

Determining Inequality and Trend of Geographic Accessibility to Pediatricians in Iran: 2007-2013

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Abstract

Introduction

The mortality rate of children is one of the most important indicators to measuring the development of countries. Equitable access to pediatricians is an important factor in reducing child mortality and promoting society health. The aim of this study was to investigate the inequality and trend of geographic accessibility to Pediatricians in Iran in the period 2007 to 2013.

Materials and Methods

We used the Gini coefficient and the index of dissimilarity for investigating the geographic distribution of pediatricians in the period 2007 to 2013 in Iran. Also, a regression model used for determining time trend of inequality. Data about the number of pediatricians and number of live birth in each province were obtained from the Statistical Center of Iran (SCI).

Results

The Gini coefficient was 0.27, 0.24, 0.26, 0.23, 0.23, 0.23, 0.25 and 0.21 in 2007 to 2013, respectively. It means that the pediatricians approximately had equal distribution during the studied period. The dissimilarity index of pediatricians were 18.35, 17.4, 19.4, 16.73, 14.93, 14.66 and 11.99 during 2007-2013. It shows that 18.35 percent of total pediatricians should be redistributed to achieve complete equality in pediatrician's distribution in 2007. The time trend analysis showed that inequality have been decreased during the studied period but it was not statistically significant ($p>0.05$).

Conclusion

The results showed that there are some inequality in Pediatricians distribution and most of pediatricians are in developed provinces. Thus, policy makers for improving child's health in Iran should develop a comprehensive plan for appropriate distribution of pediatricians.

Keywords: Dissimilarity index, Pediatricians, Health resources, Inequality, Gini coefficient, Iran.

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Received date: Feb 11, 2015 ; Accepted date: Feb 22, 2015

Introduction

Maintenance and promote the health of children as one of the most vulnerable part of any society has an important role in healthcare sector so that today child mortality is one of the main indicators for measuring degree of development of countries. This focused on the child health can be due to the importance of socioeconomic factors in decrease or increase of the child health indexes such as infant mortality rate (1, 2). There was 6.3 million under five child mortality in 2013 (17000 each day) (3). Different studies in developing countries reveals that infectious diseases, asphyxia and congenital anomalies are most important factors in under five mortality. According to the Iranian Ministry of Health records, most common causes of under five mortality in Iran are infections and different congenital anomalies (4).

Fortunately in recent years along with the expansion of healthcare services and promotion of community's public health, a significant reduction in child mortality rate occurred, for example in Iran under 5 mortality rate in 2000 was 7.34 per 1000 live births and in 2013 reduced to 16.8 per 1000 live births (5). But, there is a great disparity in reducing child mortality rate in different parts of the world so that according to world banks database in 2013 under 5 mortality rate in Luxemburg was 2 and for Angola was 16.7 per 1000 live births (6).

Access to healthcare providers is one of the main factors that can eliminate this inequality and promote public health (7). As we know pediatricians have a fundamental role in child's health (8). But unfortunately, despite increase in number of pediatricians, they distributed very unfair between cities of Iran so that many of them are concentrated in the center of provinces and people who living in other cities doesn't have adequate access to this

group of health experts. Thus investigating pediatrician's geographic distribution could be a good step toward child mortality rate reduction and promoting child and society health (9).

Different studies on geographical distribution of health sector resources especially health workers have done in Iran. Rezaei et al. (10) Kia-Daliri et al. (11) Karimi et al. (12) and Abolhallaje et al. (13) have been investigated the inequality in distribution of healthcare resources.

Previous studies on geographical distribution of health sector resources doesn't investigate the geographical distribution of pediatricians. Therefore, there was no scientific evidence about the distribution of pediatricians in Iran. This study tried to investigate inequality and trend of geographic accessibility to Pediatricians in Iran during 2007 to 2013.

Materials and Methods

This study was performed for measuring inequality in geographical distribution of pediatricians in Iran provinces from 2007 to 2013. Data were obtained from Statistical Centre of Iran (14). Two inequality measure of Gini coefficient and Dissimilarity index were used for investigating the geographical distribution of pediatricians from 2007 to 2013.

