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Investigating the Inequality Trend in Health Resource Distribution in Iran: A Case Study in Bushehr Province

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Abstract

Background: Equity in access to health resources is a fundamental goal of health systems worldwide.
Objectives: This study aims to assess the distribution of essential health resources necessary for healthcare provision in Bushehr Province.
Methods: This cross-sectional study spans ten years and utilizes several widely recognized indices in health resource distribution equity and equality, including the Gini Coefficient, Concentration Index, Horizontal Inequity, Robin Hood Index, Theil Index, Atkinson Index, and Quantile Ratio. These indices were calculated based on both the population level and the proposed resource allocation model (PRAM) using Excel Software 2018 and Stata version 18.
Results: The findings indicate a degree of inequality in the distribution of all health resources examined, with special beds exhibiting much higher levels of inequality than others. The sensitivity of the studied indices varied across the distributed resources. Moreover, the trend of inequality generally decreased for all examined resources. The PRAM results suggest that adopting a different approach to resource distribution can significantly reduce inequality levels.
Conclusions: Despite a downward trend in the inequality of health resource distribution, significant disparities persist. Altering the resource distribution system from the conventional geographical division could aid in achieving equity and equality in healthcare. Such changes could also reduce the costs associated with the health system.

Keywords: Equity, Horizontal Inequity, Gini Coefficient, Concentration Index, Robin Hood Index, Theil Index, Atkinson Index, Quantile Ratio

1. Background

The growth of healthcare, the advancement of medical technologies, rising expectations, and, subsequently, increased life expectancy have led to growing financial pressures on healthcare systems. Less developed countries, constrained by budgetary limitations, face particularly acute challenges (1). Despite a focus on equity, health systems often grapple with inequity due to unequal access for those in need (2, 3). Consequently, the equitable distribution of health facilities has emerged as a crucial policy issue (4), with the level of inequality in the distribution of health resources and the focus on equitable distribution capturing the attention of health policymakers (5).

Inequitable distribution can severely hinder access to health services, leading to inefficiency and the wastage of precious health resources (6). Thus, the optimal allocation of these scarce resources is critically important (7). Equality, deeply ingrained in social justice, views equity as fairness and justice (8). In healthcare, equity implies that the distribution of resources should match the actual, not potential, needs (9).

It's important to distinguish between inequality and inequity; inequality broadly describes differences in

access, while inequity refers to unfair inequalities (10). For example, higher service utilization by older individuals compared to younger ones is seen as a fair inequality aligned with the definition of health equity (11).

Equity can be categorized as horizontal or vertical. Horizontal equity is achieved when individuals with similar needs have equal access to and utilization of healthcare. Vertical equity means those with greater health needs should receive more care than those with fewer needs (12). Therefore, examining justice and inequality in health resource distribution is pivotal for policymaking and resource allocation, including physicians, beds, and equipment (13, 14). Numerous studies have shown that access to health resources often does not align with need, leading to varying degrees of inequity in different countries (6, 15, 16).

To examine the issue at the operational level, some developed countries have utilized the mortality rate as a measure of healthcare needs, operating under the assumption that a higher mortality rate indicates a population with greater health needs (17). In specific instances, due to unique geographical and cultural circumstances, the under-five child mortality rate and the prevalence of HIV have been considered as indicators of need (18).

While numerous studies have been conducted in Iran to explore the distribution of health resources, investigations into inequity and inequality in the distribution of these resources, using need indices and simultaneously applying multiple indices, are scarce (19-21). Furthermore, to our knowledge, no comprehensive study has assessed the level of health resource distribution in Bushehr province to date.

Bushehr province, covering 23,197 square kilometers, is located in the southwest of Iran, with a long 625-kilometer coastline along the Persian Gulf. Based on the latest 2021 estimates, the province's population was 1,240,137. It encompasses 10 counties, with Bushehr Port serving as its capital.

2. Objectives

The present study aimed to examine the level of inequality and inequity in the distribution of health resources, including hospital beds, special beds, physicians, and health workers, both at the population level and based on the need index of the mortality rate, utilizing the most common indices in Bushehr province.

3. Methods

This applied and cross-sectional study was conducted across four distinct periods: 2012, 2015, 2019, and 2022. Data on the population and health resources (hospital beds, special beds, physicians, and health workers) were sourced from Iran's Statistics Center and the Statistics Center of Bushehr University of Medical Sciences, respectively. To measure the extent of inequity or inequality in resource distribution among the province's counties, indices such as the Gini Coefficient, Concentration Index (CI), Horizontal Equity Index, Robin Hood Index, Atkinson Index, Theil Index, and Quartile Ratio were utilized. Initially, rates were calculated, followed by population ranking. Additionally, considering the population level may not effectively reflect health needs (22-27), the crude death rate was employed as a healthcare needs index, and accordingly, the Horizontal Equity Index was calculated (17).

