



An inter-district analysis of health infrastructure disparities in the Union Territory of Jammu and Kashmir

Navneet Kaur · Shazada Ahmad · Adnan Shakeel

Accepted: 19 March 2023 / Published online: 9 April 2023
© The Author(s), under exclusive licence to Springer Nature B.V. 2023

Abstract Achieving socioeconomic growth can be done by enhancing national health. The availability and provision of health infrastructure in an administrative territory affect the health of ordinary people. People’s access to healthcare is inversely correlated with the availability of a region’s health infrastructure. This study investigates inter-district health infrastructure disparities in the newly created Union Territory (UT) of Jammu and Kashmir. Using principal component analysis, this study developed a district-level health infrastructure index (HII) for 2018–2019. The study demonstrates the existence of inter-district disparities in the Union Territory’s health infrastructure. Regarding health infrastructure, Doda has the highest HII and has been designated a ‘developed’ district. Doda is followed by Jammu, Kishtwar, Udhampur, Ramban, Samba, Reasi and Kulgam, which also fall into the ‘developed’ districts category. Backward districts include Kathua, Rajouri, Poonch, Budgam, Shopian, Kupwara, Ganderbal, Baramulla, Bandipora, and Anantnag. Srinagar district, with the lowest HII, was identified as the most backward

district in the Jammu and Kashmir UT. All of the districts of the Kashmir division, apart from Kulgam, are classified as being ‘backward’ or ‘very backward’. Therefore, it is evident that the Jammu division of UT has a better health infrastructure than the Kashmir division.

Keywords Jammu and Kashmir · Principal component analysis · Inter-district discrepancies · Health Infrastructure Index

Introduction

The country’s economic development is a multidimensional development process in terms of quality of life, healthcare standards, and exemplary educational facilities (De, 2017; Jedrzejczak-Gas et al., 2021; Guo et al., 2022). The development of basic amenities like education and health infrastructure reflects the quality of life of the country’s population. A critical outcome of a country’s economic success is the growth of its health infrastructure. Health is not merely the absence of diseases but the sovereign state of entire mental, physical, and social well-being (Blanchet et al., 2021; Rao, 2004). Every citizen has a right to have good mental and physical health, which is also a paramount asset of any country’s economic development (Rao, 2004; Subhalakshmi, 2022). United Nations’ Sustainable Development Goal (SDG) 3 aims to “ensure healthy lives and promotion of

N. Kaur · S. Ahmad (✉) · A. Shakeel
Department of Geography, Faculty of Natural Sciences,
Jamia Millia Islamia, Delhi, India
e-mail: shazadahmad92@gmail.com

N. Kaur
e-mail: navneetkaur1993@gmail.com

A. Shakeel
e-mail: adnanansari23@gmail.com

wellbeing for all at all ages” (2015). The sound health of the poor is the rudimentary and principal goal of economic development (Weil, 2014; Bloom et al., 2008; Vulovic et al., 2022). Therefore, health infrastructure quality and quantity are essential elements of overall human development. By creating adequate health infrastructure, social objectives like economic growth and poverty alleviation can be achieved (Pradhan et al., 2011; Nail, 2014). Governments attempt to strengthen healthcare facilities to provide citizens with the foremost preventive and curative healthcare facilities (Koka and Mir, 2018).

The World Health Organization, 1946, affirmed that “the highest attainable standard of health is a fundamental right of every human being” (Nicholson et al., 2016). Understanding health as a fundamental human right formulates a legal obligation on the respective governments to provide their citizens with accessible, available, and affordable quality healthcare (Armenta et al., 2018). The Study by Youkta et al. (2022) reveals that out-of-pocket expenditure by households in India accounts for 60.6% of total health expenditures and 2.3% of the country’s GDP, indicating poor misallocation of funds.

The accessibility quality of physical healthcare infrastructure directly impacts an individual’s health (Lakshmi et al., 2013; Armenta et al., 2018; Shaw et al., 2020). Health infrastructure defines physical healthcare infrastructure, which includes primary health centres (PHCs), health and wellbeing centre-sub centres (HWC-SCs), health and wellbeing centre-Primary Health Centres (HWC-PHCs), community health centres (CHCs) district hospitals, hospital beds, human resources such as doctors, midwives, and nurses. Workability and distribution of healthcare facilities positively escalate the healthcare status of people.

Significant health infrastructure is a vital sign of human development. This also implies that the quality of institutions boosted human growth in several developed countries (Ullah et al., 2023). One of the biggest obstacles to obtaining and using primary healthcare services in underdeveloped countries has deteriorated health infrastructure (Banu et al., 2022). A sound healthcare system is an excellent sign of human well-being (Dutta et al., 2021). Efficient healthcare facilities eliminate illnesses, limit mobility, and decrease mortality rates. Low budgets, insufficient medical research, incompetent policy-making

and implementation, lack of resources, and other factors contribute to disparities in physical infrastructure (Lahmar et al., 2021). Previous researches suggest that sub-national healthcare disparities exist and country’s current processes are unable to adequately serve the entire nation (Srivastava et al., 2021; Banerjee, 2021; Jeffery, 2022). In light of these facts, this study investigates the health infrastructure disparities among UT Jammu and Kashmir districts.

The objective of the study

The study’s primary objective is to examine UT Jammu and Kashmir’s inter district health infrastructure disparities.

Literature review

Analysis of healthcare services, infrastructure, and outcomes is essential for academicians and policy-makers. The following is a review, examination, and scrutiny of the literature that is currently available on the health infrastructure.

Gumber (2021) compares healthcare utilization and morbidity in India with a particular focus on Gujarat and Maharashtra and stresses the importance of preparing a composite Social Vulnerability Index. Healthcare-seeking behaviour is majorly impacted by supply factors such as the expansion and availability of public and private healthcare infrastructure. The role of rural–urban disparities on utilization factors is also analyzed. According to the Study, the government health infrastructure in Bihar, Andhra Pradesh, and Uttar Pradesh still needed to be improved in 2014 compared to that in Himachal Pradesh, Kerala, and West Bengal. The research also emphasizes how Gujarat and Maharashtra’s public and private health infrastructure is well below the national average.

