INTER-REGIONAL DISPARITIES IN HEALTH INFRASTRUCTURE IN MAHARASHTRA

Dr. Dipak C. Chaudhari
Abhinav College of Arts, Commerce and Science, Bhayander (E)
Email: drdchaudhari@gmail.com

Abstract:

Covid19 pandemic has highlighted the need and importance of healthcare infrastructure. Pandemic shows how healthcare directly influenced on the growth of the nation. Good healthcare infrastructure not only help to achieve the higher GDP growth but also improve the human capital of the nation. Policymakers have not prioritized the equitable distribution of health facilities, which in turn has led to regional disparities in development. This paper examines regional imbalances in health infrastructure based on selected variables such as hospitals, primary health centres (PHCs), sub-centres, and dispensaries. To identify regional imbalances in health infrastructure, the author has used deprivation and development indices for each region.

Keywords: Deprivation Index, Development index, regional disparity

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Introduction:

Health infrastructure plays crucial role in the socio-economic progress of the nation. Access to health is very important for the well being and high productivity of the population. Maharashtra is one the most advanced states in India. Due to the imbalance and unequal distribution of the physical and social infrastructure the complex scenario of the exist with highly developed urban and underdeveloped rural region.

Maharashtra has six administrative divisions Kokan, Nashik, Pune, Aurangabad, Amravati, and Nagpur. Despite significant efforts to boost GDP growth, Maharashtra lags in the equitable distribution of hospitals, primary health centres (PHCs), subcentres, and dispensaries across its regions. Regions like Pune and Nashik have better health infrastructure facilities whereas the Kokan and Amaravati regions shows poor progress in terms of health infrastructure. This disparity not only hindered the access to health services but also exclude the socio-economic progress of the region. This paper tries to examine the inter-regional disparity in health infrastructure across the six administrative regions in Maharashtra. By identifying the disparity, the level of development level is highlighted in terms of health infrastructure.

Review of Literature:

Panmei (2013) investigated the spatial disparities in medical facilities across Manipur, concluding that regions with higher socioeconomic status, better transportation infrastructure,

and greater accessibility generally enjoy more advanced healthcare services. In contrast, many of the hill districts remain underdeveloped in terms of these amenities. Notable differences exist in the quality and organization of healthcare services between the hill and valley regions. Although there has been a substantial expansion of healthcare infrastructure, its distribution remains uneven, with several health centers either non-operational or inadequately dispersed.

Narayan [5] developed a composite health index for Haryana's districts using principal component analysis (PCA) to evaluate regional health conditions. This index incorporated three main elements: health outcomes, healthcare infrastructure, and access to/utilization of health services. The findings revealed marked disparities in health indices across districts. Both public and private sectors contribute to healthcare delivery, with the private sector seeing significant growth. The study also compared infant and child mortality rates across districts to assess health outcomes.

Hooda et al. (2017) [6] explored developmental disparities among Haryana's districts over three time periods—1991-92, 2001-02, and 2011-12—using composite indices constructed from forty indicators covering agriculture, industry, infrastructure, and socio-economic development. The research found Mahendragarh to be consistently lagging in nearly every domain, while Karnal maintained a strong performance in agriculture across the decades. Conversely, Faridabad and Gurgaon showed weaker progress.

Nandal and Monika (2019) [7] examined Haryana's social infrastructure and regional disparities for the years 2000-01 and 2017-18. The study assessed differences between more and less developed regions, employing statistical measures such as mean and coefficient of variation. A composite index was used to evaluate overall development, and PCA was applied to determine weights for selected indicators. The findings emphasized significant inter-district disparities in development levels.