Considering the longitudinal geographical position of the province along the Persian Gulf and the necessity to adhere to a classification pattern as a crucial strategy for the optimal distribution of limited resources and achieving distributive justice, we conceptually divided the province into three regions: south, north, and center. This division deviates from the common geographical subdivision of a province. Inequality and inequity values were calculated with respect to the proposed resource allocation model (PRAM) to generate new policy evidence on the distribution of health resources in Bushehr province. According to this model, the unit of interpretation and analysis of inequality and inequity indicators will be healthcare hubs

3.1. Measuring Inequality

3.1.1. Lorenz Curve and the Gini Index

The Lorenz curve was utilized to illustrate the distribution of health resources across the province, depicting the cumulative share of health resources against the cumulative share of the population when groups are ranked from those with the least to those with the most access to resources.

The Gini Coefficient, derived from the Lorenz curve, measures inequality at the population level. It ranges from 0 to 1, where 1 represents maximum inequality, and 0 indicates no inequality. Graphically, the Gini Index is the area A/(A+B) and is calculated as follows:

$$G = \left(\sum_{i=1}^{n} X_i Y_{i+1}\right) - \left(\sum_{i=1}^{n} X_i 1 Y_i\right) \quad (1)$$

Where G represents the Gini Index, n is the number of groups (counties), x indicates the cumulative share of the population ranked from minimum to maximum access to the evaluated resource, and y is the cumulative percentage of health resources corresponding to the ranked population on the x-axis (20).

3.2. Concentration Index

To assess the extent of inequity in resource distribution based on the need indicator, we used the CI derived from the concentration curve. The crude mortality rate served as a proxy for differences in health resource needs. Accordingly, the cumulative proportion of the population ranked by access to health resources (from lowest to highest) on the x-axis was plotted against the cumulative proportion of the need variable (crude mortality rate) on the y-axis. The following equation was used to calculate the CI:

$$C = \frac{2}{\mu} \sum Y_i R_i - 1 \quad (2)$$

Where C denotes the CI, u is the mean of the health resource under study, y_i represents the health variable of the ith county, and R_i is the fractional rank of the ith county (Figure 1) (6).

The CI ranges from -1 to 1. A negative (positive) CI value, resulting when the concentration curve lies above (below) the diagonal, indicates inequities in health favoring the poorer (richer) regions, which are populations with the lowest (highest) level of access to resources.

3.3. Horizontal Inequity

Horizontal Inequity (HI) was determined using Wagstaff and van Doorslaer's formula, where we computed HI by identifying the discrepancy between the distribution of resources based on the need index and the population level (3).

$$HI = Gini\ (health\ resources) - CI\ (Need) \quad (3)$$

3.4. Robin Hood Index

In this study, the Robin Hood Index was employed to evaluate the reallocation of health resources. It quantifies the proportion of health resources that need to be redistributed, essentially the amount that must be transferred from the more advantaged segments of the population to the less affluent ones to achieve complete equality in resource distribution (28). This index ranges from zero (indicating perfectly distributed resources) to one hundred percent (signifying the most inequitably distributed resources) (29). Graphically, it is represented by the maximal vertical distance between the Lorenz curve and the 45-degree line. The Robin Hood Index is calculated using the formula:

$$H = \frac{1}{2} \sum_{i=1}^{N} \left[\frac{E_i}{A_t} - \frac{E_i}{A_t} \right] \quad (4)$$

Where E_i is the quantity of health resources in the ith county, E_t is the total health resources under study, A_i is the total population of the ith county, and A_t is the total population of the study area.

3.5. Atkinson Index

The Atkinson Index, named after British economist Anthony Barnes Atkinson, measures inequalities in resource distribution, incorporating normative judgments about social welfare into the calculations (23). The index ranges from 0 (equal distribution) to 1 (maximum inequality). It is calculated as follows:

$$I_R = 1 - \left[\sum_{i=1}^{n} \left(\frac{Y_i}{\bar{Y}} \right)^{1-\epsilon} f_i \right], \ if\ \epsilon \neq 1 \quad (5)$$

$$I_R = 1 - exp\left[\sum_{i=1}^{n} f_i \log_e \frac{Y_i}{\bar{Y}} \right], \ if\ \epsilon = 1 \quad (6)$$

In this formula, ε is the inequality aversion parameter, where $0 < \varepsilon < +\infty$. A higher ε indicates greater sensitivity to inequality. y_i represents the health resources allocated to the ith county, n is the number of counties (1 to 8 in this study), f_i is each county's population proportion to the total population, and $\bar{Y}$ is the mean health resources of surveyed counties.

