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Spatial Inequalities in Maternal and Child Health in India: Examining Inter-State Disparities

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Abstract — Maternal and child health (MCH) remains a critical component of human development and public health policy in India. Despite considerable improvements in recent decades, substantial inter-state disparities persist, reflecting uneven socio-economic development and variations in health system performance. The present study constructs a **Composite Maternal and Child Health Index (MCHI)** using data from the National Family Health Survey-5 (2019–21), with the objective of examining spatial inequalities in maternal care, child health outcomes, and nutritional status across Indian states.

The index incorporates eight indicators covering antenatal care, institutional delivery, postnatal care, immunization, infant and child mortality, anemia among women, and child stunting. All indicators are standardized using **z-score normalization**, a widely accepted method for constructing composite indices (OECD, 2008), and subsequently aggregated using an equal-weighting approach. The results reveal a pronounced regional pattern characterized by a north–south divide. Southern states such as Kerala and Tamil Nadu demonstrate consistently superior performance, while northern and northeastern states, including Bihar, Uttar Pradesh, and Meghalaya, lag behind. Although improvements in healthcare utilization are evident, persistent challenges in nutrition and mortality highlight structural constraints.

The study underscores the need for region-specific policy interventions and demonstrates the utility of composite indices in capturing multidimensional health disparities. The findings have important implications for targeted public health planning and resource allocation.

Keywords: Maternal and Child Health, NFHS-5, Composite Index, Spatial Inequality, Nutrition.

I. INTRODUCTION

Maternal and child health (MCH) is widely regarded as a cornerstone of public health and a key determinant of long-term socio-economic development. Improvements in maternal care and child survival are closely linked to reductions in poverty, enhancements in human capital, and broader demographic transitions (Mosley & Chen, 1984; United Nations, 2015). Consequently, the maternal and child health indicators are frequently used to assess the effectiveness of healthcare systems and the overall well-being of populations.

In India, significant progress has been made in improving maternal and child health outcomes over the past few decades. Government initiatives such as the National Health Mission, Janani Suraksha Yojana, and Poshan Abhiyaan have contributed to increased institutional deliveries, improved immunization coverage, and greater awareness of maternal health services (IIPS & ICF, 2021; NITI Aayog, 2021). However, these gains have not been uniform across regions and inter-state disparities remain glaringly high.

India's vast geographic and socio-cultural diversity has resulted in marked disparities in health outcomes across states. Differences in income levels, educational attainment, healthcare infrastructure, and governance capacity contribute to uneven progress (Dreze & Sen, 2013). For instance, southern states have historically outperformed northern states in key health indicators, reflecting long-standing investments in social development.

Traditional approaches to measuring health outcomes often rely on individual indicators, which may fail to capture the multidimensional nature of maternal and child health. For example, improvements in institutional delivery may coexist with high

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levels of child malnutrition, leading to a fragmented understanding of overall health conditions. In this context, composite indices offer a valuable tool for integrating multiple dimensions into a single analytical framework (Nardo et al., 2008).

The present study seeks to access the maternal and child health situation across the state by constructing a Composite Maternal and Child Health Index (MCHI) using NFHS-5 data. Specifically, the study aims to:

i. develop a standardized index capturing multiple dimensions of MCH,
ii. examine inter-state disparities, and
iii. identify spatial patterns in health outcomes across India.

II. LITERATURE REVIEW

The determinants of maternal and child health have been extensively studied across disciplines, including demography, public health, and development economics. Early work by Caldwell (1979) emphasized the importance of maternal education in reducing child mortality, arguing that educated women are more likely to adopt preventive healthcare practices. Similarly, the framework proposed by Mosley and Chen (1984) integrates socio-economic variables with proximate determinants such as nutrition, sanitation, and healthcare access.

In the Indian context, analyses based on NFHS data have documented substantial improvements in maternal healthcare utilization. Institutional deliveries, for instance, have increased significantly due to targeted policy interventions (IIPS & ICF, 2021). However, improvements in child nutrition have been slower, with high levels of stunting and anaemia persisting across many states (Coffey & Spears, 2018).

