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Original Article

Analysis of Inequality in the Distribution of Various Types of Pharmacies Using the Gini Coefficient and Lorenz Curve

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Abstract

Inequitable distribution of health resources leads to high costs and sustainable poverty for households. Therefore, it is necessary to study distribution in health. The most common indicator for measuring inequality is the Gini coefficient. Therefore, the present study was conducted to measure and analyze inequality in the distribution of various pharmacies using the Gini coefficient and the Lorenz curve in Iran. This research was a retrospective cross-sectional study that looked at the state and trend of inequality in the distribution of various types of pharmacies in 11 Lorestan cities from 2016 to 2021. Data was gathered from various data centers. Finally, the Gini coefficient and the Lorenz curve were determined. Excel was utilized in this project. The results study showed an increase in the Gini coefficient of the total pharmacies in Lorestan province (0.436) which is relatively indicative of the unfair distribution of the pharmacies but this value is higher for private pharmacies (0.545). The Gini coefficient of public pharmacies was (0.377) and for rural pharmacies was (0.282). So, to achieve an appropriate level of justice in the distribution of pharmaceuticals and pharmacies, resources should be distributed according to the requirements of city residents. Different kinds of pharmacies should be considered for different population groups when developing policies.

Keywords: Pharmacoeconomics, Inequality, Pharmacies, Gini coefficient, Lorenz curve.

1. Introduction

Health systems spend a lot of money to increase people's access to health care and on the other hand, are faced with limited resources so health managers and policymakers should pay special attention to cost management [1]. Access to fair health care is one of today's most pressing health challenges. Everyone should have an equal chance to get adequate care and health services when they are needed [2]. However, healthcare expenditure will be more equitable if the cost of care is dispersed according to a household's ability to pay rather than the risk of disease [3]. These resources are spent unbalanced for various purposes and it can have irreparable consequences. The key point is evaluating and monitoring the costs and resources consumed for healthcare programs to

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make the programs more cost-effective [4]. Some of the effects of the healthcare finance system's unbalanced conditions include catastrophic expenditures and the emergence of long-term poverty for households [5]. According to the World Health Report, inefficiency and inefficiency for misuse of human, technical, and medical resources consume on average 30% of total health sector expenses [6]. One of the causes of resource waste is inequality in resource allocation between regions, resulting in excessive density and resource waste in some areas while others lack even the most basic amenities [6]. Pharmacies are also vital for medical establishments because they are required for treatment completion. They play a critical role in promoting justice, and their availability is influenced by a variety of socioeconomic conditions. Lack of proper distribution of pharmacies in urban and rural areas, either daily or around the clock, increases inequality and reduces people's access to medicine, consequently increasing costs and reducing efficiency [7]. Therefore, access to pharmacists and Timely pharmaceutical services is important for the effectiveness of the treatment cycle and health promotion. However, determining health equity is a difficult task. Countries have employed various techniques to achieve this goal [8], prompting statisticians and economists to develop new methodologies for measuring service distribution equality. The Gini coefficient, which is a symmetric ratio determined independently of the mean [9], has been suggested as the most efficient approach for estimating the inequality in the distribution of resources in the health sector. The Gini coefficient index is calculated by both graphing and accounting methods. In the graph method, Lorenz diagrams are used to determine the Gini coefficient. According to the Lorenz diagram, the population is cumulatively on the X-axis and the income of individuals or households is on the Y-axis. In a state of complete equality, the income distribution curve of society must conform to the 45-degree half-line of society, but in the real world, this never happens. There is always a gap between the income curve and the 45-degree half-line that determines the Gini coefficient [10]. On the other hand, the Lorenz curve is widely used to measure equality in the distribution of health resources, given that many studies have been conducted in Iran to determine the Gini coefficient of Health resources, but since Iran is a large country with a large population, these studies may not well reflect the level of justice in people's access to medicine and pharmacies [11, 12]. As a result, the Gini coefficient must be calculated in all cities of each province to establish how many individuals have access to medicine as the final consumer of medicine. In Iran, there are several types of pharmacies for various vocational and social groups of the population, to ensure that everyone has access to medicine. So, the current study was undertaken in the relatively deprived region of Lorestan in western Iran by us to quantify the degree of inequality in the distribution of various pharmacies using the Gini coefficient.