In his Study, Rout (2007) examined the district-level inequality of healthcare infrastructure in the districts of Orissa and created a composite indicator of healthcare infrastructure. He found that one-fourth of the state has inadequate health infrastructure, and roughly half has developed health infrastructure.

Kumar and Singh (2010) have investigated the health infrastructure and its utilization in Punjab. The study tracks down inequalities in Punjab’s rural

and urban health facilities. Government programmes have been credited with improving healthcare in rural areas. In their paper, Kumar and Singh (2010) examined inter-district HII through PCA. According to their research, more than half of the districts in the state are in deteriorating condition. Principal Component Analysis (PCA) was used by Kumari and Raman (2011) to create composite health and education indices for Uttar Pradesh. According to her report, inter-district disparities concerning health and education are prominently visible. Additionally, the report found that districts with high health infrastructure perform poorly in educational achievement and vice versa.

In order to assess health disparities in Uttar Pradesh in the areas of access to care, amenities for care and affordability, Kumari and Raman (2022) created 12 representative indices using PCA. Their research proves that all three areas of development and the overall health index are better in western districts.

In their Study, Saikia et al. (2011) used the Mazziotta-Pareto Index to identify inter-district disparities in the accessibility of healthcare facilities. The report emphasized the indispensable role of government in promoting equal distribution and allocation of health services in all the districts. Lakshmi et al. (2013) used PCA to make the Health Infrastructure Index (HII). They concluded that health infrastructure has a positive effect on the health outputs of a state (Fig. 1).

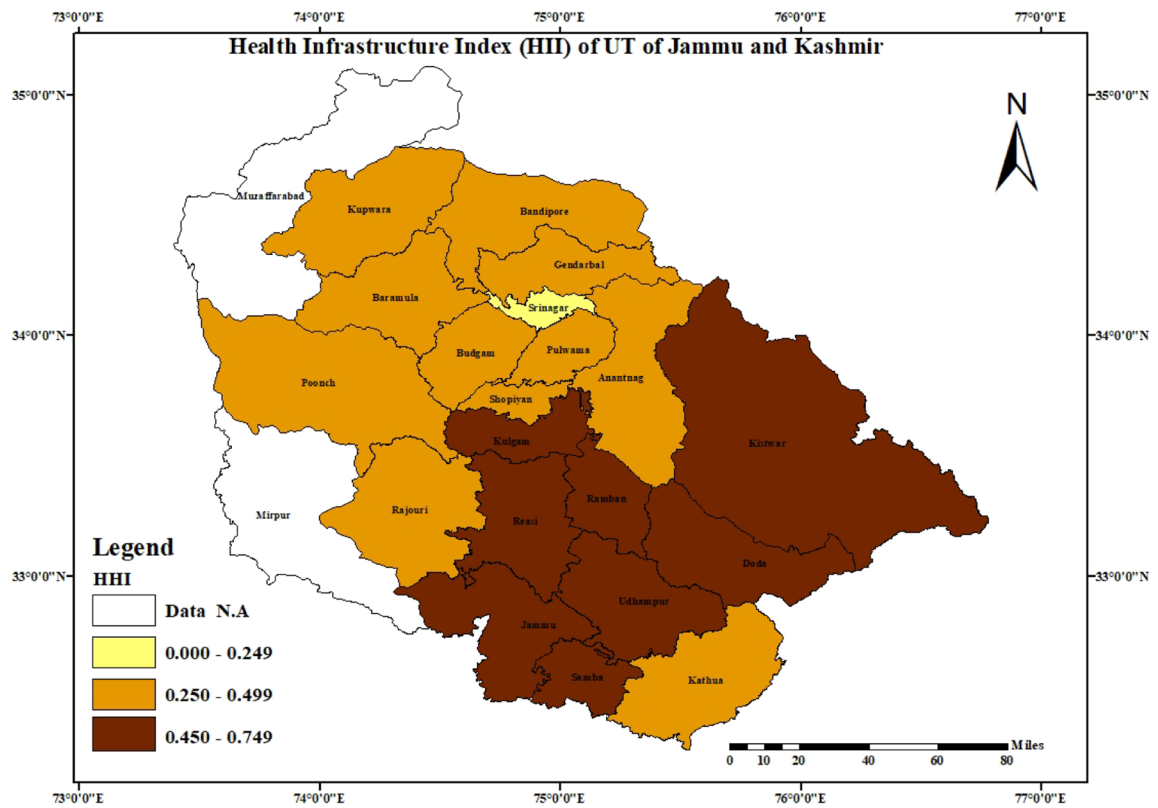
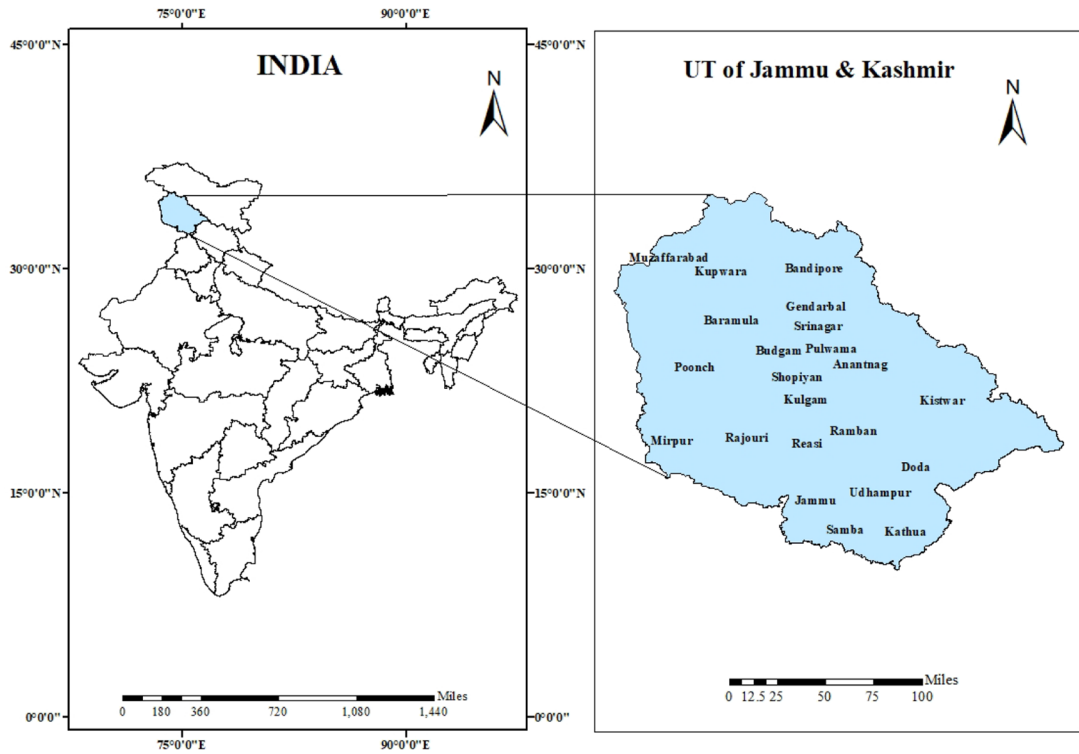
According to Gupta's (2012) analysis of Uttar Pradesh's health infrastructure disparities, the state's eastern region lags behind the western region regarding health indicators, even though the latter has better socioeconomic development. Anand (2014) examined comparative health disparities in Uttar Pradesh and Bihar. He concluded that Bihar had lower disparities in health status and Uttar Pradesh had comparatively substantial disparities in health infrastructure. Regional disparities in Birbhum District (West Bengal) were reported at the block level by Sheet and Roy (2013), who also emphasized the importance of adequate planning to balance the development of the healthcare infrastructure. Jacob (2014) revisited the argument of diminishing inequality in health infrastructure, which is assigned to Kerala's social democratic regime. Although health infrastructure has improved in recent decades, disparities have not been reduced to the extent the literature suggests.