Kumar and Singh (2020) [8] aimed to analyze variations in health infrastructure across Punjab's districts. Using principal component analysis, they constructed a district-level health infrastructure index for the years 1994, 2008, and 2018. The study identified districts such as Amritsar, Firozpur, Hoshiarpur, Jalandhar, Kapurthala, Ludhiana, Moga, Patiala, and Tarn Taran as having declining infrastructure. In contrast, Barnala, Faridkot, Mansa, and Shri Muktsar Sahib were noted for improvements. Sahibzada Ajit Singh Nagar and SBS Nagar remained relatively stable, while Bathinda, Gurdaspur, Rupnagar, and Sangrur showed fluctuating trends.

Research Methodology:

The present study is based on the secondary data from "Infrastructure Statistics of Maharashtra State 2021-22 and 2022-23" published by the Directorate of Economics and Statistics, Government of Maharashtra. To study the objectives of the present study author has selected four indicators of health infrastructure region-wise from the report for the year 2022-23. Those indicators are hospitals, PCHs, subcentres, and dispensaries. To examine the objectives of the study, different statistical techniques have been applied.

Objective 1: To study inter-region disparities in accessibility in health infrastructure.

Mean, standard deviation, and coefficient of variation are used to examine the disparity in health infrastructure for different regions.

$$A = \frac{1}{n}\sum_{i=1}^{n} ai$$

A- Arithmetic mean
n- number of values
ai-data set values

Arithmetic mean : It is equal to sum of all the values in group divided by total number of values.

Standard deviation : average degree of variability in dataset is represented by the standard deviation. It represents the average deviation of each value from the mean.

Coefficient of variation : Coefficient of variation means square root of standard deviation.

Objective 2: To study inter-region disparity of deprivation and development in health infrastructure.

To study deprivation and development level of health infrastructure in the different regions in Maharashtra. The deprivation and development in health infrastructure is determined with the help of following indices given below.

Step 1: The deprivation indices for each region based on the variables (Hospitals, PHCs, Sub Centres, and Dispensaries) have been calculated using the formula:

$$Dij = \frac{Maxi - Xij}{Maxi - Mini}$$

Where,

D*ij*- Deprivation index *i*th variable for *jth* region

Maximum and Minimum represents the highest and lowest values of the variables.

Xij represent the actual value of *ith* variable.

Step 2: Average deprivation index for the variables (Hospitals, PHCs, Sub Centres, and Dispensaries) have been calculated using formula

$$dj = \sum dij/n$$

Where,

d*j*- Average development index

∑- summation

d*ij*- deprivation index of all variables

n- number of variables

Step 3: Development index has been calculated using

Development index= 1- Deprivation index

Objective 3: To examine development level of the different region in terms of health infrastructure based on selected indicators.

Borda ranking method is used to identify the development level of each region. Where regions with more than 0.600 development index are consider as high developed regions. Those regions development index falls between 0.400-0.600 are considered as moderate developed regions and regions less than 0.400 development index are poor developed regions in terms of health infrastructure.

Data Analysis:

Different indicators have been used to understand the inter region disparity in health infrastructure of Maharashtra. The 1 table presents a comparative analysis of health infrastructure across six regions Kokan, Nashik, Pune, Aurangabad, Amravati, and Nagpur. The number of hospitals varies significantly across the regions. Aurangabad has the highest number of hospitals (106), closely followed by Nashik (103), while Kokan reports the lowest (63). The mean number of hospitals across regions is 84.67, with a standard deviation (SD) of 19.42, indicating a moderate level of variation. The coefficient of variation (CV) is 22.93%, reflecting a moderate disparity in hospital distribution across the regions.

Table 1: Health infrastructure in Maharashtra Region wise

Regions	Hospitals	PHCs	Subcentres	Dispensaries
Kokan	63	238	1419	58
Nashik	103	390	2125	79
Pune	97	405	2151	109
Aurangabad	106	371	1991	110
Amravati	67	234	1399	239
Nagpur	72	270	1663	219
Mean	84.67	318	1791.33	135.67
Sd	19.42	79.15	343.39	75.15
CV %	22.93	24.89	19.17	55.39

Source: *Infrastructure statistics of Maharashtra State 2022-23, Author's Calculation*

PHCs form the backbone of rural healthcare services. The data shows that Pune (405) and Nashik (390) have the highest number of PHCs, while Amravati (234) and Kokan (238) report the lowest. The average number of PHCs across the six regions is 318, with an SD of 79.15, and a CV of 24.89%. This suggests a relatively high variation in PHC distribution, which could indicate regional imbalances in rural primary healthcare delivery.