2. Materials and Methods

This study is a 6-year retrospective descriptive cross-sectional study that looked at

the situation and trend of inequality in the distribution of different types of pharmacies in 11 Lorestan cities from 2016 to 2021. Each city was analyzed as a separate unit in this study. The population of cities was obtained from the Iranian Statistics Center, and data from all types of pharmacies in Lorestan province, including urban and rural, private and public, and social security, were obtained from the two deputies of Lorestan University of Medical Sciences (Deputy of Food and Drug, and Deputy of Health). The Gini coefficient is determined using the formula [13, 14].

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

where (Xi) represents the cumulative proportion of the population, (Yi) represents the cumulative percentage of the pharmacy variable in cities, and (n) represents the number of cities ranked according to the researched variable, also "i" in the "Xi" and "Yi" is as the index. The Gini coefficient has a numerical value that ranges from 0 to 1. It will be more equal if its value is close to zero, and as it approaches one, the distribution of resources will become more unequal [15, 16].

This study was carried out in the Shahid Rahimi Hospital, affiliated with Lorestan University of Medical Sciences, Khorramabad, Iran. (Ethical code: IR.LUMS.REC.1400.116).

3. Results and Discussion

Approximately 330 different types of pharmacies were evaluated over 6 years in 11 cities in Lorestan province (with a population of about 1.8 million people).

Table 1 shows the Gini coefficient of the province's pharmacies by type of pharmacy and year. Based on the results, the average Gini coefficient of all pharmacies was calculated to be 0.436. The distribution of rural pharmacies has the lowest Gini coefficient among the subgroup pharmacies (0.282), indicating an acceptable dispersion between cities and rural regions. The Gini coefficient of the public (government) pharmacies is relatively acceptable (0.377). The average Gini coefficient of 24-hour pharmacies was similarly 0.479. But social security pharmacies have the highest Gini value (0.586), indicating a very unequal distribution of these pharmacies among the cities of the province. Following them, private and municipal(urban) pharmacies have the highest Gini coefficient (0.545).

Table 1: The Gini coefficient of the province's pharmacies.

YEAR/ PHARMACIES	2016	2017	2018	2019	2020	2021	AVERAG
TOTAL	0.430	0.435	0.438	0.437	0.436	0.439	0.436
URBAN	0.537	0.543	0.546	0.539	0.531	0.533	0.538
RURAL	0.282	0.282	0.282	0.282	0.282	0.282	0.282
PRIVATE	0.541	0.550	0.559	0.547	0.537	0.538	0.545
PUBLIC	0.346	0.359	0.359	0.400	0.400	0.400	0.377
FULL TIME-24H	0.454	0.460	0.460	0.465	0.517	0.517	0.479
SOCIAL SECURITY	0.586	0.586	0.586	0.586	0.586	0.586	0.586
AVERAGE	0.454	0.459	0.461	0.465	0.470	0.471	0.463

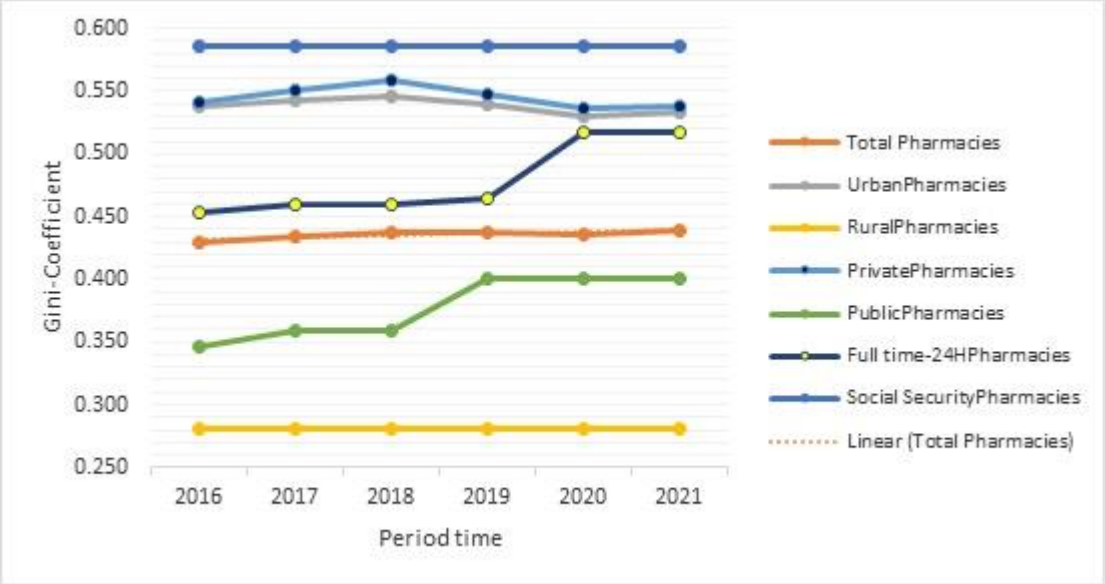

Figure 1. The Gini coefficient trend of different pharmacies.