According to Sayanti (2014), there is a considerable gap in women's health status at the level of sub-district blocks in West Bengal's Hugli district, which is primarily based on health infrastructure disparities.

According to Chatterjee et al. (2022), there exist accessibility gaps, health risk exposure gaps, and places that are under stress due to these gaps in the Durgapur district of West Bengal. Although urban areas are closer to the sources of pollution, some rural areas are under greater stress due to their distant location. The difficulties of accessing healthcare in rural areas are greater as the rural community faces a high level of poverty and increased health hazards.

Using PCA, Lyngdoh (2015) computed the HII of the northeastern states, accounting for both physical and human resources. According to his research, Assam and Meghalaya performed the worst between 2001 and 2011, whereas Arunachal Pradesh showed the most improvement in health infrastructure development. The study emphasized that numerous issues with the public healthcare system in northeastern states need to be fixed. By utilizing a state-level annual time series between 1983–84 and 2005–2006, Chaudhary (2016) explained how healthcare utilization increased up until the 1990s but stagnated in the mid-1990s. His study recommends that rural healthcare needs be strengthened by upgrading rural health infrastructure and increasing health awareness, eventually reducing health-related risks. According to Garg et al. (2015), biased and imbalanced development has been observed in health infrastructure. Most of the districts need a better level of development in terms of the HII.

Goel et al. (2018) constructed an HII of the health system in Haryana from 1991–1992 to 2011–2012. Their study demonstrates that there are disparities in the availability of healthcare infrastructure. The need for government interventions to enhance the healthcare system has been overstretched. According to Koka and Mir. (2018) analysis of the Kashmir Valley's health infrastructure, most of its districts are underdeveloped. This study emphasized revamping government policies to strengthen the valley's health infrastructure further. The Health Infrastructure Index (HHI) of the whole Union Territory has not been studied. By creating a district-level composite HII, this study analyses inter-district health infrastructure disparities in the Union Territory of Jammu and Kashmir to close the gap in the literature.



◀ **Fig. 1** Health Infrastructure Index (HII) of UT of Jammu and Kashmir

The study area's description

UT of Jammu and Kashmir is one of the most important states/UTs in the Himalayan region, characterized by a diverse demographic and vibrant economic, environmental, social, and political systems. The Indian Himalayan Region comprises 13 states/UTs, and the UT of Jammu and Kashmir is one of this region's most prominent part. There are several valleys in Jammu and Kashmir, including the Kashmir Valley, Tawi Valley, Chenab Valley, Poonch Valley, Sind Valley, and Lidder Valley. The Himalayas separate the Kashmir valley from the Tibetan plateau, while the Pir Panjal range separates it from the Punjab Plain of the Indo-Gangetic Plain. The southern Jammu region is predominantly mountainous, with the Shivaliks, middle Himalayas, and the great Himalayas running parallel to each other in a southeast-to-northwest orientation. The Chenab, Tawi, and Ravi rivers pass through Jammu.

The Jammu And Kashmir Reorganisation Act, 2019 provided for the 'reorganization' of the existing state of Jammu and Kashmir into the Union Territory (UT) of Jammu and Kashmir and the Union Territory (UT) of Ladakh. The Union Territory of Jammu and Kashmir is in the northern Himalayan region of India. It has a total population of 1226,701 and a geographic area of 222,236 square kilometers. The UT of Jammu and Kashmir consists of twenty districts. It has two administrative divisions; the Jammu division and the Kashmir division. Jammu, Kathua, Samba, Ramban, Rajouri, Poonch, Reasi, Kishtwar, Udhampur, and district Doda are the ten districts of the Jammu Division. Ten districts of the Kashmir division are Shopian, Anantnag, Pulwama, Bandipore, Baramulla, Srinagar, Budgam, Kulgam, Kupwara, and Ganderbal. The UT of Ladakh is in the north of the UT of Jammu and Kashmir (J&K), Punjab is in the southwest, and Himachal Pradesh is situated in the southeast direction.

