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HEALTH STATUS OF THE RAJBANSHI PEOPLE: A COMPARATIVE ANALYSIS BETWEEN RURAL AND URBAN AREAS OF KOCH BIHAR DISTRICT.

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Abstract: Health is a crucial indicator of overall human development and social well-being. The Rajbanshi community, one of the major ethnic groups of North Bengal, has historically remained socio-economically marginalized, which significantly influences their health status. This study aims to examine and compare the health conditions of the Rajbanshi people living in rural and urban areas of the Koch Bihar district. The research analyses key health indicators, including nutritional status, prevalence of communicable and non-communicable diseases, maternal and child health, access to healthcare facilities, sanitation, and health awareness. Primary data have been collected through household surveys, interviews, and field observations, supplemented by secondary data from government health records and census reports. The findings reveal noticeable disparities between rural and urban Rajbanshi populations, with rural areas exhibiting higher incidences of malnutrition, inadequate healthcare access, poor sanitation, and lower health awareness. In contrast, urban Rajbanshi households show relatively better access to medical facilities, improved sanitation, and health-seeking behavior, although economic constraints continue to affect their health outcomes. The study highlights that socio-economic status, education, occupational patterns, and the availability of infrastructure play a decisive role in shaping health outcomes. The paper concludes by emphasizing the need for area-specific, community-oriented health interventions, improved public healthcare delivery, and expanded health awareness programs to reduce rural-urban health inequalities among the Rajbanshi people of Koch Bihar.

1. Introduction

Ensuring the long-term health and well-being of marginalised communities remains a critical challenge for public health systems worldwide. Health sustainability is defined as the capacity of communities to maintain access to healthcare, engage in preventive behaviours, and adapt to changing health-system environments over time (ORF, 2024). In low- and middle-income country settings, conventional metrics such as morbidity or mortality provide partial insights. A more comprehensive assessment demands composite frameworks that integrate condition, access and behaviour dimensions (Akhtar, 2023). In India, the rural health system faces persistent structural deficiencies. Approximately 75% of health infrastructure is concentrated in urban areas, although about 65–70% of the population lives in rural settings (Ballard Brief, 2024). This imbalance contributes to elevated levels of infant mortality, malnutrition and untreated chronic disease in rural

communities (Ballard Brief, 2024). The "State of Health in Rural India" survey further confirms that rural households rely heavily on out-of-pocket payments, have limited insurance coverage, and face substantial travel distances to healthcare facilities (TRI, 2024). Access to primary care remains a key barrier: lack of preventive services, late diagnosis, and poor continuity of care undermine long-term health resilience (Rural Health Info, 2025).

Against this backdrop, the cultural and spatial dynamics of specific ethnic minority groups demand deeper investigation. The Rajbanshi community in the Koch Bihar district of West Bengal is one such case. Historically known as the Rajbanshi, this group has deep roots in the region and retains rich traditions of medicinal practices, social networks, and village-based health behaviour (Basu, 2003). Ethnographic studies indicate that community healers and plant-based remedies remain embedded alongside formal healthcare systems among the Rajbanshi (Barman, 2022; Mitra & Mukherjee, 2015). In rural Indian health research, the intersection of indigenous healing systems and biomedical care is increasingly recognised as a form of "medical pluralism" whose implications for sustainability remain under-explored (Mondal, Ghosh & Biswas, 2024). Spatially, Cooch Behar district is characterised by plains, flood-prone areas, and variable health infrastructure coverage. Block-level variation in facility density, transport connectivity and service outreach creates differential access environments (Gupta, 2024). Rural health equity research emphasises that geographic distance and infrastructure deficits amplify disadvantage even when communities share similar cultural orientations (Mukherjee & Dular, 2022). For an ethnic community such as the Rajbanshi, therefore, block-wise and residence-wise (rural vs urban) variations are likely to contribute meaningfully to health-sustainability differentials.

To operationalise these insights, constructing a Health Sustainability Index (HSI) offers a methodologically robust approach. The HSI aggregates key indicators, including self-reported disease severity, preference for treatment mode, facility preference, use of traditional treatment, frequency of medical check-up, health-insurance coverage, and distance to hospital. Such multifunctional indices are increasingly applied to assess health-system resilience and population-level sustainability in low-resource settings (Erjaee, 2022; ORF, 2024). The HSI thereby enables comparative analysis across spatial units and residence categories, identifying both strengths and vulnerabilities in health-sustainability profiles. This article pursues two inter-linked objectives: (i) to analyse the block-wise and urban-rural distribution of the seven constituent indicators of the HSI among the Rajbanshi community of Cooch Behar district; and (ii) to compute the HSI for each block and residence category and examine its correlations with access, behavioural, and spatial variables. By doing so, the study aims to uncover key determinants of health sustainability in this marginalised population—highlighting how cultural practices, system access, and spatial infrastructure combine to produce or constrain sustainable health outcomes.

Understanding the sustainability of health in ethnic minority communities is particularly urgent, as these groups often face layered disadvantages—including socioeconomic marginalisation, geographic isolation, and cultural exclusion—which conventional health-utilisation studies may not fully capture (Haddad, 2011). The present study thus contributes to bridging that gap by focusing explicitly on the Rajbanshi community,

integrating traditional-healing practices, system-access metrics and spatial differentiation into a unified sustainability framework. In the Indian health-policy context, large-scale programmes such as the National Health Mission (NHM) and Ayushman Bharat aim to expand coverage and improve equity (Government of India, 2023). However, progress remains uneven at the sub-district (block) level, particularly for socially marginalised communities. Fine-grained tools such as the HSI can offer actionable insights for block-level targeting and resource allocation—moving beyond urban–rural binaries to highlight micro-spatial disparities (Prakash, Singh & Gupta, 2023). By applying the HSI to the Rajbanshi community, the study advances both empirical measurement and policy-relevant understanding of health sustainability in a culturally distinct, under-researched group.

2. Literature review

Assessing health sustainability requires integrating social, economic, infrastructural, and behavioural aspects of healthcare access and utilization. Recent studies show that multidimensional indicators, rather than single metrics, are essential for understanding how health systems function across different settings (Kundu & Basu, 2023; Savoldelli et al., 2022). Frameworks that combine environmental efficiency, service accessibility, and patient-centredness provide a more realistic measure of sustainability, especially in developing regions (Alhaij et al., 2023).

Globally, research has increasingly linked healthcare sustainability to infrastructure quality and system resilience. Alhaij et al. (2023) introduced a life-cycle-based sustainability index for healthcare buildings in Saudi Arabia, emphasizing patient-centred dimensions such as safety, comfort, and accessibility. This approach complements the methods of Erjaee (2022), who used a hybrid fuzzy multi-criteria decision-making (MCDM) model to evaluate healthcare sustainability, integrating social, technical, and environmental indicators. These works underscore that sustainable health systems are not only energy-efficient but also responsive to patient needs and equitable in service delivery.

In India, spatial and socioeconomic disparities remain central to understanding healthcare sustainability. Dang et al. (2025) highlighted the uneven accessibility of primary healthcare facilities across rural districts, where distance and poor transport often deter institutional treatment. Gupta (2024) confirmed that infrastructural inequality significantly influences health outcomes, with rural households facing higher morbidity due to delayed or absent care. Similar findings were observed by Haddad (2011), who reported that social exclusion and poor physical connectivity aggravate rural health inequalities in low-income settings.

The determinants of healthcare utilization have been widely studied in the Indian context. Mukherjee and Dular (2022) found that institutional deliveries are more common among women with better education and proximity to medical facilities. Arslan Neyaz et al. (2021) and Kumar, Dansereau, and Murray (2012) both emphasized that distance to health centres and lack of transportation are critical barriers for safe maternal care. These observations align with broader national analyses such as the TRI Development Intelligence Unit (2024) report and the Government of India's National Health Mission (2023), which stress the need for decentralised health infrastructure to improve rural accessibility.