Gini coefficient

The Gini coefficient is commonly used to measure the inequality in the geographic distribution of human resources in healthcare (15, 16). The value of Gini coefficient is between 0 and 1. Zero implies the perfect equality and one shows the complete inequality in geographical distribution of interested variable. Figure.1 shows the Lorenz curve. The Gini

coefficient is derived from the Lorenz curve using the following formula:

$$G = \frac{A}{A + B}$$

G = Gini Coefficient

A = Area between the Lorenz curve and the 45° line

$A + B$ = The whole area under the 45° line

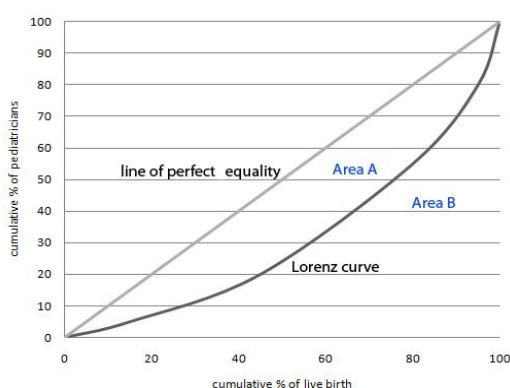


Fig.1: The Lorenz curve

Usual expression of Gini coefficient used (17):

$$G = \frac{1}{2\mu N^2} \sum_{i=1}^N \sum_{j=1}^N |y_i - y_j|$$

Where:

G : the Gini coefficient; μ : the mean of the distribution; N : sample size; y_i : number of pediatricians in i^{th} province. The value of the Gini coefficient is between 0 (perfect equality) and 1 (perfect inequality) (18, 19). It worth nothing that we considered the number of live births in each year as index of need to pediatricians in provinces. We used Jackknife variance estimator for calculating variance of Gini coefficient and tested the hypothesis test of equal

distribution of pediatricians between Iran Provinces (H_0) using student's t-test.

$$v = \frac{N - 1}{N} \sum_{i=1}^N (G_i - G)^2 \quad (2)$$

Where:

V : variance estimator; G_i : value of the coefficient when the i^{th} observation is taken out of the sample (20-22).

Index of dissimilarity indicates the percentage of all health variables, which would have to be redistributed across counties to achieve a situation of perfect equality. Value of this index is between 0 and 100. Value of Index of Dissimilarity (ID) shows the percent of available pediatricians in which should be redistributed between provinces (23). In the current study, ID calculated by following expression (24):

$$ID = \frac{1}{2} \sum_{i=1}^n |x_{ip} - x_{ih}| \quad (3)$$

Where:

ID : index of dissimilarity; X_{ip} : i^{th} province's live births share; X_{ih} : i^{th} province's pediatricians share, N : total number of provinces.

Time trend in inequality

Time trend in inequality of pediatricians from 2007 to 2013 was examined by estimating a regression model. Dependent variable was Gini coefficient and independent variable was year as follows:

$$Y = \beta_0 + \beta_1 X + \epsilon$$

Where:

Y : Gini Coefficient for geographical distribution of pediatricians; X : years from 2007 to 2013.

β coefficient captures the direction and magnitude of trend of geographical distribution of pediatricians in Iran (25). Negative β shows Gini coefficient declined over time and distribution of pediatricians became more equal. Presence of heteroscedasticity in the fitted model was examined by Breusch-Pagan test.

P-value less than 0.05 was considered statistically significant. Stata version 11 and DASP Plugin were used for data analysis.

Results

Table.1 shows the number of Pediatricians per 1000 live births in Iran Provinces in 2007 to 2013.

Also this table declares the mean, standard deviation, minimum and maximum of the number of Pediatricians in Iran provinces

between 2007 and 2013. The mean of Pediatricians per 1000 live births were 1, 1.01, 1.03, 1.10, 1.11, 0.95 and 1.03 during study period.

The maximum of Pediatricians per 1000 live births in 2007 to 2013 were 3.05, 2.95, 2.26, 2.45, 2.61, 2.97 and 2.68, respectively.

Zanjan had the maximum Pediatricians per 1000 live births in 2009 and Semnan had the maximum amount in other years. The minimum amount were 0.16, 0.25, 0.26, 0.27, 0.37, 0.14 and 0.34. Sistan and Balochestan had minimum Pediatricians per 1000 live births in 2008, 2009, 2011 and 2013. The North Khorasan had minimum amount in two years, too. Mazandaran with 0.14 Pediatricians per 1000 live births had the minimum per capita in 2012.