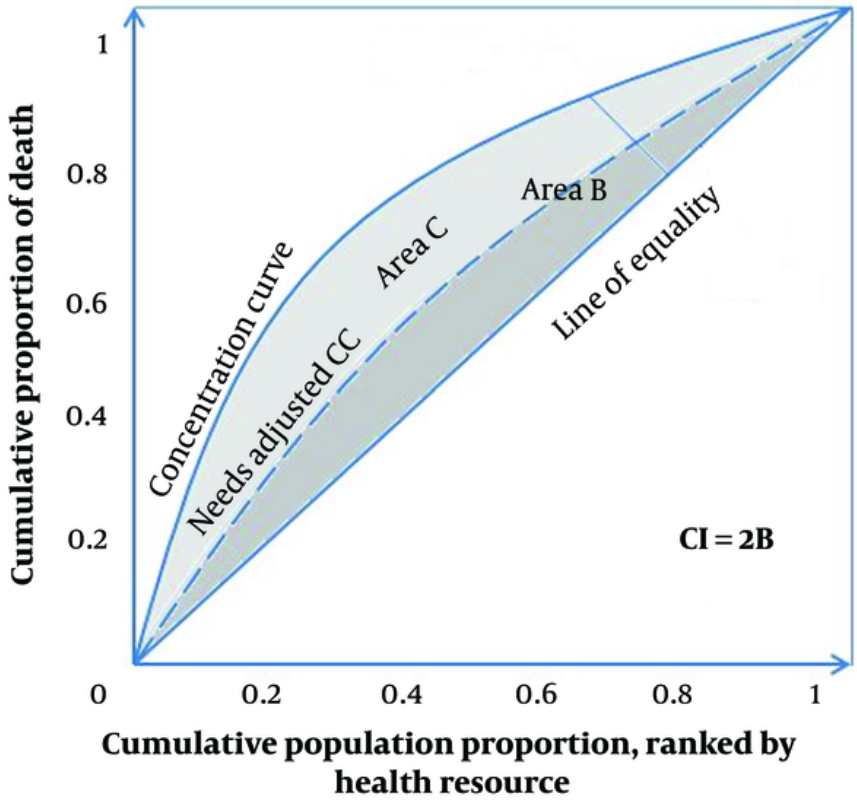

Figure 1. Concentration curve.

3.6. Theil Index

Introduced by Dutch economist H. Theil for measuring income inequality, the Theil Index is now used to assess disparities in access to health resources (30). It ranges from 0 to 1, with a higher value indicating greater inequality in health resource allocation. The index can be decomposed into within and between group components (22), which is one of its key features. The formula used is as follows:

$$T_L = \sum_{i=1}^{n} \left[\left(\frac{X_i}{X} \right) \log \left(\frac{X_i/X}{Y_i/Y} \right) \right] \quad (7)$$

In this study, n represents the number of groups (counties), x_i is the population size in the ith county, x is the total population, y_i is the number of health resources in the ith county, and y is the total health resources (31).

3.7. Quantiles

Quantiles are values that divide ranked data into equal portions. The most common quantiles include quartiles, quintiles, deciles, and percentiles. In this study, the Quartile Ratio was used to calculate the ratio of resources acquired by the top quartile compared to the lowest one. Although Quantile Ratios provide less information than other inequality measures, these simple measures are easily understood and serve as effective ways to assess the extent of inequality in access to health resources (31).

4. Results

The average numbers of general beds, special beds, physicians, and health workers during the study period

Table 1. Frequency and Standard Deviation (SD) of Health Care Resources in Bushehr Province

Year	Number of General Beds	Number of Special Beds	Number of Physicians	Health Workers
2012	1052	103	743	6027
2015	1115	124	798	6675
2019	1520	171	1042	7196
2022	1525	221	966	7817
Mean (SD)	1303 (221)	155 (45)	887 (121)	6929 (659)

Table 2. Distribution of Studied Health Resources at the Population Level

Health Resources	2012	2015	2019	2022
Physicians				
Gini Coefficient	0.45	0.45	0.48	0.45
Concentration Index	0.28	0.26	0.26	0.30
Horizontal Inequity	0.18	0.19	0.21	0.15
Robin Hood Index	0.23	0.19	0.23	0.21
Theil Index	0.14	0.10	0.13	0.10
Atkinson Index	0.52	0.53	0.55	0.50
Quartile Ratio	3.17	2.73	3.44	2.50
Health workers				
Gini Coefficient	0.41	0.42	0.42	0.42
Concentration Index	0.29	0.29	0.29	0.32
Horizontal Inequity	0.12	0.14	0.13	0.10
Robin Hood Index	0.15	0.15	0.15	0.14
Theil Index	0.06	0.06	0.06	0.06
Atkinson Index	0.52	0.51	0.50	0.50
Quartile Ratio	1.92	1.95	1.71	1.60
General beds				
Gini Coefficient	0.47	0.48	0.49	0.47
Concentration Index	0.28	0.28	0.28	0.32
Horizontal Inequity	0.19	0.21	0.21	0.16
Robin Hood Index	0.21	0.23	0.22	0.19
Theil Index	0.21	0.22	0.14	0.12
Atkinson Index	0.67	0.67	0.60	0.58
Quartile Ratio	8.76	6.66	3.07	2.82
Special beds				
Gini Coefficient	0.57	0.56	0.52	0.52
Concentration Index	0.28	0.27	0.27	0.32
Horizontal Inequity	0.29	0.29	0.25	0.21
Robin Hood Index	0.33	0.31	0.29	0.27
Theil Index	0.37	0.35	0.30	0.30
Atkinson Index	0.74	0.73	0.70	0.71
Quartile Ratio	5.86	4.41	6.29	5.29

were 1303, 155, 877, and 6929, respectively (Table 1).