Subcentres are the most peripheral and first contact point between the primary healthcare system and the community. The highest number of subcentres is found in Pune (2151) and Nashik (2125), whereas Kokan (1419) and Amravati (1399) have the least. The relatively lower CV (19.17%) here suggests somewhat lesser disparity in subcentre distribution compared to hospitals and PHCs, though the absolute difference between regions remains considerable. The number of dispensaries shows the highest level of variation among all indicators. Amravati (239) and Nagpur (219) have substantially more dispensaries compared to Kokan (58) and Nashik (79). This high coefficient of variation (55.39%) reflects significant inequality in the distribution of dispensaries across the regions, indicating a major area of concern in health infrastructure planning.

The above table clearly indicates substantial regional disparities in the availability of health infrastructure. While some regions such as Pune and Nashik are better equipped in terms of PHCs and subcentres, others like Kokan and Amravati lag in multiple categories. The disparity is most prominent in the distribution of dispensaries, as indicated by the highest CV value, followed by PHCs and hospitals.

Deprivation Index:

To analyse the regional disparities in healthcare infrastructure, a Deprivation Index (DI) is calculated for each region across four key components: hospitals, Primary Health Centres (PHCs), subcentres, and dispensaries. The Deprivation Index, range from 0 to 1, is a relative measure where a higher value indicates better availability of health infrastructure and a lower value reflects higher Deprivation compared to the region with the best performance in that category. An average DI was also computed for each region to provide a composite view of overall disparity across all health facility types.

Table 2: Deprivation index of Health Infrastructure of Maharashtra 2022-23

Regions	Hospitals ' DI	PHCs DI	Subcentres DI	Dispensaries DI	Average DI
Kokan	1.00	0.98	0.97	1.00	0.99
Nashik	0.07	0.09	0.03	0.88	0.27
Pune	0.21	0.00	0.00	0.72	0.23
Aurangabad	0.00	0.20	0.21	0.71	0.28
Amravati	0.91	1.00	1.00	0.00	0.73
Nagpur	0.79	0.79	0.65	0.11	0.58

Source: *Author's calculation based on table 1*

Among the six regions studied, Kokan exhibits the highest average DI (0.99), suggesting the most favourable distribution of health infrastructure. This region scores a perfect DI of 1.00 in hospitals and dispensaries, and maintains high indices in PHCs (0.98) and subcentres (0.97), indicating strong and balanced healthcare infrastructure across all categories. Amravati also demonstrates relatively high infrastructure availability, with an average DI of 0.73. It achieves maximum DI values of 1.00 in both PHCs and subcentres, and a high value of 0.91 in hospitals; however, it shows a complete absence of dispensary infrastructure as

reflected by a DI of 0.00, highlighting a significant service gap in that category.

Nagpur presents a moderate performance with an average DI of 0.58. While it shows decent infrastructure in hospitals (0.79) and PHCs (0.79), it falls behind in dispensary services, registering a low DI of 0.11. Aurangabad and Pune both report relatively lower average DIs of 0.28 and 0.23, respectively. Aurangabad demonstrates moderate indices across categories, with a peak of 0.71 in dispensaries but a low DI of 0.00 in hospitals. Pune, on the other hand, shows strong infrastructure in PHCs and subcentres (both at DI = 0.00, implying best-in-class access), but considerable disparity in hospitals (0.21) and dispensaries (0.72), indicating imbalanced development.