Inequality remains a central theme in the literature. Joe et al. (2016) highlight the role of socio-economic and regional disparities in shaping health outcomes, noting that children from poorer households and disadvantaged regions face significantly higher health risks. Dreze and Sen (2013) further argue that differences in public policy and governance explain much of the variation in health outcomes across Indian states.

Composite indices have emerged as important tools for measuring multidimensional phenomena. The Human Development Index (HDI) and Multidimensional Poverty Index (MPI) are widely used examples (UNDP, 2020). The OECD (2008) provides methodological guidelines for constructing such indices, emphasizing normalization, weighting, and aggregation procedures. However, there is limited application of composite indices specifically focused on maternal and child health at the sub-national level in India.

This study contributes to the literature by developing a composite index that integrates maternal care, child health, and nutritional indicators, thereby providing a multivariate assessment of spatial disparities.

III. DATA SOURCE

The study is based on data from the National Family Health Survey-5 (NFHS-5), 2019–21, conducted by the International Institute for Population Sciences (IIPS & ICF, 2021). All the State-level estimates are also derived from the children's recode file. The survey provides nationally representative data on a wide range of health and demographic indicators.

IV. METHODOLOGY

The selection of indicators for constructing the composite Maternal and Health Index (MCHI) is done from three key domains:

Maternal Health: i) Percentage of women not receiving antenatal care from a skilled provider; ii) Percentage of births not delivered in a health facility

Child Health: i) Percentage of children not receiving postnatal care within two days; ii) Percentage of children not fully immunized; iii) Infant mortality rate (${}_0q_1$); iv) Under-five mortality rate (${}_1q_5$).

Nutrition: i) Prevalence of anemia among women; ii) Percentage of stunted children.

All indicators are expressed as negative indicators, meaning that higher values indicate poorer outcomes. This ensures conceptual consistency in index construction.

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Given the heterogeneity in units and scales, indicators are standardized using z-score normalization.

$$Z = \frac{X - \mu}{\sigma}$$

This method transforms variables into a common scale with a mean of zero and a standard deviation of one, facilitating comparability across indicators (OECD, 2008).

The composite index, MCHI, is calculated as the arithmetic mean of standardized indicator.

$$MCHI = \frac{1}{n}\sum_{i=1}^{8} Z_i$$

Equal weighting is applied due to the absence of a theoretically justified alternative. This approach is consistent with standard practices in composite index construction (Nardo et al., 2008).

States are classified into five categories—Very Good, Good, Moderate, Poor, and Very Poor—based on their index values. Lower scores indicate better performance, as all indicators represent deprivation.

V. METHODOLOGICAL LIMITATIONS

While the composite index provides a useful summary measure, it has certain limitations. First, equal weighting assumes that all indicators contribute equally, which may not reflect their actual importance. Second, the use of state-level averages may mask intra-state disparities. Finally, the analysis is cross-sectional and does not capture temporal dynamics.

VI. RESULTS AND DISCUSSION

VI.I. MATERNAL HEALTH DISPARITIES

The maternal health indicators presented in Table 1 reveal considerable variation in access to essential services. For instance, Bihar reports that 32.3% of women did not receive antenatal care (ANC) from a skilled provider, compared to only 2% in Kerala. Similarly, non-institutional deliveries remain high in states such as Nagaland (54.3%) and Meghalaya (41.9%), while states like Tamil Nadu (0.4%) and Goa (0.3%) demonstrate near-universal institutional delivery coverage. Thus, maternal health indicators reveal stark inter-state disparities, which suggest that while national programs such as the National Health Mission have improved access overall, their impact has been uneven. States with better governance, stronger public health infrastructure, and higher female literacy rates tend to perform better. The findings align with earlier studies emphasizing the role of socio-economic development and health system capacity in shaping maternal health outcomes.

VI.II. CHILD HEALTH OUTCOMES

Child health indicators, summarized in **Table 2**, present a mixed picture. While improvements in immunization and mortality have been observed nationally, significant inter-state variation persists. For example, the percentage of children not fully immunized is as high as 42.1% in Nagaland and 36% in Meghalaya, compared to only 9.3% in Odisha and 11.1% in Tamil Nadu.