Health-seeking behaviour and treatment preference are also crucial components of health sustainability. Mondal, Ghosh, and Biswas (2024) documented how tribal populations often rely on traditional and complementary medicine due to cultural beliefs, accessibility issues, and cost factors. Barman (2022) and Barman (2024) described similar patterns among the Rajbanshi community, where folk medicine remains integral to local identity. Porter (2015) critiqued India's policy of "mainstreaming AYUSH," arguing that while it promotes pluralism, it may not ensure quality or safety in areas where traditional healers are unregulated. Choudhury, Mukherjee, and Dutta (2021) further suggested that traditional healing can complement public health if integrated through training and evidence-based validation.

At the same time, growing awareness of preventive and insured healthcare reflects a gradual transition toward sustainability. Patel and Sharma (2022) observed that regular health check-ups and preventive behaviour are more common among educated and insured households, reducing long-term treatment costs. Ghosh (2022) found that health insurance significantly increases the likelihood of using formal healthcare, while Ranson et al. (2007) showed that community-based insurance schemes in India can ensure equitable access when properly implemented. Kumar and George (2020) reinforced that financial protection through insurance is crucial for rural health sustainability, minimizing out-of-pocket expenditure and supporting continuity of care.

The choice between public and private healthcare providers also influences overall system equity. Singh and Suresh (2020) noted that households in West Bengal often prefer private facilities due to perceived quality, but at higher financial cost. Mishra and Banerjee (2022) found that accessibility and service reliability determine whether families opt for government or private care, a finding echoed by Gupta and Sahoo (2021), who demonstrated that household income and education shape both treatment choice and frequency of visits. Prakash, Singh, and Gupta (2023) expanded this discussion by showing significant rural–urban differentials in healthcare utilization among India's elderly, driven by affordability, awareness, and local facility density.

Several studies propose composite index approaches to measure multidimensional health sustainability, integrating accessibility, affordability, and behavioural indicators. Kundu and Basu (2023) developed a composite Health Sustainability Index (HSI) for Indian districts, using weighted indicators derived from healthcare accessibility, insurance coverage, and preventive behaviour. Their method aligns with the multidimensional poverty index (Alkire & Santos, 2014), emphasizing that well-being and sustainability must be measured through interlinked social and economic dimensions. Such indices can effectively capture intra-regional disparities, as shown by Haddad (2011) and Gupta (2024), and can guide targeted policy interventions in marginalized areas.

The literature also highlights the cultural dimension of healthcare, particularly in ethnically diverse rural regions. Basu (2003) and Barman (2022) illustrated how historical identity and indigenous knowledge systems influence treatment decisions, often balancing between traditional and biomedical practices. This pluralistic approach can either strengthen resilience or perpetuate inequality, depending on the quality and recognition of services. Ballard Brief (2024) and Rural Health Info (2025) reiterated that rural healthcare

sustainability depends not only on physical infrastructure but also on culturally sensitive outreach, awareness programs, and participatory governance.

The reviewed studies suggest that sustainable healthcare involves a balance between infrastructure, behavioural change, financial inclusion, and cultural adaptability. Integrating patient-centredness, environmental responsibility, and social equity into a unified framework—as proposed by Alhaij et al. (2023) and Kundu and Basu (2023)—offers a comprehensive path forward. However, the Indian context demands special attention to the rural–urban divide, plural medical systems, and preventive health behaviour to ensure that healthcare sustainability translates into long-term public well-being.

3. Methodology

3.1 sampling design and data collection

This study was conducted in the Cooch Behar district of West Bengal, which comprises 18 administrative blocks with both rural and urban areas. A total of 996 respondents were selected following a stratified random sampling technique to ensure balanced representation across different demographic and spatial segments. Within each block, households were classified into *rural* and *urban* strata based on official Census designations. Random sampling was then employed to select respondents proportionately from each stratum. Primary data were collected through a structured questionnaire survey conducted between March and July 2024. The questionnaire included seven key variables reflecting health condition, healthcare preference, accessibility, and preventive behavior. These variables together represent the multidimensional aspects of household-level health sustainability. The collected responses were later coded numerically to facilitate statistical analysis and index construction. Secondary information related to healthcare infrastructure and demographic distribution was obtained from the District Statistical Handbook (2023) and Health and Family Welfare Department reports for validation and cross-comparison.

3.2 Conversion of qualitative data to quantitative scores

Several indicators in the dataset—particularly those related to treatment preferences and health-seeking behavior—were originally qualitative or categorical. To integrate them into quantitative analysis, each category was assigned a numerical score based on its sustainability implications. The conversion was guided by logical hierarchy and expert judgment. Preference for Type of Treatment, Preference for Healthcare Facility, Use of Traditional Treatment, Frequency of Medical Check-up**,** and Health Insurance Coverage. These scores were assigned before normalisation, ensuring consistency in interpretation and computation.

3.3 Data normalisation

The selected indicators vary in scale and measurement units, necessitating standardisation prior to index computation. To ensure comparability, all variables were normalised using the Min–Max method, which rescales data into a dimensionless range between 0 and 1. The formula used is

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}} \; for\ benefit\ variables$$

$$X' = \frac{X_{max} - X}{X_{max} - X_{min}} \; for\ cost\ variables$$

Here, X represents the original value of a variable, X_{min} and X_{max} are the minimum and maximum observed values in the dataset, and (X') denotes the normalised score between 0 and 1.

Sl. No.	Variable	Category / Response	Assigned Score	Rationale	Supporting References
1	Preference for Type of Treatment	Allopathic	1.00	Represents reliance on scientifically validated and evidence-based healthcare systems	World Health Organization (2019); Gupta & Sahoo (2021)
		Homeopathic	0.75	Alternative system with moderate clinical acceptance and accessibility	
		Ayurvedic	0.50	Traditional but institutionally supported medical practice	
		Shaman / Traditional	0.25	Based on unverified belief systems, low clinical sustainability	
2	Preference for Healthcare Facility	Both (Govt. + Private)	1.00	Balanced access to affordable and quality healthcare	Singh & Suresh (2020); Mishra & Banerjee (2022)
		Government Hospital	0.75	Reflects affordability and accessibility but may lack availability	
		Private Hospital	0.50	High quality but less affordable; lower inclusiveness	
3	Use of Traditional Treatment	Never	1.00	Indicates full reliance on verified modern medical care	Choudhury et al. (2021)
		Sometimes	0.75	Partial reliance on traditional systems alongside medical treatment	
		Often	0.40	Frequent use may delay proper treatment and lower sustainability	
		Always	0.00	Complete dependence on unverified practices; least sustainable	

4	Frequency of Medical Check-up	Always	1.00	Regular preventive healthcare enhances early detection and sustainability	Patel & Sharma (2022); WHO (2021)
		Often	0.75	Periodic medical visits show moderate awareness	
		Sometimes	0.50	Irregular health behavior with partial prevention	
		Rarely	0.25	Limited preventive behavior	
		Never	0.00	Absence of health-seeking behavior; least sustainable	
5	Health Insurance Coverage	Yes	1.00	Financial protection reduces treatment burden and ensures access	Kumar & George (2020); Ghosh (2022)
		No	0.00	High out-of-pocket expenditure reduces health sustainability	

Table 1: Conversion of Qualitative Health Variables to Quantitative Scores

Sl. No.	Variable	Type	Description / Measurement	Orientation	Weight
1	Disease Severity Score	Quantitative	Composite score based on reported frequency and intensity of illness in the past year	Negative	0.20
2	Preference for Type of Treatment	Qualitative (ordinal)	Preference among allopathic, homeopathic, ayurvedic, or traditional healing systems	Positive	0.10
3	Preference for Healthcare Facility	Qualitative (ordinal)	Choice between government, private, or both facilities	Positive	0.15
4	Use of Traditional Treatment	Qualitative (frequency)	Frequency of using unverified traditional treatment when ill	Negative	0.10
5	Frequency of Medical Check-up	Quantitative (frequency)	Number of health check-ups per year	Positive	0.15

6	Health Insurance Coverage	Binary (0/1)	Whether the respondent or household is covered by any health insurance scheme	Positive	0.15
7	Distance to Nearest Hospital	Quantitative (km)	Euclidean distance from residence to nearest hospital	Negative	0.15

Table 2: Variables Used in Health Sustainability Index (HSI) Computation

3.4 HSI construction using Weighted Linear Combination (WLC)

The Health Sustainability Index (HSI) integrates the seven normalised variables through the Weighted Linear Combination (WLC) method. WLC is widely used for composite index construction in multidimensional assessments, as it combines indicators while retaining their relative contribution through weights.

$$HSI_i = \sum_{j=1}^{n} w_j X'_{ij}$$

where,

HSI_i = Health Sustainability Index for the *i*th household

w_j = Weight assigned to the *j*th variable

X'_{ij} = Normalized value of the *j*th variable for the *i*th household

n = Number of variables considered (n = 7)

The resulting index values range from 0 (least sustainable) to 1 (most sustainable), indicating the relative degree of household-level sustainability. Mean HSI scores were further aggregated at block and rural–urban scales to examine spatial and demographic variation across the district.