As shown in figure 1, the Gini coefficient trend of all pharmacies is relatively steady from the beginning to the end of the period. In the years under consideration, this consistent tendency was seen in rural and social security pharmacies. It was expected that the Gini coefficient trend has been somewhat growing for public and 24-hour pharmacies during the study period, however, it has been slightly dropping for urban and private pharmacies. As shown in figure 2, The Lorenz curve indicates the dispersion in the distribution of pharmacies in different deciles of the population.

The table above shows the shortage or surplus of the share of pharmacies according to the share of the population between different cities.

According to the results related to the total pharmacies, Delfan city has the most shortage of pharmacies about the population (%- 2.32) and Khorramabad city as the center of the province has a surplus of pharmacies about the population (2.07%). And in general, among the 11 cities of

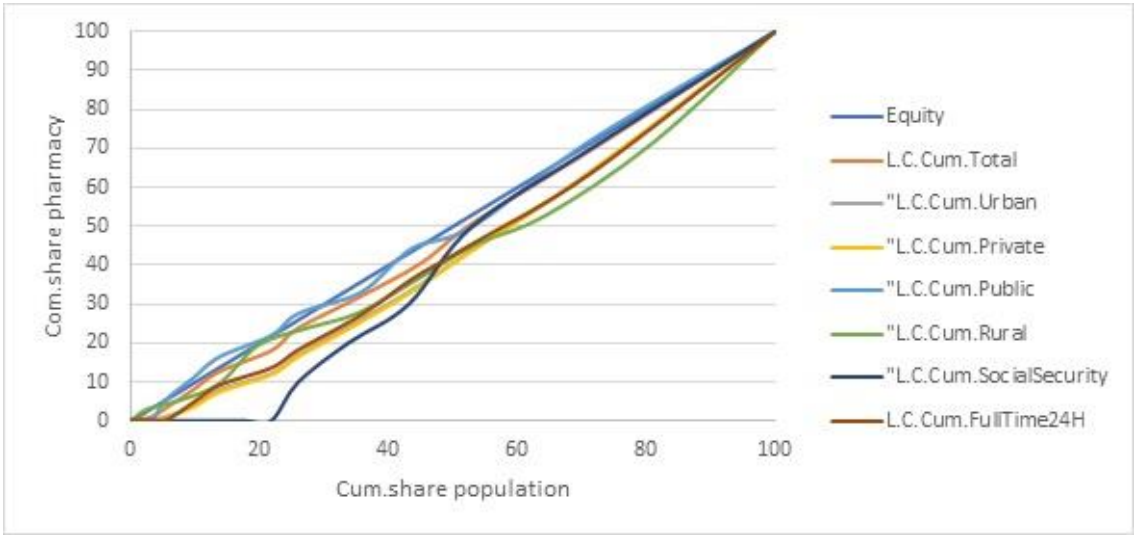

Figure 2. Lorenz curve of different pharmacies based on cumulative contribution.

the province, 4 cities have shortages and the rest have sufficient pharmacies. But for urban pharmacies, 8 cities have a shortage of different types of pharmacies, so in this regard, there is a shortage of private pharmacies (as a subgroup of urban pharmacies) in the same cities, which shows a big impact of private pharmacies in accessing drugs. And the biggest shortage is related to Delfan city (-3.57 %) and the highest surplus is for Khorramabad city (8.40). Social security pharmacies were divided unequally between the cities so that half of the cities do not have even one pharmacy and this shortage is relatively evenly distributed between these cities, although in Delfan city this ratio is more than the population (-8.11). Governmental pharmacies have a fairly reasonable distribution between cities because all cities have these pharmacies and there is no severe shortage. The city of Dorud has the highest shortage in terms of population (-3.89). There is a shortage of 24-hour pharmacies in half of the cities (5 cities), the largest shortage is in Romeshkan (-3.14) and the highest surplus is in Khorramabad (5.10). But rural pharmacies had a more accepted distribution than other pharmacies, with 4 cities having shortages. A noteworthy point is the lack of these pharmacies in big cities like Khorramabad (-9.57).