Mortality indicators further reinforce these disparities. Uttar Pradesh reports an infant mortality (${}_1q_0$) rate of 50.4 and a child mortality (${}_5q_1$) rate of 10, among the highest in the country. In contrast, Kerala records an infant mortality rate of just 4.4 and a child mortality rate of 0.8, demonstrating exceptional performance. Thus, Table 2 highlights considerable variation in child health outcomes, persistent inequalities in healthcare access, service delivery, and overall child well-being.

However, postnatal care coverage remains weak across most states, with more than 80% of children not receiving postnatal care within two days in many regions. Even high-performing states such as Kerala (93.8%) and Tamil Nadu (84.1%) report high levels of unmet need in this dimension. This indicates that improvements in institutional delivery have not been fully complemented by adequate postnatal care, suggesting gaps in continuity of care.

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Table 1: State-wise indicators of Maternal Health, NFHS-5 (2019-2021):

State	Maternal Health Parameters	
	Percentage not receiving ANC from a skilled provider[1]	Percentage of births not delivered in a health facility
Andaman and Nicobar	7.4	1.1
Andhra Pradesh	4.7	3.5
Arunachal Pradesh	23.9	20.8
Assam	14.9	15.9
Bihar	32.3	23.8
Chandigarh	5.1	3.1
Chhattisgarh	14.6	14.3
Dadra and Nagar Haveli and Div and Daman	3.1	3.5
Delhi	13.3	8.2
Goa	1.3	0.3
Gujarat	13.8	5.7
Haryana	12.9	5.1
Himachal Pradesh	14.7	11.8
Jammu and Kashmir	5.8	7.6
Jharkhand	20.8	24.2
Karnataka	3.2	3.0
Kerala	2.0	0.2
Ladakh	8.4	4.9
Lakshadweep	0.0	0.4
Madhya Pradesh	19.6	9.3
Maharashtra	7.2	5.3
Manipur	7.8	20.1
Meghalaya	16.3	41.9
Mizoram	13.5	14.2
Nagaland	29.6	54.3
Odisha	9.8	7.8
Puducherry	4.9	0.4
Punjab	14.1	5.7
Rajasthan	10.9	5.1
Sikkim	18.7	5.3
Tamil Nadu	4.7	0.4
Telangana	3.1	3.0
Tripura	16.4	10.8
Uttar Pradesh	18.5	16.6
Uttarakhand	12.8	16.8
West Bengal	15.9	8.3
India	**14.9**	**11.4**

[1] Skilled provider includes doctor, auxiliary nurse midwife, nurse, midwife, and lady health visitor

Source: National Report, NFHS-5 (2019-2021)

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Table 2: State-wise indicators of Child Health, NFHS-5 (2019-2021):

State	Child Health Parameters			
	Percentage of children who did not receive postnatal care from a skilled provider within 2 days of delivery[2]	Percentage of children who did not have full immunization	Infant Mortality ($_1q_0$)	Child Mortality ($_5q_1$)
Andaman and Nicobar	90.8	20.1	20.6	4.0
Andhra Pradesh	88.8	26.8	30.2	5.1
Arunachal Pradesh	93.0	35.1	12.9	6.0
Assam	94.4	33.3	31.9	7.4
Bihar	91.2	29.0	46.8	10.2
Chandigarh	90.8	19.1	15.5	4.2
Chhattisgarh	84.9	20.3	44.2	6.4
Dadra and Nagar Haveli and Div and Daman	91.7	5.1	31.8	5.3
Delhi	87.5	24.0	24.5	6.3
Goa	90.6	18.1	5.6	5.0
Gujarat	88.4	23.6	31.2	6.6
Haryana	83.7	23.1	33.3	5.6
Himachal Pradesh	86.6	10.8	25.6	3.4
Jammu and Kashmir	83.1	13.8	16.3	2.3
Jharkhand	87.8	25.9	37.9	7.9
Karnataka	86.7	15.7	25.4	4.2
Kerala	93.8	21.6	4.4	0.8
Ladakh	87.0	11.8	20	9.7
Lakshdweep	96.5	13.9		
Madhya Pradesh	85.5	22.6	41.3	8.2
Maharashtra	90.3	26.4	23.2	4.9
Manipur	98.3	31.2	25.0	5.2
Meghalaya	96.0	36.0	32.3	8.0
Mizoram	95.1	27.3	21.3	2.8
Nagaland	96.6	42.1	23.4	9.8
Odisha	90.5	9.3	36.3	5.0
Puducherry	89.0	17.7	2.9	1.0
Punjab	87.1	23.8	28.0	4.8
Rajasthan	88.9	19.5	30.2	7.5
Sikkim	92.8	17.5	11.2	0.0
Tamil Nadu	84.1	11.1	18.6	3.7
Telangana	88.5	20.9	26.4	3.0
Tripura	97.1	30.5	37.6	5.9
Uttar Pradesh	85.9	30.1	50.4	10.0
Uttarakhand	87.9	18.9	39.1	6.7
West Bengal	92.2	11.8	22.0	3.4
India	88.5	23.4	35.2	6.9