The Union Territory of Jammu and Kashmir has a diverse population, which includes many marginalized and vulnerable groups. Almost 73 percent of the total population of UT lives in villages, which creates a huge gap in rural–urban healthcare (Lone, 2014). To adequately cover the rural population's healthcare

needs, it is essential to strengthen the primary level healthcare infrastructure. According to the 2011 Census of India, there are approximately 3.36 lakh Scheduled caste (SC) and 10.08 lakh Scheduled Tribes (STs) in Jammu and Kashmir, representing 7.38% and 11.9% of the Union Territory's population, respectively. The majority tribal population lives in the far-flung geographical areas of the UT, and a significant chunk practices transhumance culture. To fulfil the demands of these poor and marginalized people, having a comprehensive physical health infrastructure is paramount.

Nevertheless, healthcare facilities in these places are frequently insufficient and inaccessible, exacerbating the health inequities these populations suffer. The rough topography poses challenges to the establishment of a physical health infrastructure. Establishing the health infrastructure will strengthen the medical infrastructure throughout the Union Territory to safeguard people's lives and provide the optimum medical care facilities possible. Thus, there is an urgent need to develop the Himalayan states' healthcare infrastructure to guarantee that marginalized and vulnerable groups have access to adequate healthcare services. Table 1 presents the demographic, socioeconomic, and healthcare outlines of Jammu and Kashmir compared to the national level.

In the UT of Jammu and Kashmir, the public healthcare infrastructure functions at distinguishing three levels (i) at the primary level consisting of SCs, PHCs, CHCs, HWC-PHCs and CWC-SCs for preventive, promotive, curative, rehabilitative and palliative care such as maternal healthcare, neonatal and infant care, family welfare, chronic communicable diseases, non-communicable diseases; (ii) at secondary, district and tehsil level hospitals for supplying remedial and for the preventative care of the diseases to patients; (iii) at the territory level comes the district-level public hospitals which provide specialized healthcare facilities for inpatient and outpatient care.

The database and approach

The present study aspires to investigate district-level inequalities in the health infrastructure of the Union Territory of Jammu and Kashmir by constructing a district-level composite HII. Various indicators have been used to develop the HII, which was

Table 1 Demographic, socio-economic and health profile of Union Territory of Jammu and Kashmir in comparison to aggregate at national level

S.no.	Indicator	UT of Jammu and Kashmir	All India	Source
1	Total population in (million)	12.26	1210.85	Chandramouli, (2011)
2	Density of population	290	382	Chandramouli, (2011)
3	Sex ratio	889	940	Chandramouli, (2011)
4	Population growth	23.64%	17.64	Chandramouli, (2011)
5	Literacy	67.17%	74.04	Chandramouli, (2011)
6	Crude birth rate	14.9	19.7	SRS Statistical Report (2019)
7	Crude death rate	4.6	6.0	SRS Statistical Report (2019)
8	Total fertility	1.4	2.0	NFHS-5, 2019–2020
9	Infant mortality rate	9.8	35.2	NFHS-5, 2019–2020
10	Multidimensional poor Population in percentage	12.8	25.01	National Multidimensional Poverty Index, NITI Ayog (2021)
11	Male literacy	75%	82.14	Chandramouli, (2011)
12	Female literacy	56.43	65.46	Chandramouli, (2011)
13	Schedule caste population	924,485	201,378, 372	Chandramouli, (2011)
14	Schedule tribe population	1,275,106	10, 42, 81,034	Chandramouli, (2011)

selected based on an understanding from reviewing the available literature (Kumar and Singh, 2020; Kumari and Raman, 2022). Secondary data has been utilized, which was collected from different government sources like the Rural Health Statistics, Ministry of Health and Family Welfare, Statistics Division (2018–2019). The indicators (altered) utilized to establish HII are as shown below:

1. Number of district hospitals per 10,000 population; designated as A_1
2. Number of sub district hospitals per 10,000 population; designated as A_2
3. Number of primary health centres per 10,000 population; designated as A_3
4. Number of community health centres per 10,000 population; designated as A_4
5. Number of health and wellbeing centres-sub centres per 10,000 population; designated as A_5
6. Number of health and wellbeing primary health centres per 10,000 population; designated as A_6

Here, the indicators A_1 , A_2 , A_3 , A_4 , A_5 and A_6 represent physical infrastructure in the UT of Jammu and Kashmir health sector. Sub-centres (SCs), and Primary Health Centres (PSCs) serve rural areas. SCs are peripheral contact points

between the community and the healthcare system. PHCs are connecting bridges between the medical officer and the village community. CHCs are nodal points for PHCs. Health and Wellbeing Sub-Centres (WHC-SCs) and Wellbeing Centres- PHCs have been established to strengthen healthcare at the primary level on the recommendation of the National Health Policy, 2017.

Multiple health infrastructure aspects have been incorporated to calculate district-level composite HII. Calculating the HII, the study sought to scrutinize interdistrict health infrastructure disparities in Jammu and Kashmir. The index indicators have been selected based on acquired understanding from examining the literature. The Government of Jammu and Kashmir's Statistical Abstract of Jammu and Kashmir 2018–2019 was the main source of secondary data for the current study. Before employing statistical tools to gather an accurate result, the data has been normalized. The subsequent process has been used (OECD, 2008; Goel & Garg, 2018).

$$NVid = 1 - \frac{MaxAi - O Aid}{MaxAi - MinAid}$$

$MaxAi$ is the maximum value of the indicator, $O Aid$ is the observed value of the indicator for the district, and $MinAi$ is the minimum value of the indicator.

NVi_d is the normalized value of the indicator for a given district. (Hair et al., 2006).