3.5 Correlation Analysis

To identify the interdependence among the variables and their association with the Health Sustainability Index, a Pearson correlation matrix was computed. This analysis measures the degree and direction of linear relationships among all normalised variables and the composite HSI score. The significance of correlation coefficients ((r)) was tested at both 1% and 5% probability levels using two-tailed tests. The results helped determine which health-related factors most strongly influence sustainability outcomes. Positive correlations indicate mutually reinforcing variables contributing to better health sustainability, while negative correlations suggest inverse relationships—where improvement in one aspect may correspond with decline in another. All computations, including normalisation, WLC integration, descriptive statistics, and correlation analysis, were performed in Python and Microsoft Excel 2021 for verification and tabulation.

4. Results

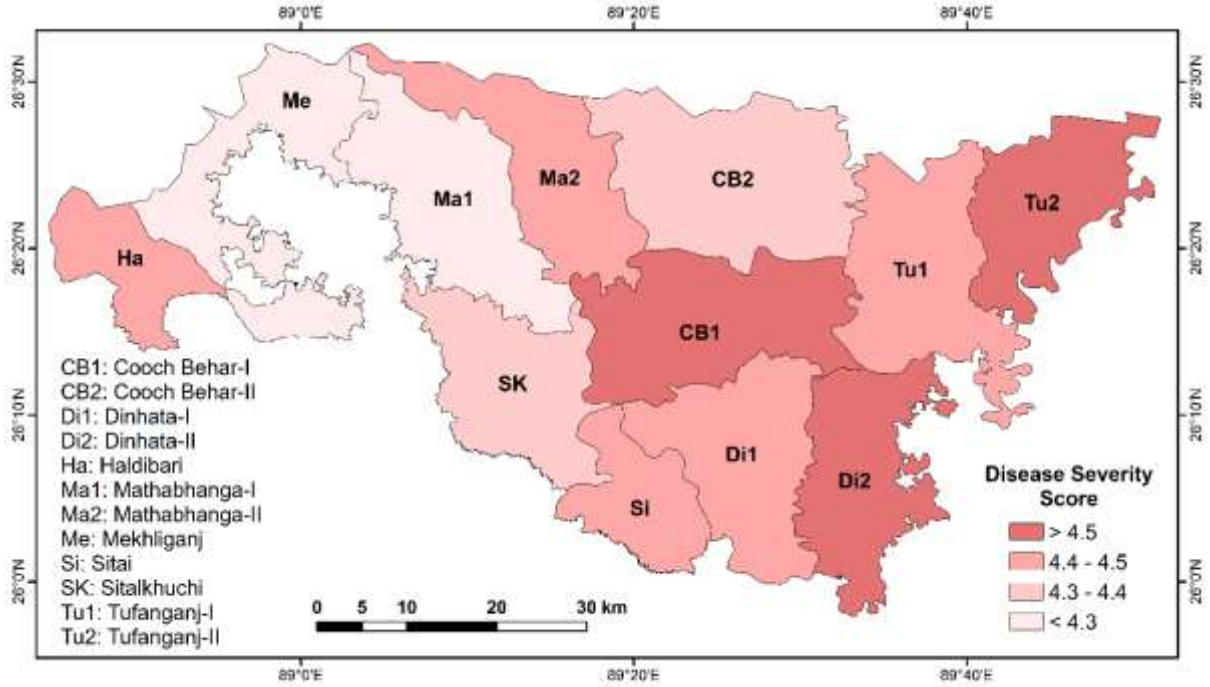
4.1 Indicators: Block-wise, urban, and rural analysis

Table 3 and the block–residence summary table provide the foundation for understanding the spatial and demographic variation of the seven core indicators that constitute the Health Sustainability Index (HSI). These variables capture both the health condition dimension (disease severity) and the health-seeking behaviour and access dimensions (treatment preference, facility preference, traditional treatment use, frequency of medical check-ups, health insurance, and distance to hospital). Across the twelve blocks of the Cooch Behar District, mean indicator values show moderate but consistent variation, reflecting differences in service provision, cultural practice, and accessibility within the Rajbanshi Community.

4.1.1 Disease severity

Disease severity shows an overall mean of about 4.45 (Table 3), with the lowest block mean in Mekhliganj (4.20) and the highest in Tufanganj II (Fig. 1). These values suggest that most respondents report mild to moderate morbidity rather than severe or chronic illness.

Within-block residential differences are marginal; for instance, rural and urban households in Cooch Behar I report nearly identical values (4.71 vs. 4.65). A similar pattern occurs in Dinhata-I, where the urban score



(4.70) slightly exceeds the rural score (4.29). These small deviations indicate that health condition, measured through self-reported disease severity, is broadly uniform across the study area.

Fig 1. Block-wise disease severity scores in Koch Bihar district. Darker shades indicate higher severity, while lighter shades indicate lower severity.

4.1.2 Preference for type of treatment

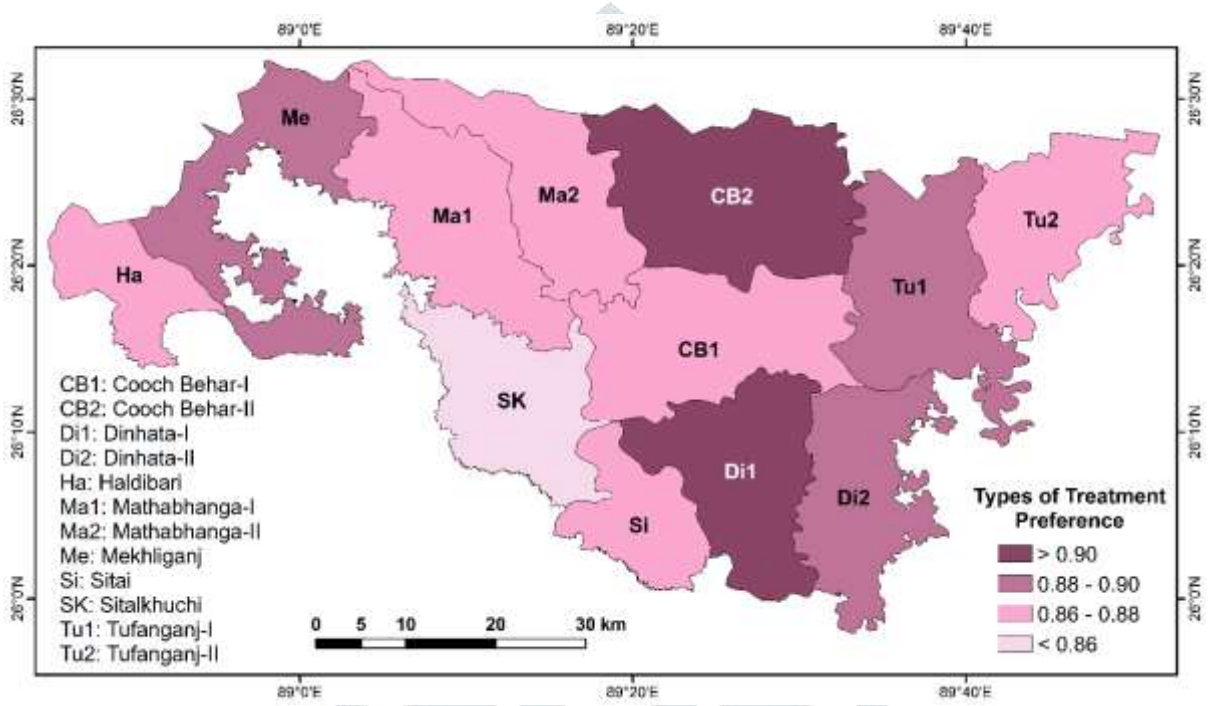
Preference for the type of treatment exhibits uniformly high mean scores ranging from 0.86 to 0.93 (Fig. 2), indicating a strong inclination toward allopathic treatment, depending on local familiarity and perceived effectiveness. The consistency of this variable across blocks underscores community-wide adherence to