The results of this study indicate a relative increase in the Gini coefficient of the total pharmacies in the Lorestan province (0.436) but this rate is higher for private pharmacies (0.545). Compared to other similar studies in other provinces of Iran, it shows an increase of about 0.10 to 0.15, so in Nouraei's study that examined the distribution of health resources, including private pharmacies in Lorestan province, the average Gini coefficient between 2006 to 2014 it was calculated at around 0.38[6]. In the study of Meshkani on the study of Gini coefficient of pharmacies in Kerman province, the average Gini coefficient in the years 2006-2011 was calculated to be about 0.39, it had a slight upward trend [7]. In the Rezaie study, the average Gini coefficient of the distribution of pharmacies in Kurdistan province was calculated as 0.218. It varied between 0.25 at the beginning and 0.16 at the end of the period [17] and the average Gini coefficient of pharmacies in Kermanshah province during 2005-2011 was about 0.202[18]. It seems that due to the homogeneity of economic, social, and cultural indicators of Lorestan province with other neighboring provinces such as Kermanshah and Kurdistan. Gini coefficient index of distribution of pharmacies compared to the mentioned studies of these provinces, there is a significant decrease in the level of equality in access to pharmacies for the population of the province. Therefore, it seems that Pharmaceutical officials of the Lorestan province should make a fundamental revision in the policy of distribution of pharmacies to reach the same level of the Gini coefficient index as the provinces of the region. Other studies in Iran indicate a significant decrease in the Gini coefficient in the private sector [19-21]. Therefore, it is inferred that the Gini coefficient of private and municipal pharmacies (0.538) is relatively high, it's necessary to analyze cities within the province to find the cause of this injustice. But it is aligned with a study in Tehran that Mohammadi showed that the distribution of pharmacies in terms of population and areas is inappropriate [4, 5, 10]. It is important to consider that the demographic structure of Tehran's urban geography differs from that of Lorestan, which may impact the

results of comparative studies. The Gini coefficient of urban and private pharmacies in this study appears to differ from other similar studies, indicating an unfair distribution of pharmacies in different provinces, particularly in Lorestan province. However, it agrees with the study by Tinyami Erick Tandi, who examined the deficit and inequality in the geographical distribution of health personnel in Cameroon which the Gini coefficient of pharmacists was calculated at 0.507 [22]. In our study, the Gini coefficient of distribution of public pharmacies (0.377) was lower than private pharmacies (0.545), and government-owned pharmacies including hospitals and rural pharmacies were fewer than urban and private pharmacies. While in the study of Shiraz pharmacies, the Gini coefficient for public pharmacies was calculated between 0.33 to 0.4 it is consistent with our results [21]. the Gini coefficient of public pharmacies is similar which indicates the stability of government policies in the distribution of resources among the provinces, unlike private pharmacies. Lin also measured access to pharmacies in urban and rural areas of the United States, he found that the average distance for an elderly person in Illinois to find a local pharmacy was 0.9 miles in urban areas, but that distance was six times greater (5.9 miles) in rural areas. At least 10% of rural elderly people had to travel more than 11.8 miles to find a local pharmacy, but only 0.1% had to travel more than 20 miles [23]. While in our study the lowest Gini coefficient is related to rural pharmacies (0.282). The extensive and effective system of health networks with rural health centers and houses in remote areas has increased people's access to all services, including medicine, which may be the main reason for the improved healthcare outcomes. This finding is consistent with Nouraei's study. In other words, the distribution of rural health homes that provide universal access to basic health and pharmaceutical services seems more desirable and equitable [6]. Given the vital importance of medicine as a finish line of treatment, access to medicine is an undeniable necessity, so paying attention to its fair distribution among cities should be a policy with priority, so timely access to medicine can prevent irreparable damage and other costs.

Due to the high Gini coefficient presented in this report, it is necessary to pay attention to the ratio of pharmacy distribution to the population for less privileged cities, as Table 2 shows that cities need more pharmacies and investments. This study confirms inequality in access to pharmacies, so to increase access to the distribution of drugs, more social and private pharmacies should be distributed in different regions for different occupational and social groups. Fulltime-24h pharmacies, which serve during the night and day, can be an important factor in increasing people's access to medicine and decreasing the Gini coefficient. Greater access to health services will lead to an improvement in the general health of the community, but only an increase in the number of resources in the health sector will not lead to a fair distribution of these resources; Therefore, how resources are distributed among different regions is of particular importance as one of the social determinants affecting health. Therefore, continuous health system monitoring to distribute resources fairly is necessary. Injustice in access to healthcare facilities in the region can be due to the unbalanced allocation of these resources. In this regard, access to pharmacies is important because

sometimes the patient needs to receive medicine on time, especially in remote towns and villages or in demographically disadvantaged and occupational groups, so failure to deliver medicine on time causes irreparable damage to the patient.