Weights for the selected variables are obtained using the PCA of factor analysis. PCA ascertains the association between the large variables by representing them in the sense of their common underlying dimensions or factors. Principal components or factors ($P_i, i = 1$ to n), which are orthogonal to each other, are linear combinations of variables ($P_i, i = 1$ to m) which can be presented as:

$$P_1 = a_{11}A_1 + a_{12}A_2 + a_{13}A_3 + \dots + a_{1m}A_m$$

$$P_2 = a_{21}A_1 + a_{22}A_2 + a_{23}A_3 + \dots + a_{2m}A_m$$

$$P_n = a_{n1}A_1 + a_{n2}A_2 + a_{n3}A_3 + \dots + a_{nm}A_m$$

or

$$P_i = \sum_{j=1}^m a_{ij}A_j$$

where a_{ij} is a factor loading, it shows the correlation between the factor and the initial variable (whose principal components are constructed so that they are uncorrelated). According to Malhotra and Dash (2018), the first principal component has the most variation of data, the next-highest variance is attributed to the second component, and so on. Factor loadings describe how variables connect to the underlying elementary factors, and large factor loadings indicate a close relationship between the two. The significant factor loadings with values greater than or equal to 1.0 are kept in the calculation. The eigenvalue criterion, or latent root, has been used to extract components. The variance percentage explained by a factor is shown by its eigenvalue. Factors with a higher eigenvalue than 1 are significant and utilized in the analysis.

Following the computation of the Rotated Component and Total Initial Eigenvalues, each indicator weight was determined utilizing the formula below:

$$Wi = \sum (|Pin| \times GVn)$$

Wi is the weight of the i th indicator, Pin is the n th component of the i th indicator, and GVn represents the complete initial eigenvalue for that component, which is constant. Weights are determined for each

indicator using the formula above. The HII of every district in Jammu and Kashmir is calculated by applying the following equation, which considers normalized values and weights.

$$HIII_d = \frac{\sum [NVi \times Wi]}{\sum_{i=1}^6 Wi}$$

By assigning rankings to the districts, it has been determined where each district stands in relation to the Health Infrastructure Index based on the HII index. The district with the highest index has been given rank 1st, while the district with the next-highest index has been given rank 2. Compared to the districts that received rankings of 1st and 2nd, the district that received rank 3rd is predicted to have lower health infrastructure facilities.

Results and discussion

The UT of Jammu and Kashmir is performing relatively well in providing health and medical amenities to its citizens, yet the level still needs to be improved (Nanda, 2022) yet the government health institutions at the primary, secondary, and tertiary levels miss the mark recommended by World Health Organization standards (Hamid et al., 2018; Bhat & Wani, 2019; Nomani et al., 2020). This study considers all 20 districts of the UT of Jammu and Kashmir. The study does a pragmatic examination concerning district-level disparities in the health infrastructure of the UT of Jammu and Kashmir, also witnessed during the COVID-19 pandemic (Bhasin, 2022; Wani et al., 2022).

A composite HII has been created to investigate health infrastructure disparities at the district level. Given the diversity of indicators that make up health infrastructure, the HII for the years 2018–2019 was developed using weights established by the PCA approach to factor analysis.

Table 2 displays the outcome of factor analysis for a subset of indicators from 2018 to 2019. In the twenty districts of the UT of Jammu and Kashmir, three factors have been taken from six health infrastructures, as shown in Table 2. The first factor explains 40.12 percent of the inequality in the health infrastructure of all inter-districts in Jammu and Kashmir. The most significant indicator loaded on

Table 2 Result of Factor Analysis for the years 2018–2019

Variables	Factor loadings			Weights
	Component 1	Component 2	Component 3	
A ₁	0.839	−0.079	0.135	2.275
A ₂	0.578	0.612	0.281	2.535
A ₃	0.807	0.272	0.076	2.397
A ₄	−0.035	0.939	−0.063	1.437
A ₅	0.154	−0.006	0.920	1.382
A ₆	−0.720	0.086	0.578	2.481
	Total weight			12.506

Bold value indicates the highest factor loading of a variable on components

Source: Authors' calculation using SPSS version 23

the first factor is the number of district hospitals per 10,000 population with a factor loading of 0.839, followed by the number of Primary Health Centres per 10,000 Population (0.807), number of HWC-Primary Health Centres per 10,000 Population (0.720) and number of Sub District Hospitals per 10,000 Population (0.578). The 2nd factor accounts for 22.79 percent of total inter-district disparities. It contains indicators such as Community Health Centre per 10,000 population, Sub District Hospitals per 10,000 population, and HWC-Primary Health Centres per 10,000 population, with factor loading values of 0.939, 0.612, and 0.086, respectively. 18.16 the third factor explains percent of all inter-district variances in health infrastructure. The number of Health and Wellbeing Centres-Sub Centres per 10,000 population, with a factor loading of 0.920, is the most significant factor loaded on the third component, followed by the number of HWC-Primary Health Centres per 10,000 population (0.578), and the number of Sub District Hospitals per 10,000 population (0.281).

Table 3 demonstrates that district Doda of the Jammu Division topped the ranking with an index value of 0.717, demonstrating that Doda is the most developed in UT in terms of health infrastructure. The fact that district Doda has the second-largest number of sub-centres and health and wellbeing sub-centres is crucial, resulting in its receiving the highest HII score. Doda comes in first in the ranking, followed by Jammu, Kishtwar, Udhampur, and Ramban in that order (ranking second, third, fourth, and

Table 3 Health Infrastructure Index.

S. no.	District	HII	Rank
1	Srinagar	0.063	20
2	Anantnag	0.271	19
3	Baramulla	0.339	17
4	Kupwara	0.398	15
5	Budgam	0.432	12
6	Pulwama	0.424	13
7	kulgam	0.526	8
8	Bandipore	0.311	18
9	Ganderbal	0.387	16
10	Shopian	0.422	14
11	Jammu	.698	2
12	Rajouri	0.484	10
13	Kathua	0.486	9
14	Udhampur	0.653	4
15	Poonch	0.445	11
16	Doda	0.717	1
17	Samba	0.573	6
18	Reasi	0.547	7
19	Ramban	0.607	5
20	Kishtwar	0.691	3

Vertical column (iii), 1st rank represents a relatively better position of a district, while 20th rank represents the worst position of a district in terms of health infrastructure in the UT

Source: Author's calculation using SPSS version 23

fifth, respectively). According to the survey, Srinagar, Anantnag, Bandipore, Baramulla, and Ganderbal are in 20th, 19th, 18th, 17th, and 16th place, respectively. With a health infrastructure value of 0.063, Srinagar ranks last out of the twenty UT districts.