stable treatment preferences, suggesting that differences in health sustainability arise not from treatment preferences themselves but from the opportunities and constraints associated with accessing facilities.

Fig.2 **Block-wise preference for type of treatment in Koch Bihar district. Darker shades indicate a higher preference for allopathic treatment, while lighter shades indicate a lower preference.**

4.1.3 Preference for healthcare facility

Preference for healthcare facilities reveals slightly wider variation, with block means ranging from 0.71 in Mathabhanga-I to 0.78 in Mekhliganj (Fig. 3). The overall mean of 0.75 reflects a moderate reliance on formal healthcare institutions. Urban areas tend to score marginally higher than their rural counterparts: Cooch Behar-II urban residents average 0.79 compared to 0.75 for rural, reflecting better proximity and confidence in institutional services.



4.1.4 Use of traditional treatment

Use of traditional treatment demonstrates a more heterogeneous pattern, averaging around 0.54 but varying from 0.47 in Cooch Behar-I urban to 0.60 in Cooch Behar-II rural (Table 3). Rural households in nearly all blocks show greater reliance on traditional and indigenous medical practices. This behaviour likely reflects cultural continuity and limited access to organized medical facilities. Despite modernization of healthcare delivery, the persistence of traditional practices forms part of the community's adaptive health behaviour rather than an outright rejection of formal medicine (see Barman, 2024; Barman & Adhikary, 2024).

Fig.3 Block-wise preference for healthcare facilities in Koch Bihar district. Darker shades indicate higher values, representing a greater proportion of the population preferring private hospitals.

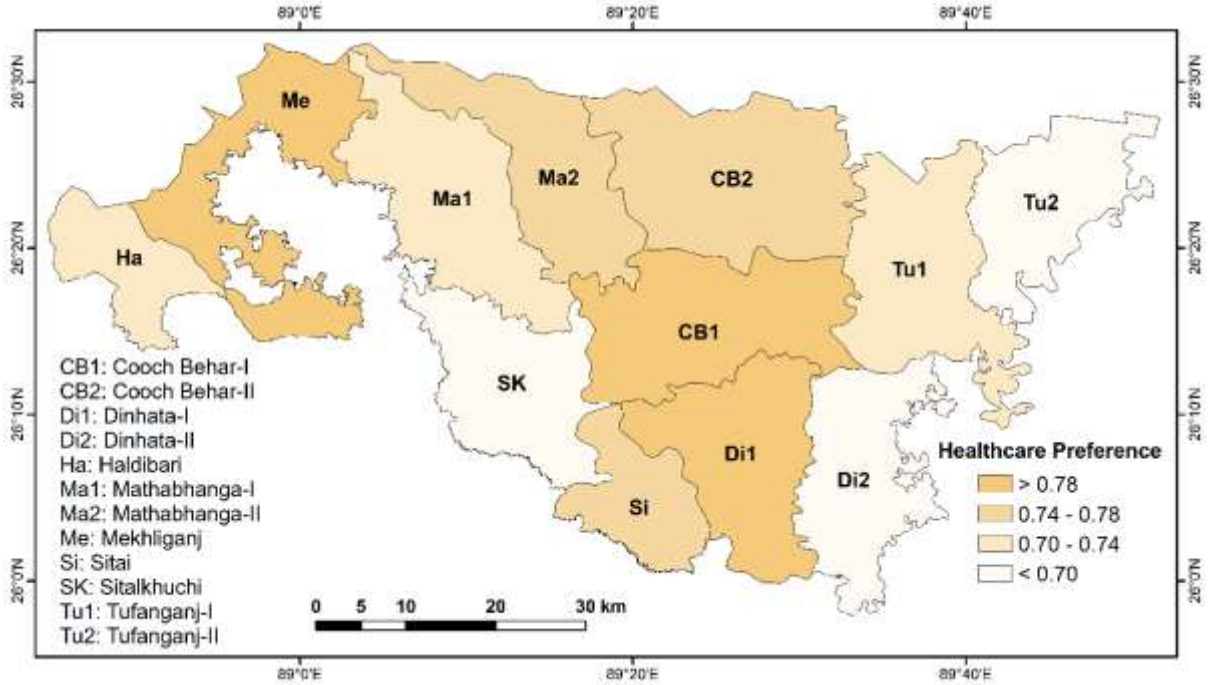
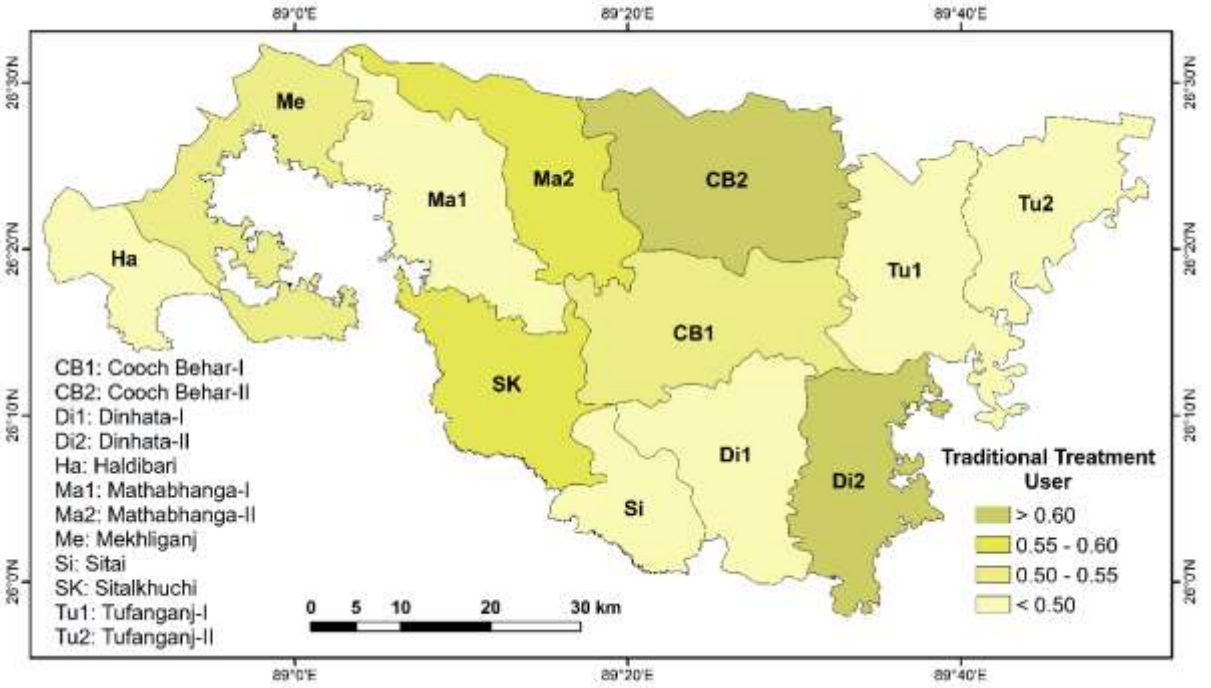


Fig.4 Block-wise preference for traditional treatment in Koch Bihar district. Darker shades indicate higher values, meaning a greater proportion of the population prefers traditional treatment.