4.1. Findings Related to the Distribution of Health Resources at the Population Level

The calculation of the Gini Coefficient for health resources, including general beds, special beds, physicians, and health workers at the population level, indicates that the highest and lowest levels of inequality among the studied resources were related to special beds and health workers (0.57 and 0.41 in 2012, respectively) (Table 2 and Appendix 1).

Table 3. Distribution of Studied Health Resources at the PRAM

Health Resources	2012	2015	2019	2022
Physicians				
Gini Coefficient	0.22	0.23	0.25	0.22
Concentration Index	0.22	0.21	0.22	0.23
Horizontal Inequity	0.00	0.02	0.03	-0.01
Robin Hood Index	0.05	0.05	0.06	0.03
Theil Index	0.01	0.01	0.01	0.00
Atkinson Index	0.38	0.39	0.41	0.37
Health workers				
Gini Coefficient	0.24	0.24	0.23	0.23
Concentration Index	0.22	0.21	0.22	0.23
Horizontal Inequity	0.02	0.03	0.01	0.00
Robin Hood Index	0.11	0.11	0.09	0.09
Theil Index	0.04	0.03	0.02	0.02
Atkinson Index	0.42	0.41	0.39	0.39
General beds				
Gini Coefficient	0.27	0.27	0.27	0.25
Concentration Index	0.22	0.21	0.22	0.23
Horizontal Inequity	0.06	0.06	0.05	0.02
Robin Hood Index	0.12	0.12	0.11	0.09
Theil Index	0.05	0.04	0.03	0.02
Atkinson Index	0.45	0.43	0.42	0.41
Special beds				
Gini Coefficient	0.31	0.31	0.28	0.29
Concentration Index	0.22	0.21	0.22	0.23
Horizontal Inequity	0.09	0.10	0.06	0.06
Robin Hood Index	0.16	0.15	0.13	0.13
Theil Index	0.08	0.06	0.05	0.05
Atkinson Index	0.51	0.48	0.42	0.43

The CI calculation for the studied resources showed that the highest level of inequity was related to health workers, general and special beds in 2022 as 0.32, and the lowest value was for physicians in 2015 and 2019 as 0.26 (Table 2 and Appendix 2).

The HI index calculation results revealed that the highest amount of HI was related to special beds at 0.29 in 2012 and 2015. Conversely, the lowest value was for the distribution of health workers in 2022, at 0.10. Moreover, results indicated that the slope of the HI line for all studied health resources has been decreasing (Table 2 and Appendix 3).

The calculation of the Robin Hood Index showed that the highest level of inequality was related to special beds in 2012 at 0.33, and the lowest one belonged to health workers in 2022 at 0.14 (Table 2 and Appendix 4).

The calculation of the Theil Index for the examined health resources indicated that the highest level of inequality was associated with special beds in 2013, at 0.37, while the lowest value belonged to health workers at 0.06 in all studied periods (Table 2 and Appendix 5).

The results revealed that the highest level of the Atkinson Index was related to special beds in 2012, at 0.74, and the lowest level of inequality belonged to health workers in 2019 and 2022, as well as physicians in 2022, at 0.50. Additionally, the trend has been decreasing (Table 2 and Appendix 6).

Results indicated that the highest Quartile Ratio was for general beds in 2012, where the most advantaged quartile benefited roughly 9 times more than the poorest one. Conversely, the lowest Quartile Ratio was for health workers in 2022, at 1.60 times (Table 2 and Appendix 7).

4.2. Findings Related to the Distribution of Health Resources at the Proposed Resource Allocation Model

(PRAM)

The calculation of the Gini Coefficient with regard to PRAM shows that the maximum and minimum amounts were for special beds in 2012 and 2015, at 0.31, and for physicians in 2012 and 2022, at 0.22, respectively (Table 3 and Appendix 8).

Additionally, the calculation of the CI reveals that the value of this index for the studied resources did not change significantly from 2012 to 2022, fluctuating between 0.21 and 0.23 (Table 3 and Appendix 9).

The calculation of the HI index showed that physicians and health workers had the most equitable distribution, with the index ranging from 0.00 to 0.03. In contrast, the worst distribution was for special beds, ranging from 0.06 to 0.10 (Table 3 and Appendix 10).

The study of the Robin Hood Index also indicates that the trend of the studied resources using this index has been decreasing. Similar to the aforementioned indicators, physicians and special beds had the best and the worst distributions, respectively (Table 3 and Appendix 11).

The examination of the distribution of resources using the Theil and Atkinson indices also confirms the findings of the previous indices, with the distribution of physicians and special beds having the lowest and highest values, respectively (Table 3 and Appendix 13, 14).

