.2	0.24	0.32	5.58	5.43	3.19
Golestan	1.13*	3.05	3.16	0.26	0.21	0.16	0.26	0.25	0.21	2.17	4.21	2.62
Gilan	3.72	3.22	3.34	0.58	0.26	0.19	0.32	0.21	0.22	2.89	4.55	2.93
Lorestan	3.08	2.82	3.14	0.2	0.2	0.18	0.16	0.15	0.18	2.51	3.9	2.71
Mazandaran	3.28	3.56	3.52	0.3	0.3	021	0.28	0.28	0.3	3.19	5.75	2.6
Markazi	1.25	2.55	2.54	0.26	0.26	0.17	0.22	0.22	0.19	2.38	3.47	2.25
Hormozgan	2.2	2.12	2.17	0.37	0.15	0.13	0.29	0.12	0.2	2.46	3.76	2.56
Hamedan	2.51	2.74	2.78	0.17	0.16	0.17	0.25	0.18	0.24	3.08	4.88	2.7
Yazd	2.37	2.59	2.54	0.69**	0.22	0.27	0.74**	0.25	0.37	2.62	6.72	3.27

HRPR: Human resource per population ratio; GPs: General physicians; * shows lowest ratio; ** shows highest ratio; N/A: Data was not available

Table 2. Robin Hood index and Gini coefficient in terms of Population, NAIM and NAIB in provinces of Iran, years 2010-2012

Year		2010		2011		2012	
Index		Robin hood	Gini	Robin Hood	Gini	Robin Hood	Gini
General Practitioners	population	16.1%	0.23	13.2%	0.187	11.9%	0.173
	NAIM*	15.9%	0.219	13%	0.176	11%	0.16
	NAIB**	17%	0.231	14.2%	0.201	13.1%	0.183
Midwives	population	12.5%	0.176	12.6%	0.176	13.5%	0.19
	NAIM	11.9%	0.17	11.8%	0.168	12%	0.172
	NAIB	12.8%	0.178	13%	0.177	13.7%	0.193
Pediatricians	population	19.2%	0.259	12.7%	0.185	11.4%	0.159
	NAIM	18.2%	0.239	13.7%	0.192	13.3%	0.177
	NAIB	21.5%	0.298	18.3%	0.247	17.4%	0.232
Gynecologists	population	22.6%	0.297	29.8%	0.39	10.2%	0.152
	NAIM	20.4%	0.272	30%	0.391	11.3%	0.161
	NAIB	25.4%	0.332	34.7%	0.442	15.7%	0.216

*NAIB: Need adjusted index for birth; **NAIM: Need adjusted index for mortality.

Table 3. Number of transferable worker per 10 health workforces

2010				2012		
Index	NAIB	NAIM	population	NAIB*	NAIM**	population
General practitioners	1.7	1.6	1.6	1.3	1.1	1.2
Midwives	1.3	1.2	1.25	1.4	1.2	1.4
Pediatricians	2.16	1.8	1.9	1.7	1.3	1.14
Gynecologists	3.8	3.1	3.4	1.6	1.1	1.0

*NAIB: Need adjusted index for birth; **NAIM: Need adjusted index for mortality.