Block	Residence	Disease Severity Score	Preference for types of treatment	Preference of healthcare facility	When you are sick do you use traditional treatment	Frequency of medical checkup	Health insurance coverage	Distance to the nearest hospital
Cooch Behar-I	Rural	4.71	0.90	0.77	0.60	0.62	0.26	2.18
Cooch Behar-I	Urban	4.65	0.89	0.78	0.47	0.62	0.17	1.81
Cooch Behar-II	Rural	4.33	0.93	0.75	0.59	0.62	0.16	2.45
Cooch Behar-II	Urban	4.18	0.87	0.79	0.42	0.78	0.24	1.87
Dinhata-I	Rural	4.29	0.92	0.77	0.52	0.57	0.14	2.43
Dinhata-I	Urban	4.70	0.91	0.78	0.52	0.62	0.33	2.03
Dinhata-II	Rural	4.60	0.91	0.72	0.60	0.61	0.24	2.37
Haldibari	Rural	4.43	0.90	0.74	0.52	0.58	0.22	2.30
Mathabhanga-I	Rural	4.05	0.86	0.69	0.55	0.58	0.12	3.25
Mathabhanga-I	Urban	4.45	0.94	0.78	0.48	0.60	0.10	2.72
Mathabhanga-II	Rural	4.50	0.89	0.76	0.57	0.56	0.22	2.21
Mekhliganj	Rural	4.28	0.90	0.76	0.53	0.66	0.24	2.02
Mekhliganj	Urban	4.13	0.93	0.78	0.52	0.64	0.22	2.67

Sitai	Rural	4.52	0.90	0.75	0.52	0.62	0.28	2.91
Sitalkhuchi	Rural	4.28	0.86	0.71	0.57	0.59	0.17	2.34
Tufanganj-I	Rural	4.36	0.91	0.71	0.50	0.61	0.17	2.32
Tufanganj-I	Urban	4.58	0.92	0.75	0.53	0.61	0.20	2.26
Tufanganj-II	Rural	4.71	0.90	0.72	0.52	0.66	0.17	2.12

Table 3: Mean Values of All Variables by Rural and Urban Areas

4.1.5 Frequency of medical check-up

The frequency of medical check-ups ranges between 0.56 and 0.66 across blocks (Fig.5), indicating moderate engagement with preventive healthcare. Urban areas generally report slightly higher check-up frequencies, reflecting better access and awareness. However, the narrow range of variation suggests that health-seeking behaviour is relatively consistent throughout the Rajbanshi population.

Fig.5 Block-wise frequency of medical check-ups in Koch Bihar district. Darker shades indicate a higher frequency of medical check-ups, while lighter shades represent a lower frequency.

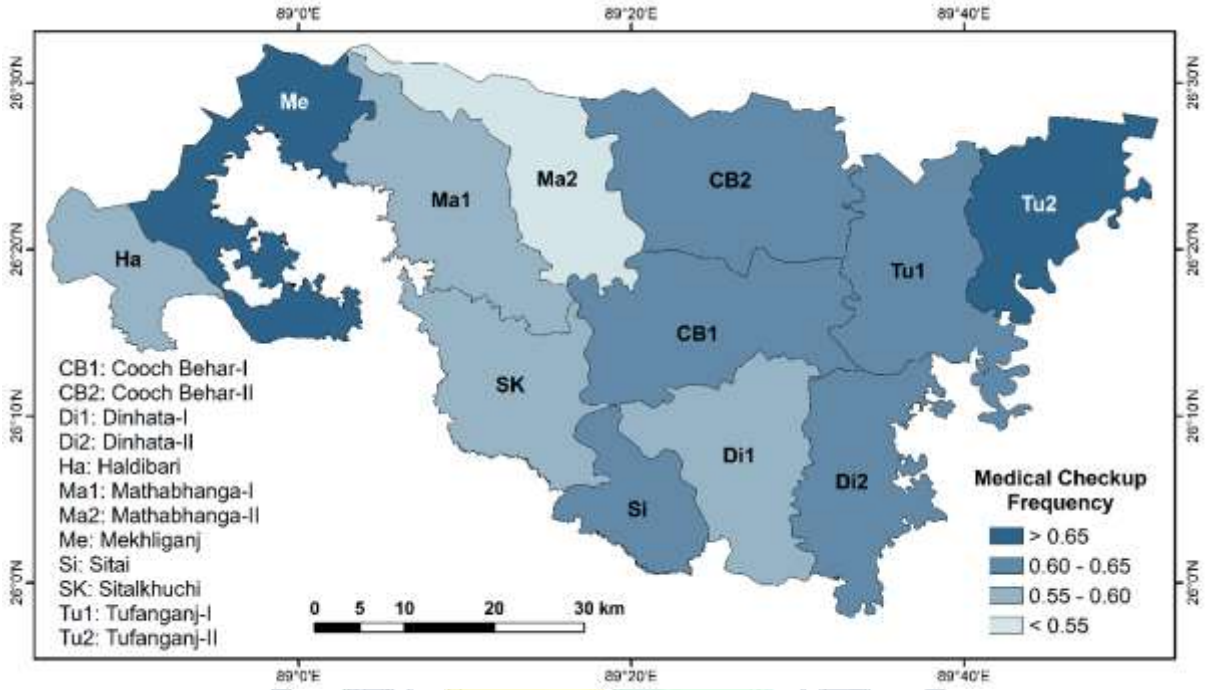
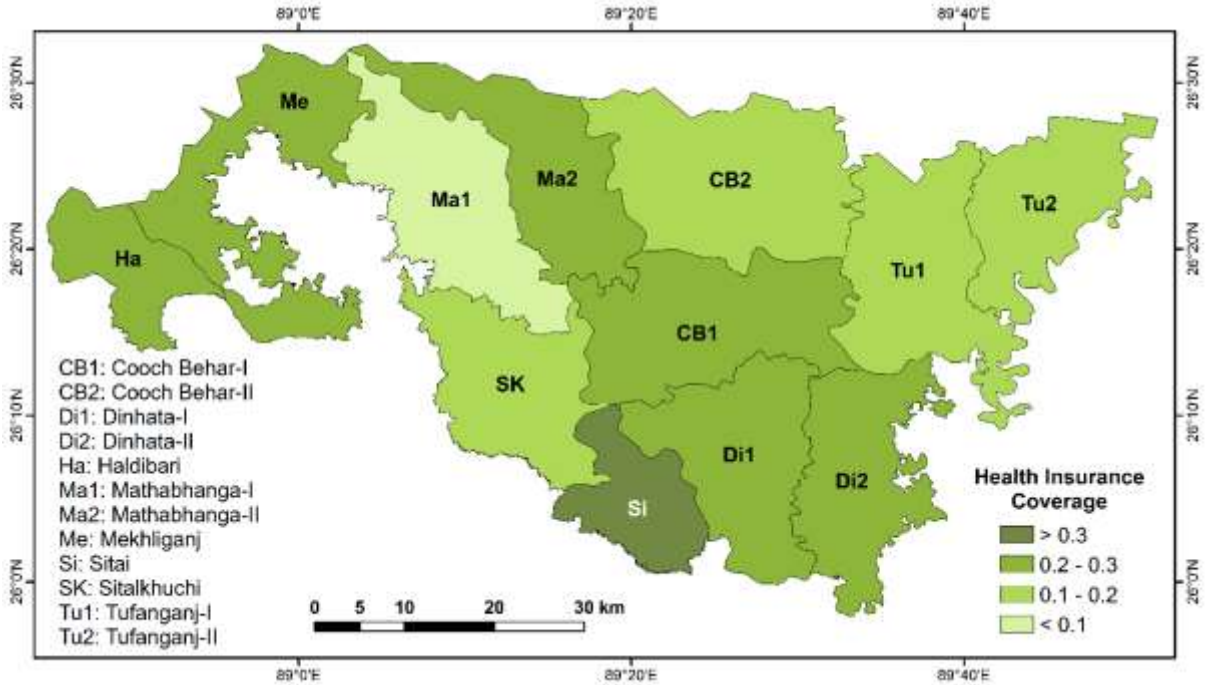


Fig.6 Block-wise health insurance coverage in Cooch Behar district. Darker shades indicate higher coverage, while lighter shades indicate lower coverage.