Source: National Report, NFHS-5 (2019-2021)

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Table 3: State-wise indicators of Maternal and Child Nutrition, NFHS-5 (2019-2021):

State	Nutrition Parameters	
	Anamia among Women	Percentage of children with stunted growth
Andaman and Nicobar	57.5	22.5
Andhra Pradesh	58.8	31.2
Arunachal Pradesh	40.3	28.0
Assam	65.9	35.3
Bihar	63.5	42.9
Chandigarh	60.3	25.3
Chhattisgarh	60.8	34.6
Dadra and Nagar Haveli and Div and Daman	62.5	39.4
Delhi	49.9	30.9
Goa	38.9	25.8
Gujarat	65.0	39.0
Haryana	60.4	27.5
Himachal Pradesh	53.0	30.8
Jammu and Kashmir	65.9	26.9
Jharkhand	65.3	39.6
Karnataka	47.8	35.4
Kerala	36.3	23.4
Ladakh	92.8	30.5
Lakshdweep	25.8	32.0
Madhya Pradesh	54.7	35.7
Maharashtra	54.2	35.2
Manipur	29.4	23.4
Meghalaya	53.8	46.5
Mizoram	34.8	28.9
Nagaland	28.9	32.7
Odisha	64.3	31.0
Puducherry	55.1	20.0
Punjab	58.6	24.5
Rajasthan	54.4	31.8
Sikkim	42.0	22.3
Tamil Nadu	53.4	25.0
Telangana	57.6	33.1
Tripura	67.2	32.3
Uttar Pradesh	50.4	39.7
Uttarakhand	42.6	27.0
West Bengal	71.4	33.8
India	57.0	35.5

Source: National Report, NFHS-5 (2019-2021)

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Table 4: State-wise Maternal and Child Health Index, NFHS-5 (2019-2021):

State	MCHI	category
Andaman and Nicobar	-0.43	Good
Andhra Pradesh	-0.15	Good
Arunachal Pradesh	0.11	Moderate
Assam	0.62	Poor
Bihar	1.33	Very Poor
Chandigarh	-0.41	Good
Chhattisgarh	0.31	Moderate
Dadra and Nagar Haveli and Div and Daman	0.12	Moderate
Delhi	-0.09	Good
Goa	-0.77	Very Good
Gujarat	0.31	Moderate
Haryana	-0.16	Good
Himachal Pradesh	-0.18	Good
Jammu and Kashmir	-0.59	Very Good
Jharkhand	0.77	Poor
Karnataka	-0.37	Good
Kerala	-0.95	Very Good
Ladakh	0.28	Moderate
Lakshdweep	-0.92	Very Good
Madhya Pradesh	0.38	Moderate
Maharashtra	-0.09	Good
Manipur	-0.10	Good
Meghalaya	1.14	Very Poor
Mizoram	-0.17	Good
Nagaland	0.99	Poor
Odisha	0.13	Moderate
Puducherry	-0.95	Very Good
Punjab	-0.21	Good
Rajasthan	0.06	Moderate
Sikkim	-0.59	Very Good
Tamil Nadu	-0.89	Very Good
Telangana	-0.32	Good
Tripura	0.61	Poor
Uttar Pradesh	0.70	Poor
Uttarakhand	0.03	Moderate
West Bengal	0.18	Moderate
India	0.31	Moderate

Source: Author's Calculations

VI.III. NUTRITIONAL CHALLENGES

Nutritional indicators, as shown in **Table 3**, emerge as a critical constraint across nearly all states. The prevalence of anaemia among women remains alarmingly high, exceeding 60% in states such as West Bengal (71.4%), Gujarat (65%), and Assam (65.9%). Similarly, child stunting rates are particularly high in Bihar (42.9%), Meghalaya (46.5%), and Uttar Pradesh (39.7%).