Table1: The descriptive analysis of the number of Pediatricians per 1000 live births in Iran Provinces 2007-2013

Province	2007	2008	2009	2010	2011	2012	2013
East Azarbaijan	1.50	1.51	1.45	1.52	0.99	0.98	0.95
West Azarbaijan	0.73	0.70	0.71	0.74	0.63	0.88	1.12
Ardabil	0.52	0.64	0.80	0.92	1.05	1.06	0.97
Isfahan	0.92	1.03	1.22	1.52	1.44	1.38	1.36
Ilam	1.20	1.21	1.20	1.40	1.36	1.47	1.40
Bushehr	0.96	0.94	0.74	0.84	0.84	0.89	0.87
Tehran	0.51	0.48	0.45	0.65	1.24	1.12	0.90
Chaharmahal and Bakhtiari	1.28	1.03	0.80	0.96	1.48	0.83	1.03
South Khorasan	0.63	0.76	0.67	1.17	1.24	0.68	0.86
Razavi Khorasan	1.05	1.03	0.93	0.97	0.98	1.00	0.97
North Khorasan	0.16	0.34	0.31	0.27	0.43	0.49	0.50
Khuzestan	0.93	1.07	1.03	1.16	1.25	1.07	1.02
Zanjan	1.47	1.13	2.26	1.67	1.54	1.43	1.12
Semnan	3.05	2.95	2.14	2.45	2.61	2.97	2.68
Sistan and Baluchestan	0.31	0.25	0.26	0.38	0.37	0.36	0.34
Fars	0.72	0.74	0.58	0.70	0.69	0.70	1.13
Qazvin	1.12	1.10	1.09	1.38	0.89	0.85	1.46
Qom	1.24	1.16	1.25	1.17	1.19	0.49	0.57
Kurdistan	1.14	1.12	0.65	0.99	0.55	0.68	0.68

Kerman	0.50	0.80	0.78	0.58	0.66	0.52	0.54
Kermanshah	0.70	0.85	0.66	0.84	0.58	0.85	0.66
Kohgiluyeh and Boyer-Ahmad	0.56	0.55	0.99	1.00	0.92	1.13	1.38
Golestan	0.87	0.97	0.96	1.14	1.07	0.80	1.10
Gilan	1.33	1.16	1.32	1.50	1.47	1.74	1.44
Lorestan	0.62	0.62	0.62	0.54	0.89	0.65	0.87
Mazandaran	1.85	1.89	2.03	1.77	2.13	0.14	1.69
Markazi	0.90	1.09	1.02	1.02	1.47	0.83	0.77
Hormozgan	0.60	0.60	0.81	0.81	0.90	0.56	0.60
Hamadan	1.19	1.17	1.23	1.16	0.98	0.99	1.18
Yazd	1.42	1.46	1.88	1.76	1.61	0.94	0.89
Mean	1	1.01	1.03	1.10	1.11	0.95	1.03
SD*	0.55	0.51	0.51	0.47	0.49	0.51	0.45
Max	3.05	2.95	2.26	2.45	2.61	2.97	2.68
Min	0.16	0.25	0.26	0.27	0.37	0.14	0.34

*Standard Deviation: SD

The Gini coefficient and dissimilarity index of Pediatricians distribution in Iran provinces in 2007-2013 have shown in (Table.2). As shown in this table the Gini coefficient against live births was 0.27, 0.24, 0.26, 0.23, 0.23, 0.23, 0.25 and 0.21 in the study period, respectively. The standard error of Gini coefficient was 0.03 in 2013. The t- statistics for Gini coefficient were more than 1.96 for all years and therefore the hypothesis of equal

distribution of Pediatricians was rejected. The dissimilarity index of Pediatricians were 18.35, 17.4, 19.4, 16.73, 14.93, 14.66 and 11.99 during 2007-2013. The number of Pediatricians in which should be redistributed for reaching equal distribution of this health resource showed in the table, too. As it shown 206 of available Pediatricians in 2007 should be redistributed, this amount was 139 Pediatricians for 2013.