It should be noted that the best hospitals, including the Govt. Medical College Srinagar and five affiliated hospitals, the SKIMS medical college in Soura Srinagar, and the SKIMS medical college in Bemina Srinagar, all located in the Srinagar district, are not included in the study. This can be one of the reasons Srinagar is ranked last out of all the districts.

All UT districts are divided into three groups based on the HII's performance in 2018–2019: 'backward', 'developed', and 'highly developed'. Table 4 shows how the districts were grouped based on their HII results. A district is considered "developed" if its index value is between 0.500 and 0.749, "backward" if it has a value between 0.250 and 0.499, and "very backward" if it has a value between 0.000 and 0.249.

Table 4 Categorization of the Districts of the UT of Jammu and Kashmir According to Performance in Health Infrastructure Index

District category	Range	Number of district	Name of district
Developed	0.500–0.749	8	Doda, Kulgam, Reasi, Samba, Ramban, Udhampur, Kishtwar, Jammu
Backward	0.250–0.499	11	Anantnag, Bandipore, Baramulla, Ganderbal, Kupwara, Shopian, Pulwama, Budgam, Poonch, Rajouri, Kathua
Highly backward	0.000–0.249	1	Srinagar

Source: Author's calculation based on available data for the study period

According to Table 4, the Jammu division's district Doda has a developed Health Infrastructure Index Score of 0.717. After District Doda, the following six districts are Jammu, Kishtwar, Udhampur, Ramban, Samba, Reasi, and Kulgam. Every district in the “developed” category, except for Kulgam, is in the Jammu division of the UT. Eight districts from the Kashmir Division—Anantnag, Bandipore, Baramulla, Ganderbal, Kupwara, Shopian, Pulwama, and Budgam—and three districts from the Jammu Division—Poonch, Rajouri, and Kathua—are included in the backward category. Except for a few low-lying areas, the districts of Rajouri and Poonch have a steep, rough landscape. These are the most remote districts of Jammu and Kashmir; they are conflict-prone regions with significant military presence; and over the past several decades, due to porous borders, they have suffered the most from militancy and ceasefire violations (Mahajan, 2021; Verma et al., 2019).

Srinagar, which has the lowest HII score, is a very underdeveloped district in terms of primary healthcare infrastructure. This demonstrates that the UT of Jammu and Kashmir's health infrastructure has significant discrepancies. Significant infrastructural discrepancies exist in the Jammu and Kashmir region's health system. Policies must be created to ensure the fair and balanced expansion of the health infrastructure in UT. Government authorities should pay close attention to UT's health infrastructure for better healthcare.

According to the 2011 Census, the population of the Kashmir Division is 22.91 percent greater than that of the Jammu Division. The population density in the Kashmir division is more than twice as high (431.93 people per square km) as in the Jammu division (200 people per square km). It explains why the Kashmir division's healthcare infrastructure needs are greater than its neighbouring division's.

The National Health Mission's data illuminates the fact that the district-wise list of health institutions in Jammu and Kashmir clarifies the fact that the primary health infrastructure is more robust in the Jammu division than in the Kashmir division (National Health Mission, Government of J&K), which eventually leads to a lower number of health institutes in Kashmir division compared to Jammu division. Except for Kulgam (developed category), all districts in the Kashmir division are classified as backward and underdeveloped, as primary healthcare institutions are scarcer in Kashmir than in the Jammu division. Jammu's region is less mountainous and well connected with the rest of India compared to Kashmir, which is less developed and more mountainous.

Militancy in the Kashmir division has had an impact on the healthcare system in recent decades (Geelani, 2012). Because of its proximity to India's mainland, the Jammu division has seen medical advances. Geographically, Jammu Division's terrain is more suitable for physical infrastructure development and is well connected through road connectivity. Physical access is complex, and the terrain in Kashmir is more mountainous, which adversely impacts the physical healthcare infrastructure. Now, government initiatives are being taken to improve the healthcare system in Jammu and Kashmir.

Summary and conclusion

Based on a district-level composite Health Infrastructure Index, the study aims to assess disparities in the health infrastructure in the UT of Jammu and Kashmir at the district level. The analysis reveals that the healthcare infrastructure in Jammu and Kashmir's UT is distributed inequitably. In the UT of J&K, districts like Doda, Kulgam, Reasi, Samba, Ramban, Udhampur, Kishtwar, and Jammu are developed. In contrast,

other districts, including Anantnag, Bandipore, Baramulla, Ganderbal, Kupwara, Shopian, Pulwama, Budgam, Poonch, Rajouri, and Kathua, are backward in terms of health infrastructure development. Srinagar falls under the category of a highly backward district in terms of health infrastructure. The values of health infrastructure development indicate a high level of inequality in the two administrative divisions of Jammu and Kashmir.

This study further reveals disparities between the two administrative divisions, the Jammu Division and the Kashmir Division, in the UT. Except for Kulgam, all the districts of the Kashmir division fall under the backward and highly backward categories. All the districts of the Jammu division fall under the developed category other than Poonch, Rajouri, and Kathua. Poonch and Rajouri districts of the Jammu division come under the “backward” category. The geographically inaccessible location of the Rajouri and Poonch districts is the prime reason for poor health infrastructure development. Based on the above discussion, we conclude that these disparities themselves reveal the need for government intervention to upgrade the status of health infrastructure and to improve the status of healthcare for people in the different districts of the UT of J&K. There is more scope for the development of health infrastructure in the Kashmir division than in the Jammu division of the UT.