Moreover, the trend of inequality has been downward. The results of the proposed model also indicate significant reductions in inequality among the districts.

5. Discussion

In this comprehensive study, we investigated seven important practical indicators related to the distribution of resources for four main healthcare services, considering two different approaches over four periods. The results from all investigated indicators show that although the studied indicators have shown different sensitivities to the status of resource distribution at the population level of the province, the inequality in distributed resources varied depending on the type of resource, with the trend mostly decreasing. Specifically, the distribution of special beds, a critical and costly hospital care resource, experienced the greatest inequality compared to other resources reviewed.

The examination of the results from the proposed resource distribution model also shows that adopting a health-specific stratification system for resource distribution could greatly enhance the operational feasibility of achieving equity and equality, especially considering budget constraints.

The calculation of the HI index further highlighted disparities in access levels among individuals with similar needs across the province, although this trend has been decreasing.

The results also identified that the highest level of equality was associated with health workers. This fairness is likely due to the allocation and recruitment of health workers being in line with the population's needs.

Moreover, the Quartile Ratio Index results indicate this index's high sensitivity to distributed resources, as in some instances, the ratio of the most advantaged quartile to the least advantaged quartile is nearly tenfold.

While many studies have investigated the distribution of health resources in Iran, most have employed only a few indicators to demonstrate the level of inequality or inequity (2, 3, 20, 21, 25, 27, 29).

In a study by Goudarzi et al., it was shown that the distribution of general practitioners in Iran, as measured by the Gini and Atkinson indices, exhibited a degree of inequality (32). However, the level of inequality calculated for the entire country was lower than that found in the present study. This discrepancy might be due to the implementation of stricter equity-oriented policies at the national level compared to those at the provincial level.

Tofighi et al. concluded that the distribution of special beds in the country, as indicated by the Gini Coefficient, was marked by inequality (33). Interestingly, the level of inequality they found was lower than the one in the present study, suggesting that resource allocation among the counties of the province has been inefficient.

Lotfi et al., who investigated the distribution of hospital resources in Iran using the Gini Coefficient, found that hospital beds were more equitably distributed compared to the findings of the present study (34). One possible explanation for this variance is that, although the distribution of beds in the country has been generally based on the population index, this

standard has not been strictly adhered to at the provincial level.

The analysis of the HI index in this study indicates that if health resources had been distributed based on the need index throughout the province, access to health resources would have been more equitable. Furthermore, the trend of this index suggests an improvement in resource distribution in the province, indicating that health policymakers have increasingly focused on an equity-based approach in the distribution of health resources over the studied years.

In their study titled " HI in Access to Outpatient Services among Shiraz City Residents," Kavosi et al. found that the HI index was -0.076, showing no significant inequality in the actual amount of outpatient utilization (3). Another study in China by Li et al. revealed the presence of pro-rich inequity in healthcare utilization for both the likelihood and frequency among the middle-aged and elderly (35).

Raznahan et al., in their study on the equity of cataract surgery utilization in Iran, found that despite considering equal needs based on the severity of cataracts, the use of cataract surgery was unequal among economic quintiles (36).

This study's examination of the Robin Hood Index also showed that health resource distribution was marked by inequality. To achieve complete equality, a significant portion of resources would need to be redistributed, supporting our findings. The Robin Hood Index's use to investigate health resource distribution has been explored in other studies as well (25, 28, 29, 34).

Consistent with other studied indicators, the Theil Index results indicated an unequal distribution of resources with a downward trend. The findings also suggest that by altering the geographical pattern of resource distribution, resources would be distributed more equally and equitably.

Wiseman et al., in their study "Measuring inequalities in the distribution of the Fiji health workforce using Theil and Gini," concluded that inequalities at the provincial level were higher than those at the division level, which aligns with our findings (16). The Theil Index has also been used to investigate inequality in other studies (23, 29, 30).

Similar to other indicators, the calculation of the Atkinson Index revealed a degree of inequality in resource distribution, with a decreasing trend.

Goudarzi et al.'s findings in Iran, using the Atkinson Index, showed that health resources were distributed unequally, and this inequality worsened when adjusted for the need index (32). The index calculated in our study is significantly lower than that found in Goudarzi et al.'s study, possibly due to differences in study approaches. Our study's index was calculated at the provincial level, whereas Goudarzi et al.'s study had an inter-provincial approach. Other studies have also confirmed inequality in health resource distribution using the Atkinson Index (23).

The Atkinson Index results in our study, like those in Goudarzi et al.'s research in Iran, highlight unequal health resource distribution, which worsens when adjusted for the need index (32). The discrepancy in inequality levels between the national and provincial levels could be due to the implementation of more stringent equity-oriented policies at the national level.

The index calculated in this study is highly less than the amount obtained in the present study, one of the reasons attributed to this difference could be related to the approach of the study, as the index investigated in the present study was calculated at the provincial level, but the approach of mentioned study has been inter-provincial.