Table2: the Gini coefficient and dissimilarity index of Pediatricians in Iran, 2007-2013

Year	Gini Coefficient			Dissimilarity index	
	Estimate	STE*	t-statistic	Estimate	No redistribt**
2007	0.27	0.04	6.7	18.35	206
2008	0.24	0.04	6	17.4	203
2009	0.26	0.03	8.6	19.4	223
2010	0.23	0.03	7.6	16.73	212
2011	0.23	0.03	7.6	14.93	200
2012	0.25	0.04	6.2	14.66	159
2013	0.21	0.03	7	11.99	139

*Standard error, ** Number of redistribution.

Time trend in inequality

The result of regression analysis for investigation of time trend of inequality is shown in (Table.3). As the table shown,

the β -coefficient for the effect of time on Gini coefficient was -0.007 and this effect was not statistically significant ($p>0.05$).

The Breusch-Pagan test for heteroskedasticity showed there was no heteroskedasticity in fitted model ($\chi^2 = 0.20$, $p > 0.5$). The r-squared of the regression model was 0.52.

Table3: Time trend analysis of Gini coefficients for pediatricians in Iran 2007-2013

β -coefficient	Std. Err.*	P value
-0.007	0.003	0.06
R-squared	0.51	
Breusch-Pagan test	$\chi^2 = 0.20$ P-value = 0.65	

*standard error.

Discussion

According to millennium development goals that agreed by all world's countries, in less than one decade (until 2015) child mortality rate most decrease to 75% of 1990 (26). When factors that influence child mortality rate being determined and resolved then a country can easily reach to this goal. Access to health sector resources especially health workers is one of the main factors on child health. Therefore, we investigated the inequality and trend of geographic accessibility to Pediatricians in Iran in the period 2007 to 2013. According to the results pediatrician's per capita rate had unequal distribution and high variance. But most of this variability was in developing provinces (Semnan and Zanjan) and resident population of deprived provinces like Sistan and Baluchestan, Kerman and Hormozgan always had been some geographical problems for accessing to the pediatricians. Similar studies reveal that deprived provinces like Sistan and Baluchestan, West Azerbaijan and Hormozgan are deprived in term of access to health sector services (13, 27-29). This results could confirm this hypothesis that socio-

economic factors and health have direct correlation with each other.

Investigating Gini index trend in study period cleared that Gini index had decreased but most of this decrease is due to increase in pediatricians in developing provinces and deprived provinces still have serious problems for accessing to this type of health experts. For investigating this issue we surveyed pediatrician's growth in different provinces in study period. As defined in (Table.1), Semnan, Zanjan and Mazandaran as industrial and tourist centers experienced a higher growth in number of pediatricians and Sistan and Baluchestan, North Khorasan, Kerman and Hormozgan as deprived and border provinces experienced a less growth in number of this health resource. Thus despite of increase in the total number of pediatricians in Iran, there are some degrees of inequality in access to pediatricians, yet and some of deprived provinces have serious problems in access to pediatricians. Also, Investigating dissimilarity index revealed that total geographical distribution of pediatricians become better during the studied period but further investigation is needed to determine the status of deprived provinces in term of access to pediatricians.

Some studies like Tanimura and Shima in Japan (9), revealed that unequal distribution of healthcare services could worsen public health status (30-32). In this study we investigate the geographical access to pediatricians that is one of the main factors that can improve public health but we don't consider other factors such as financial barriers, organizational and personal factors that can affect on services utilization. These factors could limit the utilization of available healthcare services.

Overall, two used indices of inequality, both Gini Coefficient and dissimilarity index showed that total inequality in distribution of pediatricians was decreased

in provinces of Iran between 2007 and 2013; but deprived provinces need more attention and strategic plans for improving access to pediatrician's services. Regard the vital role of pediatricians in decreasing the child mortality and improve the public health, equal distribution of these physicians could have important impact on improving health indicators and society's health and welfare, thus Iranian policy makers with strategic planning must decrease inequality in access to pediatricians.

Conclusion

In this study we investigate the geographical distribution of Pediatricians in 6 years and results showed that there is unequal trend in Pediatricians distribution so that most of Pediatricians are in developed provinces. Thus policy makers for improving child's health in Iran should develop a comprehensive plan for equitable distribution of Pediatricians.

Conflict of interest: None.

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