4. Discussion

The current study assessed geographic need and access distribution indices of general practitioners (GPs), midwives, pediatricians and gynecologists in the public sector of Iran during 2010-2012. Distribution of health workforces according to population and need (birth and mortality) was measured. The number of these health workforces per 10,000 population was increased for GPs and pediatricians, decreased for gynecologists and constant for midwives, during study period. Although findings showed that GPs distribution in terms of population, NAIB and NAIM improved during the study period; based on the Robin Hood index, redistribution of GPs can help in reaching a more equitable situation. GPs distribution was less equitable based on birth, and in turn, more GPs should be redistributed in Iran provinces. Tehran, the capital of Iran and Alborz are the most deprived provinces based on GP allocation. It may be because the GPs of these provinces are working more in the private sector. It is also important to note that in this study, we did not analyze the inequality between the cities in a province. Distribution of GPs in Turkey is slightly better than Iran in which Gini coefficient improved significantly from 0.24 to 0.12 between 2002 and 2012 (23). A 2006 study by Theodorakis also showed that distribution of GPs has improved between the years 2000 and2004 in Albania (21). However, Tanihara in 2011 showed that increasing the number of physicians in Japan did not lead to a more equitable allocation (24). Findings about midwives' distribution showed a slightly worsening trend in terms of population, NAIB and NAIM. Robin Hood index also showed more redistribution need for better equality in terms of NAIB. Tehran and Alborz provinces are the most deprived provinces based on midwives' allocation like GPs and it may be because of private sector preference in these provinces. Chaharmahal Bakhtiari province - with traditional culture and having nomads as a major population - is the most sparse province in terms of midwives' allocation. So, midwives' demand in this province is high. Gökyıldız showed that people living in mountains and plains like nomads, prefer traditional health practices such as midwifery for their maternal health (25), which can explain our results. Although Izutsu showed improvement in midwives' distribution in Japan from 2000 to 2010 (26), distribution of midwives worsened from 2006 to 2008 in this country which was similar to our results. Distribution of gynecologists had different trends. First it became worse and then improved markedly. The Iran Ministry of health (IMOH), in a national plan in 2011, required last-year gynecologic residents to spend one month in deprived provinces according to national allocative needs. It could be the reason of equity improvement in the last year of study. Robin Hood index also showed reduction in redistribution need for gynecologists at the end of study. Also, we should note that decrease in the number of gynecologists had no negative effect on distribution that

showed good policy making of IMOH. Karyani, in his study also showed increasing and decreasing trends in Gini coefficient of gynecologists during 2008-2013 (27) that is similar to our results. Our results showed an improving trend in pediatricians' distribution. Although equity improved, the Robin Hood index showed the possibility to receive better equity condition - especially in terms of birth need - by redistributing pediatricians. Kerman and Sistan Baluchestan were the most deprived provinces in terms of pediatricians, in 2010 and 2011. On the other hand, Sistan Baluchestan had the highest mortality rate of infants under 1 year and children under 5 years (28) in the period of study, and special attention is required. Semnan and Yazd provinces are the richest. Investigating Gini coefficient trend in our study, showed that Gini coefficient had decreased, but most of this reduction is due to increase in pediatricians in developing provinces, and deprived provinces still have serious problems in accessing these types of health experts. Kazemi, in his study, showed that industrial and tourist centers like Semnan had more growth in the number of pediatricians, and border provinces like Sistan Baluchestan had less growth (17). For achieving perfect equality, we should see all factors. Matsumoto, in 2010, showed that by increasing the number of physicians and health workforces in the USA and Japan, there is no evidence of equal distribution yet (29). It means that other factors than number of health workforces, may affect equality condition. This study had some limitations. Statistics about the number of GPs, gynecologists and pediatricians were not available in 2010 in some provinces such as Fars and Tehran, which forced us to remove these provinces. We didn't study private sector and distribution status within a province that could make more clear aspects of distribution and equity.

5. Conclusions

The reduction or increase in human resources throughout the country does not lead to a better or worse human resource distribution in the country, unless equal distribution is intended. Health workforce distribution had various trends in Iran. Although the resultant of these trends was better condition there was no evidence regarding special attention to deprived provinces. Gini coefficient had decreased, but most of this reduction is due to increase in health workforce in developing provinces, and deprived provinces still have serious problems for accessing posture. The health system could achieve better equality by considering deprived provinces and using Robin Hood index together. This policy could improve equality conditions.

Acknowledgments:

This study was part of a Master thesis number 91-6410, financially supported by Shiraz University of Medical Sciences and approved by the University Research Council in January 8, 2013.

Conflict of Interest:

There is no conflict of interest to be declared.

Authors' contributions:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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