4.1.6 Health-insurance coverage



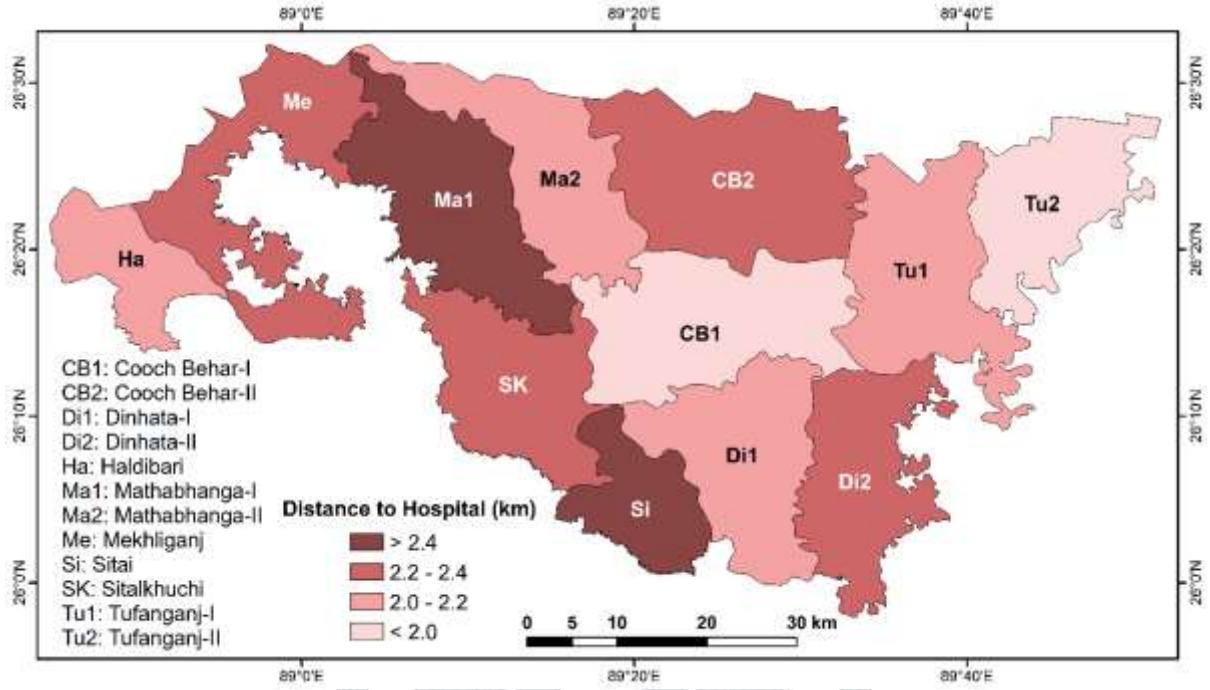
Health insurance coverage remains critically low across all blocks, averaging approximately 0.20 (SD = 0.40). Block means vary from 0.11 in Sitalkuchi to 0.28 in Cooch Behar-II (Fig.6), confirming that formal

financial protection against medical expenditure is still rare. Only a small fraction of households reported any insurance membership. This uniform deficiency represents one of the most significant challenges for improving health sustainability in the region.

Fig.7 Block-wise distance to the nearest hospital in Cooch Behar district. Darker shades indicate greater distances, while lighter shades represent shorter distances to the nearest hospital.

4.1.7 Distance to the nearest hospital

The distance to the nearest hospital varies notably, from 1.99 km in Tufanganj-II to 2.98 km in Mathabhanga-I (Fig. 7). The overall mean distance of 2.37 km highlights the structural gap in healthcare accessibility. Rural sectors consistently show greater distances than urban ones, indicating that physical accessibility remains a determinant barrier to equitable healthcare utilization.



4.2 HEALTH SUSTAINABILITY INDEX: BLOCKWISE, URBAN AND RURAL ANALYSIS

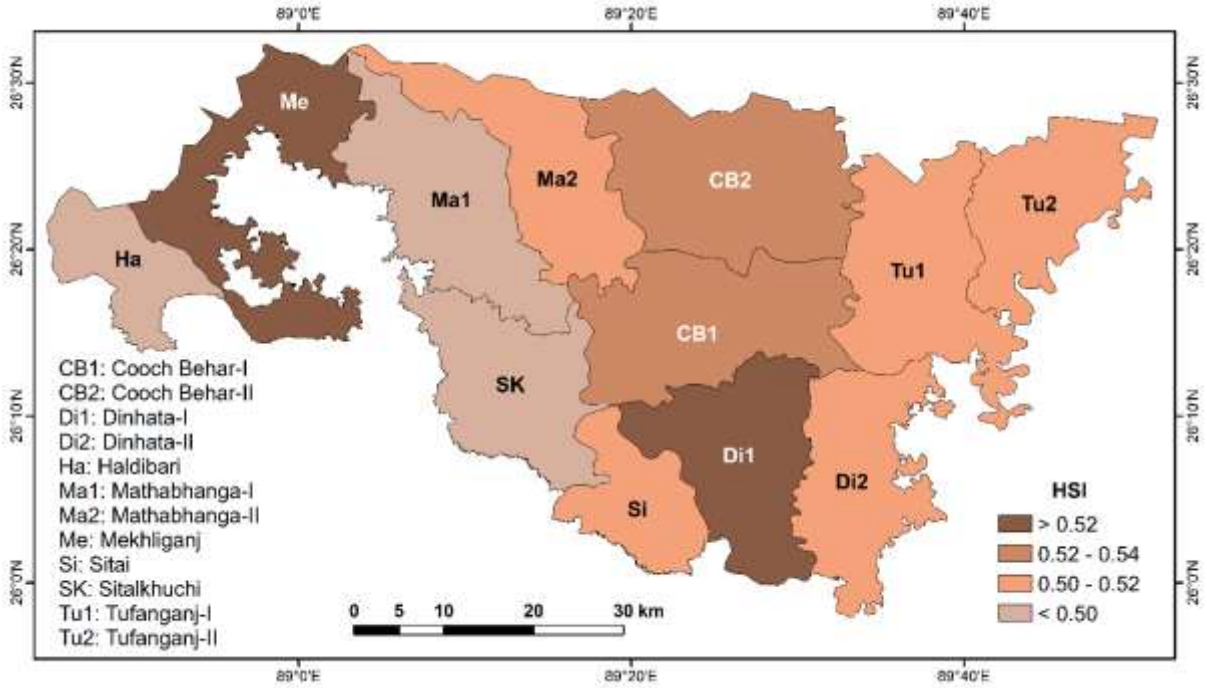
The composite Health Sustainability Index (HSI), derived from the seven normalized indicators, provides a holistic measure of the community's health resilience and access status. The results summarised in Tables 4 reveals a relatively narrow range of block-wise variation, yet notable patterns emerge. Across all blocks, mean HSI values range from 0.51 to 0.56 (Fig.8), suggesting a moderate level of health sustainability throughout the Rajbanshi community. Mekhliganj records the highest average HSI (0.56), closely followed by Dinhata-I (0.55), while Mathabhanga-I and Sitalkuchi occupy the lower end of the scale (0.51). The overall mean of 0.53 (Table 4) confirms that differences are modest but meaningful. Spatially, blocks located nearer to district headquarters (Cooch Behar-I, Dinhata-I, Mekhliganj) perform better, largely due to improved healthcare infrastructure, shorter travel distances, and slightly higher insurance penetration. Peripheral or flood-prone blocks (Mathabhanga-I, Sitalkuchi) lag behind, reflecting structural and logistical disadvantages.