4. Conclusion

According to the results of this study, there is a big difference between different cities of the province in terms of the degree of having pharmacies. the concentration of these resources has been more in the center of the province, Therefore, it is suggested that redistributive policies be reformed and that pharmacies be distributed in less developed areas, so we will see a reduction in inequality and gaps between cities to achieve social justice in access to medicine in the future. Achieving a high level of success in the process of allocating drugs and pharmacies is available when the distribution of resources is calculated according to the population needs of each city. so, it requires different types of pharmacies should be considered for each city which each pharmacy can cover different population groups.

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Conflict of interest

The authors declare to have no conflict of interest.

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Table 2: The share of pharmacies according to the share of the population of cities.

	Roomeshkan	Doureh	Azna	Poldokhtar	Delfan	Selselleh	Dorood	Aligoudarz	Kouhdasht	Boroujerd	Khorramabad	Total
Population (%)	55682 (3.14)	41756 (2.35)	74936 (4.22)	73744 (4.15)	143973 (8.11)	73154 (4.12)	174508 (9.83)	137534 (7.75)	166658 (9.39)	326452 (18.39)	506471 (28.54)	1774868 (100)
Total Pharmacies (%)	4.00 (1.22)	8.00 (2.44)	15.67 (4.78)	16.00 (4.88)	19.00 (5.80)	18.17 (5.54)	26.67 (8.13)	27.67 (8.44)	29.33 (8.95)	63.00 (19.22)	100.33 (30.60)	327.83 (100)
Difference %	-1.92	0.09	0.56	0.73	-2.32	1.42	-1.70	0.69	-0.44	0.82	2.07	0
UrbanPharmacies (%)	1.00 (0.47)	2.00 (0.94)	8.67 (4.09)	6.00 (2.83)	9.00 (4.25)	10.17 (4.80)	19.67 (9.28)	14.67 (6.92)	18.33 (8.65)	44.00 (20.77)	78.33 (36.98)	211.83 (100)
Difference %	-2.67	-1.41	-0.13	-1.32	-3.86	0.68	-0.55	-0.83	-0.74	2.38	8.44	0.00
PrivatePharmacies (%)	1.00 (0.57)	1.00 (0.57)	6.50 (3.69)	5.00 (2.84)	8.00 (4.55)	8.17 (4.64)	16.67 (9.47)	11.83 (6.72)	15.50 (8.81)	37.33 (21.21)	65.00 (36.93)	176 (100)
Difference %	-2.57	-1.78	-0.53	-1.31	-3.57	0.52	-0.36	-1.03	-0.58	2.82	8.40	0
Social SecurityPharmacies (%)	0.00 (0.00)	0.00 (0.00)	1.00 (10.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	2.00 (20.00)	1.00 (10.00)	1.00 (10.00)	2.00 (20.00)	3.00 (30.00)	10 (100)
Difference %	-3.14	-2.35	5.78	-4.15	-8.11	-4.12	10.17	2.25	0.61	1.61	1.46	0.00
PublicPharmacies (%)	0.00 (0.00)	1.00 (5.94)	1.00 (5.94)	1.00 (5.94)	1.00 (5.94)	1.00 (5.94)	1.00 (5.94)	1.83 (10.89)	1.00 (5.94)	3.50 (20.79)	4.50 (26.73)	16.83 (100)
Difference %	-3.14	3.59	1.72	1.79	-2.17	1.82	-3.89	3.14	-3.45	2.40	-1.80	0
Full time-24H Pharmacies (%)	0.00 (0.00)	0.00 (0.00)	1.00 (5.45)	1.00 (5.45)	1.00 (5.45)	1.00 (5.45)	1.83 (10.00)	1.50 (8.18)	1.50 (8.18)	3.33 (18.18)	6.17 (33.64)	18.33 (100)
Difference %	-3.14	-2.35	1.23	1.30	-2.66	1.33	0.17	0.43	-1.21	-0.21	5.10	0
RuralPharmacies (%)	3.00 (2.59)	6.00 (5.17)	7.00 (6.03)	10.00 (8.62)	10.00 (8.620	8.00 (6.90)	7.00 (6.03)	13.00 (11.21)	11.00 (9.48)	19.00 (16.38)	22.00 (18.97)	116 (100)
Difference %	-0.55	2.82	1.81	4.47	0.51	2.77	-3.80	3.46	0.09	-2.01	-9.57	0