Inequality in the distribution of health resources using the Atkinson Index has been confirmed in other studies (23).

The calculated inequality in the distribution of health resources has been also reflected in the calculation of quantiles. Similar to the trend of other indices calculated in this study, the calculation of the Quartile Ratio also shows a decreasing trend. Nevertheless, the Quartile Ratio for special beds was much higher compared to that of other studied resources.

The possible reason for the high disparity between the first and fourth quartile is that, unlike other health resources, providing special beds in all geographical areas, considering the budgetary constraints and the complex nature of the related services to them, is difficult.

The calculation of the Quartile Ratio further demonstrates a decreasing trend in inequality, yet highlights significant disparities, particularly for special beds. This could be attributed to the complexity and cost of providing special beds across all geographical

areas under budget constraints. This is supported by Ahmad Kiadaliri et al.'s 2011 study, which also found unequal distribution of health resources in favor of privileged groups (31).

Further studies have explored health resource distribution using quantiles, concluding that resource allocation has favored privileged groups (37, 38). Overall, the various indicators highlight an unfair and unequal distribution of resources across the province's counties. However, it's noteworthy that there's a decreasing trend, suggesting that equity and equality-focused policies have been a priority for health policymakers in the province. A significant strength of this study is its comprehensive approach to addressing provincial inequality using multiple indices, marking it as a pioneering effort in this area.

However, the study has limitations, including its reliance on data from a single province, which cautions against broad generalizations to other provinces. Additionally, due to the unavailability of accurate population data post-2015, the population figures used in this study were estimated, potentially impacting the results to some extent.

5. Conclusions

In conclusion, the findings reveal that all examined resources demonstrated some level of inequality, as confirmed by all applied indices. However, inequality does not precisely mirror the degree of inequity in resource allocation. Therefore, it's crucial to focus on need-based indices for health resource distribution. Furthermore, given financial constraints, there's a need to rethink the health resource distribution system beyond the traditional geographical division of a province. Such an approach could significantly enhance justice and equality, leading to notable reductions in healthcare costs. A notable limitation of this study was the use of crude mortality rates as a measure of need.

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Supplementary Material

Supplementary material(s) is available here [To read supplementary materials, please refer to the journal website and open PDF/HTML].

Footnotes

Authors' Contribution: M.R.: Conceptualization, methodology, data curation, software, supervision, validation, writing – review, and editing; M.A.: Conceptualization, methodology, data curation, software, supervision, validation, writing of the original draft; F.L.: Conceptualization, methodology, software, supervision, validation, roles/writing of the original draft; H.O.: Conceptualization, data curation, methodology, software, project administration, investigation, supervision, validation, Writing, review, and editing.

Conflict of Interests: The authors declared no conflicts of interest.

Data Availability: The datasets generated and analyzed during the current study are not publicly available because they contain information that could compromise the privacy of research participants, but are available from the corresponding author upon reasonable request.

Ethical Approval: This study was conducted in accordance with the International Declaration of Helsinki. The present study was approved by the Research Ethics Committee of Bushehr University of Medical Sciences under the code of IR.BPUMS.REC.1399.145 .

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References

1. Matsaganis MD, Wilkin HA. Communicative social capital and collective efficacy as determinants of access to health-enhancing resources in residential communities. *J Health Commun*. 2015;**20**(4):377-86. [PubMed ID: 25529115]. https://doi.org/10.1080/10810730.2014.927037.
2. Etemad K, Yavari P, Mehrabi Y, Haghdoost A, Motlagh ME, Kabir MJ, et al. Inequality in Utilization of In-patients Health Services in Iran. *Int J Prev Med*. 2015;**6**:45. [PubMed ID: 26124942]. [PubMed Central ID: PMC4462769]. https://doi.org/10.4103/2008-7802.158169.