Finally, appropriate maintenance and operation of the health infrastructure are required in addition to its supply and provision to achieve a sustainable health status. Therefore, keeping up the accessibility of physical health infrastructure should be taken care of at all levels to advance and strengthen the health status of the people of Jammu and Kashmir.

Acknowledgements Ministry of Minority Affairs, Government of India is to be thanked for providing the lead author with the Maulana Azad National Fellowship (Senior Research Fellowship) throughout this research project.

Declarations

Ethical approval This manuscript is original, not an extension of prior work, and has not been published anywhere else in any form or language. It has not been submitted to more than one journal. Results are provided in a clear, genuine manner without exaggeration, falsification, or improper data modification. In this paper, editorial and academic ethics have been upheld. The authors did not use any of their previously published original works.

Human and animal rights This article does not contain any studies with human participants or animals performed by any authors.

References

- Anand, M. (2014). Health status and health care services in Uttar Pradesh and Bihar: A comparative study. *Indian Journal of Public Health*, 58(3), 174.
- Armenta, B., Rathi, N., Assasnik, N., & Kamimura, A. (2018). Structural quality of healthcare facilities in India. *International Journal of Health Care Quality Assurance*, 31(6), 483–488.
- Banerjee, S. (2021). Determinants of rural-urban differential in healthcare utilization among the elderly population in India. *BMC Public Health*, 21(1), 1–18.
- Banu, N., & Biswas, B. (2022). Role of international border on healthcare access in West Bengal, India: A geographical analysis. *GeoJournal*, 87(4), 2949–2974.
- Barman, B., & Roeoy, R. (2018). Regional disparities of health care infrastructure in Koch Bihar district, West Bengal. *Research Journal of Humanities and Social Sciences*, 9(4), 949–959.
- Bhasin, S. (2022). Improving healthcare system in India. DailyExcelior.com. <https://www.dailyexcelior.com/improving-healthcare-system-in-jk/>
- Bhat, A., & Wani, M. H. (2019). Assessing discrepancies in healthcare & health sector in Jammu and Kashmir. *Indian Journal of Economics and Development*, 7(3), 1–7.
- Blanchet, R., Batal, M., Johnson-Down, L., Johnson, S., Willows, N., Okanagan Nation Salmon Reintroduction Initiatives Colette Louie Eliza Terbasket Pauline Terbasket Howie Wright. (2021). An Indigenous food sovereignty initiative is positively associated with wellbeing and cultural connectedness in a survey of Syilx Okanagan adults in British Columbia, Canada. *BMC Public Health*, 21, 1–12.
- Bloom, D. E., & Canning, D. (2009). Population health and economic growth. *Health and growth*, 24.
- Chandramouli, C., & General, R. (2011). Census of India 2011. *Provisional Population Totals*. New Delhi: Government of India, 409–413.
- Chatterjee, S., & Sarkar, K. (2022). Appraisal of urban–rural disparities in access to health care facilities and exposure to health risk factors: A case study of Durgapur Industrial region, India. *GeoJournal*, 87(5), 4007–4024.
- Chaudhary, S. (2016). Health in Rural India: Towards a Comprehensive Health Index. *Journal of Rural Development*, 35(3), 377–395.
- De, K. (2017). Social infrastructure: Urban and rural health and education. *Journal of Infectious Diseases*, 1(1), 7–13.
- Dutta, B., Das, M., Roy, U., et al. (2022). Spatial analysis and modelling for primary healthcare site selection in Midnapore town. *West Bengal. GeoJournal*, 87(6), 4807–4836.
- Garg, I & Gupta, k. (2015). A Study of Inter-District Disparities in Health Infrastructure in Haryana, India.