A residence-wise breakdown reveals only minor urban–rural disparities. For instance, in Cooch Behar-I, the rural HSI (0.55) exceeds the urban (0.53); in Dinhata-I, the urban (0.56) surpasses the rural (0.53); Mathabhanga-I shows a similar pattern, with urban HSI (0.52) slightly above

Fig.8 Block-wise Health Sustainability Index in Cooch Behar district. Darker shades indicate higher sustainability scores, while lighter shades represent lower scores.

Block	Rural	Urban
Cooch Behar-I	0.55	0.53
Cooch Behar-II	0.54	
Dinhata-I	0.53	0.56
Dinhata-II	0.53	
Haldibari	0.52	
Mathabhanga-I	0.49	0.52
Mathabhanga-II	0.53	
Mekhliganj	0.56	0.56
Sitai	0.53	
Sitalkhuchi	0.51	
Tufanganj-I	0.52	0.54
Tufanganj-II	0.53	

Table 4. Mean Health Sustainability Scores (HSS) by Rural and Urban Areas



rural (0.49). Mekhliganj presents identical means for rural and urban (0.56 each). These small gaps (0.01–0.03) imply that intra-block factors and local health systems exert stronger influence on sustainability than residential status alone (Table 5). The clustering of HSI values around the mean indicates that while the Rajbanshi community as a whole maintains moderate health sustainability, structural parity has not yet been achieved. Blocks with higher HSI correspond to those with shorter hospital distances, greater preventive check-up frequency, and

Class Lower	Class Upper	Mid-Point	Frequency	Frequency (%)
0.17	0.24	0.20	4	0.40
0.24	0.30	0.27	37	3.72
0.30	0.37	0.34	90	9.04
0.37	0.44	0.41	129	12.95
0.44	0.51	0.48	189	18.98
0.51	0.58	0.55	173	17.37
0.58	0.65	0.61	173	17.37
0.65	0.72	0.68	112	11.25
0.72	0.79	0.75	60	6.02
0.79	0.86	0.82	21	2.11
0.86	0.92	0.89	8	0.80

Table 5: Frequency Distribution of Health Sustainability Scores (HSS)

stronger facility preference. Conversely, blocks with lower HSI typically show poorer accessibility and weaker financial security through insurance. Overall, the HSI pattern underscores a context of relative homogeneity with localized deficiencies. The observed differences may reflect the uneven spatial

distribution of healthcare facilities, varying success of outreach programmes, and residual socioeconomic contrasts within the district.

Variable	Mean	Median	Mode	SD	Skewness	Kurtosis
Disease Severity Score	4.45	4.00	4.00	1.67	0.13	-0.37
Preference for types of treatment	0.90	1.00	1.00	0.17	-1.83	3.29
Preference of healthcare facility	0.75	0.75	0.50	0.22	0.01	-1.70
When you are sick do you use traditional treatment	0.54	1.00	1.00	0.50	-0.14	-1.98
Frequency of medical checkup	0.61	0.50	0.50	0.27	0.22	-1.24
Health insurance coverage	0.20	0.00	0.00	0.40	1.49	0.23
Distance to the nearest hospital	2.37	2.00	3.00	1.79	0.86	0.27
Health_Sustainability_Score	0.53	0.54	0.45	0.14	0.06	-0.40

Table 6: Descriptive Statistics of Health Sustainability Scores (HSS)

4.3 Descriptive statistics

Descriptive statistics for all indicators and the composite HSI (Table 6) provide insight into the central tendency, dispersion, and distributional shape. The disease severity score (mean = 4.45; SD = 1.67) displays a near-normal distribution (skewness = 0.13), suggesting a balanced representation of morbidity levels within the sample. This variable shows the greatest absolute variance among all indicators, confirming that self-reported illness levels vary considerably between households. Preference for treatment type (mean = 0.90; SD = 0.17) is highly left-skewed (skewness = −1.83), indicating that most respondents consistently prefer a particular treatment system. This uniformity demonstrates behavioural coherence within the community's medical choices. Preference for healthcare facilities (mean = 0.75; SD = 0.22) is approximately symmetric, indicating a balanced perception of institutional facilities. The standard deviation reveals moderate variability, consistent with differing access across blocks. Use of traditional treatment (mean = 0.54; SD = 0.50) displays a bimodal pattern: half the respondents rely on traditional remedies, while the remainder depend primarily on formal medical systems. This dual structure exemplifies the coexistence of traditional knowledge and modern healthcare within the same population. The frequency of medical check-ups (mean = 0.61; SD = 0.27) is moderately right-skewed, suggesting that a small proportion of respondents undertake check-ups more frequently than the majority. Health-insurance coverage (mean = 0.20; SD = 0.40; skewness = 1.49) is distinctly right-skewed, with many zeros, confirming extremely low insurance penetration across the district. The distance to the nearest hospital (mean = 2.37; SD = 1.79; skewness = 0.86) shows a wide spread and a long right tail, indicating that while many respondents live close to hospitals, a subset travels substantial distances. Finally, the Health Sustainability Index itself shows

a mean of 0.53 and SD of 0.14, with minimal skewness (0.06). The low dispersion suggests that although small inter-block variations exist, the community maintains a broadly similar level of health sustainability.

4.4 Correlation analysis between variables and HSI

Correlation coefficients (Table 7) and their respective significance levels (Table 8) elucidate the relationships between individual indicators and the composite HSI. The strongest positive correlation emerges between HSI and preference for healthcare facility ($r = 0.59$, $p < .001$). This indicates that greater reliance on institutional healthcare is strongly associated with higher sustainability scores. Accessibility and trust in formal services, therefore, form a primary pillar of health sustainability. Health-insurance coverage also correlates positively and significantly ($r = 0.51$, $p < .001$), underscoring the importance of financial security in sustaining health outcomes. Insured households are less vulnerable to medical expenses and are more likely to seek timely care, enhancing overall sustainability. The frequency of medical check-ups shows a substantial positive association ($r = 0.48$, $p < .001$). Regular health check-ups represent preventive behaviour and early disease detection, both critical to long-term health sustainability. A somewhat unexpected positive correlation is observed between use of traditional treatment and HSI ($r = 0.43$, $p < .001$). This suggests that traditional health practices, far from opposing modern healthcare, may complement it in this cultural context. Households practicing traditional treatment may simultaneously engage in preventive measures and institutional consultations, representing a hybrid model of care. Preference for type of treatment shows a weaker yet significant correlation ($r = 0.25$, $p < .001$), implying that while treatment preference reflects cultural orientation, it exerts limited influence on sustainability compared to facility preference or preventive behaviour. Conversely, distance to the nearest hospital exhibits a moderate negative correlation ($r = -0.35$, $p < .001$). Longer travel distances are directly associated with lower HSI, validating physical accessibility as a structural constraint on sustainable healthcare utilization. The disease-severity score correlates weakly and non-significantly with HSI ($r = -0.06$, $p = .06$). This marginal relationship implies that, within the cross-sectional dataset, self-reported illness levels do not systematically determine sustainability once behavioural and access factors are accounted for.