3. Kavosi Z, Mohammadbeigi A, Ramezani-Doroh V, Hatam N, Jafari A, Firoozjahantighi A. Horizontal inequity in access to outpatient services among Shiraz City residents, Iran. *J Res Health Sci*. 2015;**15**(1):37-41. [PubMed ID: 25821024].
4. Melhado EM. Health planning in the United States and the decline of public-interest policymaking. *Milbank Q*. 2006;**84**(2):359-440. [PubMed ID: 16771822]. [PubMed Central ID: PMC2690168]. https://doi.org/10.1111/j.1468-0009.2006.00451.x.
5. Rój J. Inequality in the Distribution of Healthcare Human Resources in Poland. *Sustainability*. 2020;**12**(5). https://doi.org/10.3390/su12052043.
6. Zhang T, Xu Y, Ren J, Sun L, Liu C. Inequality in the distribution of health resources and health services in China: hospitals versus primary care institutions. *Int J Equity Health*. 2017;**16**(1):42. [PubMed ID: 28253876]. [PubMed Central ID: PMC5335774]. https://doi.org/10.1186/s12939-017-0543-9.
7. Condorelli D. Market and non-market mechanisms for the optimal allocation of scarce resources. *Games Econ Behav*. 2013;**82**:582-91. https://doi.org/10.1016/j.geb.2013.08.008.
8. Minow M. Equality Vs. Equity. *Am J L Equal*. 2021;**1**:167-93. https://doi.org/10.1162/ajle_a_00019.
9. Lopes LMN, Acurcio FA, Diniz SD, Coelho TL, Andrade EIG. (Un)Equitable distribution of health resources and the judicialization of healthcare: 10 years of experience in Brazil. *Int J Equity Health*. 2019;**18**(1):10. [PubMed ID: 31154997]. [PubMed Central ID: PMC6545719]. https://doi.org/10.1186/s12939-019-0914-5.
10. Arcaya MC, Arcaya AL, Subramanian SV. Inequalities in health: definitions, concepts, and theories. *Glob Health Action*. 2015;**8**:27106. [PubMed ID: 26112142]. [PubMed Central ID: PMC4481045]. https://doi.org/10.3402/gha.v8.27106.
11. Chu CL, Chu YH, Lin CY, Hsieh YP, Ho CS, Su YY, et al. Inequality in outpatient resource utilization among older adults during the 2007-2008 financial crisis: findings from Taiwan. *BMC Health Serv Res*. 2019;**19**(1):621. [PubMed ID: 31477104]. [PubMed Central ID: PMC6721238]. https://doi.org/10.1186/s12913-019-4466-6.
12. Zhu L, Peng M, Jiang L, Wang Z. Inequality of opportunity in health service utilization among middle-aged and elderly community-dwelling adults in China. *Arch Public Health*. 2023;**81**(1):13. [PubMed ID: 36698213]. [PubMed Central ID: PMC9878938]. https://doi.org/10.1186/s13690-022-01010-1.
13. He D, Yu H, Chen Y. Equity in the distribution of CT and MRI in China: a panel analysis. *Int J Equity Health*. 2013;**12**:39. [PubMed ID: 23742755]. [PubMed Central ID: PMC3682935]. https://doi.org/10.1186/1475-9276-12-39.
14. Pu L. Fairness of the Distribution of Public Medical and Health Resources. *Front Public Health*. 2021;**9**:768728. [PubMed ID: 34858935]. [PubMed Central ID: PMC8631734]. https://doi.org/10.3389/fpubh.2021.768728.
15. Erdenee O, Paramita SA, Yamazaki C, Koyama H. Distribution of health care resources in Mongolia using the Gini coefficient. *Hum Resour Health*. 2017;**15**(1):56. [PubMed ID: 28851438]. [PubMed Central ID: PMC5576166]. https://doi.org/10.1186/s12960-017-0232-1.
16. Wiseman V, Lagarde M, Batura N, Lin S, Irava W, Roberts G. Measuring inequalities in the distribution of the Fiji Health Workforce. *Int J Equity Health*. 2017;**16**(1):115. [PubMed ID: 28666460]. [PubMed Central ID: PMC5493125]. https://doi.org/10.1186/s12939-017-0575-1.
17. Wilkinson D, Symon B. Inequitable distribution of general practitioners in Australia: estimating need through the Robin Hood Index. *Aust N Z J Public Health*. 2000;**24**(1):71-5. [PubMed ID: 10777982]. https://doi.org/10.1111/j.1467-842x.2000.tb00726.x.
18. Munga MA, Maestad O. Measuring inequalities in the distribution of health workers: the case of Tanzania. *Hum Resour Health*. 2009;**7**:4. [PubMed ID: 19159443]. [PubMed Central ID: PMC2655278]. https://doi.org/10.1186/1478-4491-7-4.
19. Chavehpour Y, Rashidian A, Woldemichael A, Takian A. Inequality in geographical distribution of hospitals and hospital beds in densely populated metropolitan cities of Iran. *BMC Health Serv Res*. 2019;**19**(1):614. [PubMed ID: 31470849]. [PubMed Central ID: PMC6717334]. https://doi.org/10.1186/s12913-019-4443-0.
20. Meskarpour-Amiri M, Dopeykar N, Ameryoun A, Mehrabi Tavana A. Assessment inequality in access to public cardiovascular health services in Iran. *Med J Islam Repub Iran*. 2016;**30**:420. [PubMed ID: 28210585]. [PubMed Central ID: PMC5307612].
21. Moalemi S, Meshkani Z, Moosavi Nejad SM, Valipour yekani N. Inequality in distribution of human resource in health sector: case study of dentists in Fars province. *Health_Based Res*. 2018;**4**(3):261-72. Persian.
22. Tao Y, Henry K, Zou Q, Zhong X. Methods for measuring horizontal equity in health resource allocation: a comparative study. *Health Econ Rev*. 2014;**4**(1):10. [PubMed ID: 26054400]. [PubMed Central ID: PMC4884040]. https://doi.org/10.1186/s13561-014-0010-x.
23. Toyabe S. Trend in geographic distribution of physicians in Japan. *Int J Equity Health*. 2009;**8**:5. [PubMed ID: 19257879]. [PubMed Central ID: PMC2662844]. https://doi.org/10.1186/1475-9276-8-5.
24. Auerbach AJ, Hassett KA. A New Measure of Horizontal Equity. *Am Econ Rev*. 2002;**92**(4):1116-25. https://doi.org/10.1257/00028280260344650.
25. Honarmand R, Mozhdehifard M, Kavosi Z. Geographic distribution indices of general practitioners, midwives, pediatricians, and gynecologists in the public sector of Iran. *Electron Physician*. 2017;**9**(6):4584-9. [PubMed ID: 28848634]. [PubMed Central ID: PMC5557139]. https://doi.org/10.19082/4584.
26. Griffin S, Love-Koh J, Pennington B, Owen L. Evaluation of Intervention Impact on Health Inequality for Resource Allocation. *Med Decis Making*. 2019;**39**(3):171-82. [PubMed ID: 30819034]. https://doi.org/10.1177/0272989X19829726.
27. Hosseinpoor AR, Bergen N, Barros AJ, Wong KL, Boerma T, Victora CG. Monitoring subnational regional inequalities in health: measurement approaches and challenges. *Int J Equity Health*. 2016;**15**:18. [PubMed ID: 26822991]. [PubMed Central ID: PMC4730638]. https://doi.org/10.1186/s12939-016-0307-y.
28. Habib O, Farhad L, Hossein S, Sanaz Zargar Balaye J, Javad M, Milad S. Equity in Distribution of Health Care Resources; Assessment of Need and Access, Using Three Practical Indicators. *Iran J Public Health*. 1970;**42**(11).
29. Shahraki M, Ghaderi S. Inequality in distribution of physician and general practitioner in Sistan and Baluchestan province, Iran (2009-2017). *Health Monit J Iran Inst Health Sci Res*. 2020;**19**(2):177-86. https://doi.org/10.29252/payesh.19.2.177.
30. Fu Y, Wang J, Sun J, Zhang S, Huang D. Equity in the Allocation of General Practitioner Resources in Mainland China from 2012 to 2019. *Healthcare (Basel)*. 2023;**11**(3). [PubMed ID: 36766973]. [PubMed Central ID: PMC9913937]. https://doi.org/10.3390/healthcare11030398.
31. Ahmad Kiadaliri A, Najafi B, Haghparast-Bidgoli H. Geographic distribution of need and access to health care in rural population: an ecological study in Iran. *Int J Equity Health*. 2011;**10**:39. [PubMed ID:

21939511]. [PubMed Central ID: PMC3196912]. https://doi.org/10.1186/1475-9276-10-39.

32. Goudarzi R, Meshkani Z, Barooni M, Jahanmehr N, Moalemi S. [Distribution of General Practitioners in the Health System of Iran Using Equity Indices (Gini, Atkinson)]. *Health Dev J*. 2015;**4**(3):247-58. Persian.
33. Tofighi S, Meskarpour Amiri M, Ameriuon A, naseri H. Equity in distribution of intensive care beds in Iran with Gini coefficient and Lorenz curve approach. *Scientific Magazine Yafte*. 2011;**12**(2):0. Persian.
34. Lotfi F, Bayati M, Yusefi AR, Ghaderi S, Barati O. Inequality in Distribution of Health Care Resources in Iran: Human Resources, Health Centers and Hospital Beds. *Shiraz E-Med J*. 2018;**19**(6). https://doi.org/10.5812/semj.63700.
35. Li C, Dou L, Wang H, Jing S, Yin A. Horizontal Inequity in Health Care Utilization among the Middle-Aged and Elderly in China. *Int J Environ Res Public Health*. 2017;**14**(8). [PubMed ID: 28933772]. [PubMed Central ID: PMC5580546]. https://doi.org/10.3390/ijerph14080842.
36. Raznahan M, Emamian MH, Alipour F, Hashemi H, Zeraati H, Fotouhi A. Horizontal inequity in the utilization of cataract surgery in Iran: Shahroud Eye Cohort Study, 2009-2014. *Med J Islam Repub Iran*. 2019;**33**:116. [PubMed ID: 31934575]. [PubMed Central ID: PMC6946921]. https://doi.org/10.34171/mjiri.33.116.
37. Zere E, Suehiro Y, Arifeen A, Moonesinghe L, Chanda SK, Kirigia JM. Equity in reproductive and maternal health services in Bangladesh. *Int J Equity Health*. 2013;**12**:90. [PubMed ID: 24228997]. [PubMed Central ID: PMC3842788]. https://doi.org/10.1186/1475-9276-12-90.
38. Theodorakis PN, Mantzavinis GD, Rrumbullaku L, Lionis C, Trell E. Measuring health inequalities in Albania: a focus on the distribution of general practitioners. *Hum Resour Health*. 2006;**4**:5. [PubMed ID: 16504028]. [PubMed Central ID: PMC1395320]. https://doi.org/10.1186/1478-4491-4-5.