Nashik emerges as the region with the highest overall disparity, recording the lowest average DI of 0.27. It particularly underperforms in PHCs (0.09) and subcentres (0.03), which are critical for primary and rural healthcare delivery. Despite showing somewhat better performance in hospitals (0.07) and dispensaries (0.88), the poor infrastructure in foundational health services makes Nashik one of the most underserved regions in this analysis.

Development Index :

The table 3 presents the Average Deprivation Index and corresponding Development Index for six regions in Maharashtra: Kokan, Nashik, Pune, Aurangabad, Amravati, and Nagpur. The Deprivation Index reflects the extent deprivation in health infrastructure in each region. Higher values indicating greater levels of deprivation. Conversely, the Development Index is a complementary measure representing development level of the region in terms of health infrastructure.

Table 3: Development Index of Health Infrastructure of Maharashtra 2022-23

Regions	Average DI	Development Index
Kokan	0.99	0.01
Nashik	0.27	0.73
Pune	0.23	0.77
Aurangabad	0.28	0.72
Amravati	0.73	0.27
Nagpur	0.58	0.42

Source: *Author's calculation based on table 1*

Among the regions, Kokan exhibits the highest deprivation (0.99), corresponding to the lowest development level (0.01), demonstrate the highest need for infrastructure development due to highest Average DI. On the other end Pune and Nashik show the lowest deprivation levels (0.23 and 0.27, respectively) and the highest development indices (0.77 and 0.73), suggesting relatively better level of health infrastructure. Aurangabad presents a similar profile to Nashik, while Amravati and Nagpur reflect moderate to high deprivation (0.73 and 0.58), with lower development indices (0.27 and 0.42), highlighting regional disparities in development in health infrastructure within the state.

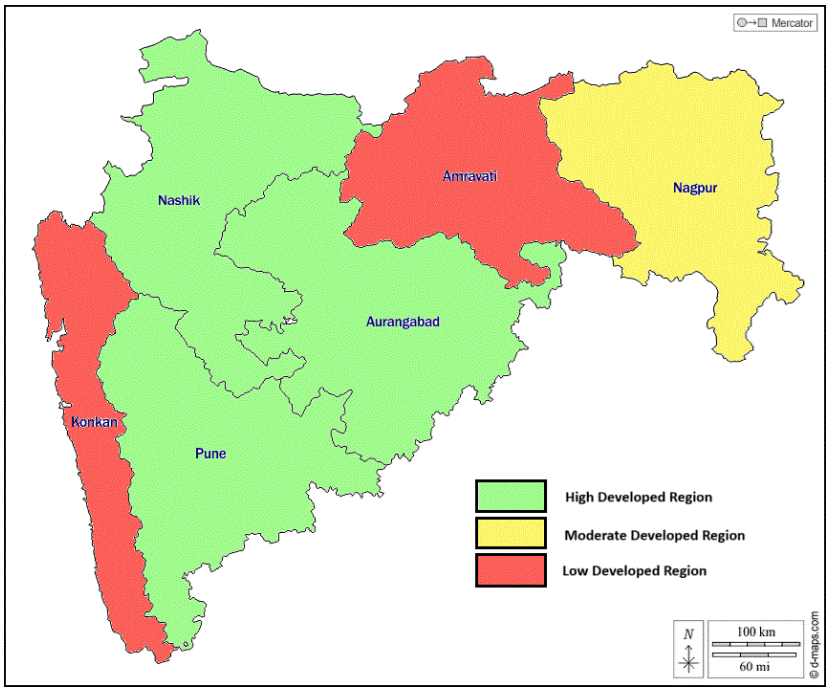
The regional development analysis of Maharashtra, based on the Average Deprivation Index and its complementary Development Index, highlights stark socio-economic disparities across different regions. The regions are classified into three development categories: high, moderate, and low, offering insight into the different levels of progress and deprivation. The regions at high development level Nashik, Pune, and Aurangabad are characterized by a deprivation index of less than 0.400 and a development index exceeding 0.600. These regions benefit from advanced infrastructure of healthcare.