	Disease Severity Score	Preference for types of treatment	Preference of healthcare facility	When you are sick do you use traditional treatment	Frequency of medical checkup	Health insurance coverage	Distance to the nearest hospital	Health Sustainability Score
Disease Severity Score	1	0.01	0.02	0.05	0.14	0.19	-0.27	-0.06
Preference for types of treatment	0.01	1	0.05	-0.02	-0.04	0.02	0.03	0.25
Preference of healthcare facility	0.02	0.05	1	0.03	0.12	0.04	-0.10	0.59
When you are sick do you use traditional treatment	0.05	-0.02	0.03	1	0.05	0.07	-0.08	0.43
Frequency of medical checkup	0.14	-0.04	0.12	0.05	1	0.05	-0.17	0.48
Health insurance coverage	0.19	0.02	0.04	0.07	0.05	1	-0.26	0.51
Distance to the nearest hospital	-0.27	0.03	-0.10	-0.08	-0.17	-0.26	1	-0.35
Health Sustainability Score	-0.06	0.25	0.59	0.43	0.48	0.51	-0.35	1

Table 7: Correlation Matrix of Health Sustainability Scores (HSS) and Related Variables

	Disease Severity Score	Preference for types of treatment	Preference of healthcare facility	When you are sick do you use traditional treatment	Frequency of medical checkup	Health insurance coverage	Distance to the nearest hospital	Health Sustainability Score
Disease Severity Score	1.00	0.86	0.53	0.14	0.001	0.001	0.001	0.06
Preference for types of treatment	0.86	1.00	0.14	0.60	0.26	0.44	0.35	0.001
Preference of healthcare facility	0.53	0.14	1.00	0.36	0.001	0.21	0.001	0.001
When you are sick do you use traditional treatment	0.14	0.60	0.36	1.00	0.14	0.04	0.01	0.001
Frequency of medical checkup	0.001	0.26	0.001	0.14	1.00	0.15	0.001	0.001
Health insurance coverage	0.001	0.44	0.21	0.04	0.15	1.00	0.001	0.001
Distance to the nearest hospital	0.001	0.35	0.001	0.01	0.001	0.001	1.00	0.001
Health Sustainability Score	0.06	0.001	0.001	0.001	0.001	0.001	0.001	1.00

Table 8: P-Value Matrix for Health Sustainability Scores (HSS) and Related Variables

5. Discussion

This study provides an empirical examination of health sustainability among the Rajbanshi community in the Cooch Behar district by analysing indicator data, composite HSI scores, descriptive statistics, and correlation relationships. The discussion below interprets the findings in three interrelated dimensions—access and system engagement, cultural/behavioural health-seeking, and spatial/infrastructure constraints—and situates them within the existing literature.

5.1 Institutional access and service utilisation

One of the most salient findings is the strong positive relationship between preference for a healthcare facility and the Health Sustainability Index (HSI). In other words, respondents who place higher value on formal health institutions also tend to exhibit higher sustainability scores. This echoes findings from broader Indian contexts where utilisation of institutional health services is significantly influenced by service availability and proximity (Kumar, Dansereau & Murray, 2012). For instance, increased distance to a facility consistently reduces the probability of institutional delivery in rural India. Similarly, the positive correlation between frequency of medical check-ups and HSI highlights that preventive and routine engagement with the health system strongly underpin sustainability. Preventive behaviour has been shown to correlate with improved outcomes in other rural populations (Arslan Neyaz et al., 2021). Health-insurance coverage emerged as another critical dimension: higher coverage corresponds with higher HSI. Studies on rural Indian populations suggest that financial protection via insurance is linked to increased utilisation of health services and reduced self-medication (Ranson et al., 2007). Hence, despite cultural inclination toward treatment (as shown by high treatment-preference scores), actual sustainability appears strongly moderated by system-enabled access (facilities + insurance) and behavioural alignment (check-ups).

5.2 Socio-cultural dimensions of health-seeking behaviour

The moderate positive association between use of traditional treatment and HSI is noteworthy. Conventional expectation might be that reliance on traditional remedies substitutes for formal care and thus reduces sustainability; however, in this context the association is positive. Literature on Indian health-seeking shows that traditional, complementary and indigenous medical systems often coexist with formal services—what has been termed "medical pluralism" (Mondal, Ghosh & Biswas, 2024). In rural and semi-rural Indian settings, use of traditional practitioners may lower entry-barriers to care, embed health-seeking in culturally familiar forms, and facilitate eventual engagement with formal services. For example, qualitative work from the Spiti Valley shows that rural patients may choose traditional treatments for culturally acceptable conditions while still resorting to modern medicine for more serious issues. In the case of the Rashbangshi community, the uniformity of treatment-preference scores indicates that cultural orientation toward care is widespread and does not vary substantially across blocks. Therefore, the differentiating elements of sustainability seem less about what people prefer and more about how they act on it—whether they translate preference into service utilisation, routine check-ups, and institutional facility use. The positive relationship with traditional treatment

suggests that rather than hindering sustainability, culturally embedded practices may serve as complementary pathways when combined with formal care. This nuance is important in conceptualising health-sustainability frameworks in culturally heterogeneous populations.

5.3 Geographical accessibility and infrastructure disparities

Distance to nearest hospital emerged as a moderate yet meaningful negative correlate of HSI. This finding confirms that geographic access remains a structural barrier to sustainable health outcomes even when cultural orientation and health-seeking behaviour are relatively consistent. The literature on rural India repeatedly confirms that increased travel distance reduces utilisation of institutional delivery services and other care domains (Kumar et al., 2012; Mukherjee & Dular, 2022). The block-wise data further demonstrates that although the overall HSI range is narrow (0.51–0.56), blocks closer to district infrastructure hubs report higher sustainability scores. This suggests that local health-system architecture (density of facilities, road/transport infrastructure, outreach capacity) matters more than rural vs urban designation. Indeed, the minimal urban–rural difference within blocks (0.01–0.03) reinforces that block-level service environment is a more salient determinant of sustainability than binary residence status. This aligns with the notion that health-service access inequality is primarily spatial and structural rather than simply rural vs urban (Prakash et al., 2023).

6. Conclusion

The Health Sustainability Index (HSI) developed for the Rajbanshi community in Cooch Behar district offers an integrated view of how accessibility, behavioural adaptation, and cultural continuity collectively shape community health resilience. The overall moderate HSI values (0.51–0.56) indicate that the community maintains a balanced but vulnerable level of sustainability, with disparities mainly driven by infrastructural and spatial constraints rather than by differences in morbidity or cultural preference. Among the seven core indicators, institutional access and preventive health behaviour emerge as the strongest determinants of health sustainability. The significant positive associations between HSI and both healthcare-facility preference ($r = 0.59$) and frequency of medical check-ups ($r = 0.48$) underscore that engagement with formal health systems directly enhances sustainability (Kumar, Dansereau, & Murray, 2012; Arslan Neyaz et al., 2021). Furthermore, the positive correlation with health insurance coverage ($r = 0.51$) reinforces the role of financial security as a critical enabling factor for timely healthcare utilization (Ranson et al., 2007). These findings are consistent with broader Indian and global studies linking service utilisation, financial protection, and preventive practices with sustained health outcomes (Prakash et al., 2023).

Equally significant is the observed positive contribution of traditional treatment practices to overall sustainability. The Rajbanshi community demonstrates a culturally hybrid health-seeking behaviour in which traditional and modern systems coexist productively—a phenomenon aligned with the “medical pluralism” framework observed in several Indian tribal and rural settings (Mondal, Ghosh, & Biswas, 2024). Rather than diminishing sustainability, traditional health practices serve as supplementary care strategies that maintain cultural cohesion while bridging gaps in formal access. Spatial and

infrastructural disparities remain the most persistent constraints. The negative correlation between distance to hospitals and HSI ($r = -0.35$) highlights the enduring challenge of geographical accessibility, echoing previous findings that physical proximity remains a decisive factor in health outcomes, particularly in rural India (Mukherjee & Dular, 2022). Blocks closer to administrative or transport hubs, such as Mekhliganj and Dinhata-I, exhibit higher sustainability due to higher facility density and better connectivity.

In conclusion, health sustainability within the Rajbanshi community is primarily determined by functional access, preventive engagement, and cultural adaptability. Disease prevalence alone fails to explain sustainability levels, reaffirming that the ability to access, afford, and culturally navigate health systems is central to long-term resilience. Future research should extend this multidimensional HSI framework to other ethnic communities and districts to facilitate spatially targeted and culturally sensitive health planning.

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