- International Journal of Education and Management Studies*, 5(1), 23. 30, March.
- Geelani, S. Z. A. (2012). Effect of militancy on the educational standards in Jammu And Kashmir State. *The communications*, 21(2), 23
- Goel, M. M., & Garg, I. (2018). Construction of health infrastructure index in Haryana: An econometric approach. *Journal of Technology Management for Growing Economies*, 9(1), 103–123.
- Gumber, A. (2021). Equity in healthcare utilization and cost of treatment in Western India. *Journal of Social and Economic Development*, 23(Suppl 1), 131–152.
- Guo, Y., & Liu, Y. (2022). Sustainable poverty alleviation and green development in China's underdeveloped areas. *Journal of Geographical Sciences*, 32(1), 23–43.
- Gupta, A. (2012). Magnitude of urban health disparity in Uttar Pradesh. *Asia Pacific Journal of Social Sciences*, 4(2), 108–124.
- Gupta, K. (2015). A study of inter-district disparities in health infrastructure in Haryana, India. *International Journal of Education and Management Studies*, 5(1), 23.
- Hair, E., Halle, T., Terry-Humen, E., Lavelle, B., & Calkins, J. (2006). Children's school readiness in the ECLS-K: Predictions to academic, health, and social outcomes in first grade. *Early Childhood Research Quarterly*, 21(4), 431–454.
- International Institute for Population Sciences (IIPS) and Macro International National Family Health Survey (NFHS-5), 2019–20. Mumbai, India: IIPS, 2020.
- Jacob, S. (2014). The Kerala regime and regional disparities in health infrastructure versus outcomes. *India Review*, 13(1), 58–77.
- Jędrzejczak-Gas, J., Barska, A., & Wyrwa, J. (2021). Economic development of the European Union in the relation of sustainable development—Taxonomic analysis. *Energies*, 14(22), 7488.
- Jeffery, R. (2022). Health policy and federalism in India. *Territory, Politics, Governance*, 10(1), 67–85.
- Koka, A. A., & Mir, M. A. Inter district disparities in health infrastructure development in Kashmir: A principal component analysis.
- Kumar, R., & Kumar, S. (2020). Multidimensional Poverty Index. Yojana December 2020 (English): A development monthly, 28.
- Kumar, G., & Singh, J. (2020). Health infrastructure disparities in Punjab: An inter-district analysis. *Journal of Infrastructure Development*, 12(1), 25–38.
- Kumar, K., & Singh, S. (2010). Health infrastructure and utilization pattern in rural Punjab: Emerging public policy issues. *Journal of Economic and Social Development*, 6(2), 79–96.
- Kumari, R., & Raman, R. (2011). The inter-District disparity in health care facility and education: A case of Uttar Pradesh. *Journal of Education and Practice*, 2(1), 38–56.
- Kumari, R., & Raman, R. (2022). Regional disparities in healthcare services in Uttar Pradesh, India: A principal component analysis. *GeoJournal*, 87(6), 5027–5050.
- Lahmar, B., Dridi, H., & Akakba, A. (2021). Territorial health approach outputs of geo-governance of health facilities: Case study of Batna, Algeria. *GeoJournal*, 86(5), 2305–2319.
- Lakshmi, S. T., & Sahoo, D. (2013). Health infrastructure and health indicators: The case of Andhra Pradesh, India. *IOSR Journal of Humanities and Social Science*, 6(6), 22–29.
- Lone, R. A. (2014). Socioeconomic impact of national rural health mission in Jammu Kashmir.
- Lyngdoh, L. M. (2015). Inter-state variations in rural health-care infrastructure in North-East India. *The NEHU Journal*, 13(2), 31–48.
- Mahajan, C. (2021). Pastoral subjectivity: Sedentarisation and healthcare challenges of the Gujjars of Jammu and Kashmir. *Journal of the Indian Anthropological Society*, 56(2), 154–172.
- Malhotra, N., & Dash, S. (2018). Marketing research : An applied orientation, 7th edition (7th ed.). *Pearson Education*, New Delhi.
- Mir, A. H., & Bhat, S. A. (2018). Health status and access to health care services in Jammu and Kashmir state. *Asian Review of Social Sciences*, 7(3), 52–57.
- Naik, M. G. (2014). Development of social infrastructure in Karnataka A study of Gadag district.
- Nanda, A.M. (2022). Access to healthcare facilities and the hardship of tribes. Greater Kashmir. <https://www.greaterkashmir.com/todays-paper/op-ed/access-to-healthcare-facilities-and-the-hardships-of-tribals>
- Nicholson, T., Admay, C., Shakow, A., & Keshavjee, S. (2016). Double standards in global health: Medicine, human rights law and multidrug-resistant TB treatment policy. *Health and Human Rights*, 18(1), 85.
- Nomani, M. Z. M., Lone, A. A., Alhalboosi, A. K., Raj, A. A., & Allail, B. (2020). Therapeutic perception of access to medicines and health care in government hospital of union territory of Jammu and Kashmir. *Call for Editorial Board Members*, 13(1), 57.
- OECD Annual Report. (2008). OECD Annual Report 2008. OECD Annual Report, OECD iLibrary. https://www.oecd-ilibrary.org/economics/oecd-annual-report-2008_annrep-2008-en. (1887, January 1).
- Pradhan, R. P., Kumar, M., & Sanyal, G. S. (2011). Health infrastructure in India: The input and output association with economic growth. *Journal of Health Management*, 13(1), 59–75.
- Rao, K. N. (2004). Trends in health status in Andhra Pradesh: An empirical analysis. *Indian Economic Journal*, 51(1)—(Google Search, n.d.)
- Rout, H. S. (2007). Health infrastructure in Orissa: An inter-district analysis. *The Icfai Journal of Infrastructure*, 5(4), 58–71.
- Saikia, H., & Bhattacharjee, D. (2011). Quantifying basic health care facilities in Assam: Where do the districts stand. *Elixir Soc. Sci*, 36(304), 3476–3482.
- Sayanti, P. (2014). A Study of Spatial Variation of Women Health Status in Hugli District of West Bengal, India. *International Research Journal of Social Sciences*, 3(1), 20–26.
- Shaw, S., & Sahoo, H. (2020). Accessibility to primary health centre in a tribal district of Gujarat, India: Application of two step floating catchment area model. *GeoJournal*, 85(2), 505–514.
- Sheet, S., & Roy, T. A. (2013). Micro level analysis of disparities in health care infrastructure in Birbhum district,

- West Bengal, and India. *IOSR Journal of Humanities and Social Science*, 7(3), 25–31.
- Srivastava, S., Chauhan, S., & Patel, R. (2021). Socioeconomic inequalities in the prevalence of poor self-rated health among older adults in India from 2004 to 2014: A decomposition analysis. *Ageing International*, 46(2), 182–199.
- Subhalakshmi, G. (2022). Delay in disposing legal disputes: A study factoring mental health and way forward. In *Handbook of health and wellbeing: Challenges, strategies and future trends* (pp. 761–777). Springer Nature Singapore.
- Sustainable Development Goals (2015). Sustainable Development Goals. United Nations.
- Ullah, K., & Majeed, M. T. (2022). District-level multidimensional poverty and human development in the case of Pakistan: Does institutional quality matter? *GeoJournal*, 88(1), 561–581. <https://doi.org/10.3390/books978-3-03897-865-7-3>
- Verma, V. R., Gandhi, S., & Dash, U. (2019). Traversing the margins: Access to healthcare by Bakarwals in remote and conflict-prone Himalayan regions of Jammu and Kashmir. *Pastoralism*, 9(2), 1–16.
- Vulovic, V., & Chaloupka, F. J. (2022). Taxation of tobacco, alcohol and sugar-sweetened beverages for achieving the sustainable development goals. *Good Health and Wellbeing*, 55.
- Wani, M. A., Farooq, J., & Wani, D. M. (2022). Risk assessment of COVID-19 pandemic using deep learning model for J&K in India: a district level analysis. *Environmental Science and Pollution Research*. <https://doi.org/10.1007/s11356-021-17046-9>
- Weil, D. N. (2014). Health and economic growth. In *Handbook of economic growth* (Vol. 2, pp. 623–682). Elsevier.
- Youkta, K., & Paramanik, R. N. (2022). Convergence analysis of health expenditure in Indian states: Do political factors matter? *GeoJournal*, 87(3), 1469–1478.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.