In contrast, Nagpur falls under the moderate development category, with a deprivation index between 0.400 and 0.600, and a development index between 0.400 and 0.600. This intermediate positioning reflects uneven development. The table suggest that there is need of targeted policies to improve health infrastructure in the region to bring it in to high development level bracket.

Table 4: Development level of the Regions based on the health infrastructure

Development level	Regions	Average Deprivation index	Average Development index
High	Nashik,Pune, Aurangabad	Less than 0.400	More than 0.600
Moderate	Nagpur	Between 0.400 - 0.600	Between 0.400 - 0.600
Poor	Kokan, Amravati	More than 0.600	Less than 0.400

Source: *Author's calculation based on table 1*



The most concern is about the low development regions Kokan and Amravati. These region's deprivation index above 0.600 and a development index below 0.400. Kokan, with an extremely high deprivation score of 0.99, represents the most backword region in terms of health infrastructure in the state. Similarly, Amravati exhibits significant deprivation. These

regions require urgent policy attention, with focused efforts on improving infrastructure.

Table 5 presents the comparative assessment of health infrastructure across six regions using the Borda Count ranking method for the four key indicators: the number of hospitals, Primary Health Centres (PHCs), subcentres, and dispensaries. Each region was assigned a rank from 1 (lowest) to 6 (highest) per indicator based on its value, and the total Borda score was calculated by summing the individual indicator scores. A higher total score reflects better overall health infrastructure availability.

Table 5: Borda Ranking of the regions in terms of health infrastructure

Region	Hospitals	PHCs	Subcentres	Dispensaries	Total Score	Final Rank
Kokan	1	2	2	1	6	6th
Nashik	4	4	5	2	15	4th
Pune	3	5	6	4	18	1st
Aurangabad	6	3	4	5	18	1st
Amravati	2	1	1	6	10	5th
Nagpur	5	6	3	3	17	3rd

Source: *Author's calculation based on table 1*

Pune and Aurangabad are at the top position, each with a total Borda score of 18, indicating strong and well-balanced health infrastructure. Pune demonstrated exceptional strength in subcentres and PHCs, while Aurangabad ranked highest in the number of hospitals and performed consistently across all categories. Nagpur and Nashik follow with scores of 17 and 15 respectively, both occupying the 3rd and 4th rank due to their balanced performance in most indicators. Nagpur ranked highest in PHCs and performed well in other domains, while Nashik showed strong subcentre coverage. However, their slightly lower scores in hospitals and dispensaries relative to the top-ranked regions limited their overall standing.

Amravati, despite ranking 1st in dispensaries, scored only 10 points, placing it at 5th position. This suggests a skewed infrastructure profile, where dispensaries are relatively abundant but other key components such as PHCs, hospitals, and subcentres are significantly lacking. Finally, Kokan ranks the lowest with a total Borda score of 6, reflecting widespread infrastructural deficits across all health indicators

Conclusion:

The study provides comprehensive analysis of regional disparities in health infrastructure across the six regions in Maharashtra. To measure the regional disparity deprivation index and development index is use. The finding reveals the significant imbalances in critical health infrastructure including hospitals, dispensaries, primary health centres, subcentres. Region like Kokan and Amravati are relatively poor in terms of health infrastructure. Nashik, Pune, Aurangabad demonstrate comparatively better in health infrastructure. These disparities are further emphasized by the development index, which highlight where targeted intervention is needed. The inverse relationship between average

deprivation index and development index underscores the critical insight in to disparities in health infrastructure. Addressing these disparities is essential for promoting equitable access to healthcare. Policy makers must adopt region specific strategies, prioritized resource allocation based on need and strengthen the primary and preventive healthcare networks to bridge the gap.

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