Even states with strong healthcare systems, such as Tamil Nadu and Kerala, continue to face moderate levels of anaemia and stunting, indicating that economic growth and healthcare access alone are insufficient to address nutritional deficiencies. These

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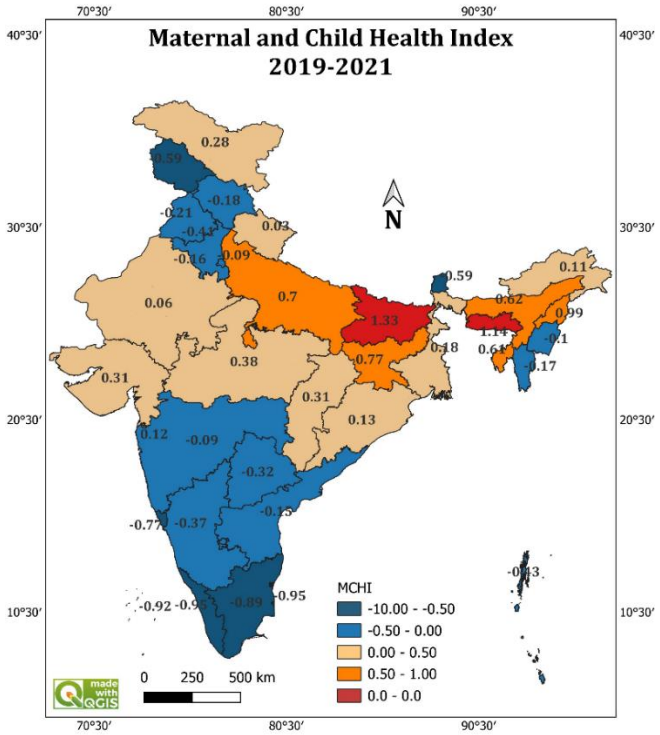
findings highlight the multidimensional nature of maternal and child health, where improvements in service delivery do not automatically translate into better nutritional outcomes.

VI.IV. COMPOSITE MATERNAL AND CHILD HEALTH INDEX (MCHI)

The Composite Maternal and Child Health Index (MCHI) (Figure 1) reveals pronounced inter-state disparities in India, reflecting uneven progress across maternal care, child health outcomes, and nutritional status. As shown in Table 4, the national average MCHI value stands at 0.31, placing India in the *moderate* category. However, these aggregate masks stark regional variations.

Figure 1: Maternal and Child Health Index, India 2019-2021:



Source: computed from NFHS-5 data.

A clear north–south divide is evident. Southern states such as Kerala (−0.95), Tamil Nadu (−0.89), and Puducherry (−0.95) fall within the *very good* category, indicating consistently strong performance across all dimensions of maternal and child health. In contrast, states such as Bihar (1.33) and Meghalaya (1.14) fall under the *very poor* category, highlighting severe deficiencies. Similarly, Uttar Pradesh (0.70), Jharkhand (0.77), and Assam (0.62) are categorized as *poor*, reflecting persistent structural challenges.

VI.V. COMPOSITE PATTERNS AND REGIONAL INEQUALITY

The integration of these indicators into the MCHI reveals that poor-performing states tend to exhibit deficiencies across multiple dimensions rather than a single indicator. For example, Bihar and Uttar Pradesh perform poorly in maternal care, child mortality, and nutrition simultaneously, suggesting deeply entrenched structural disadvantages.

In contrast, high-performing states demonstrate consistent performance across indicators, reflecting long-term investments in health, education, and social welfare. The results thus reinforce the argument that maternal and child health outcomes are closely linked to broader development processes.

Furthermore, the clustering of poor-performing states in the northern and northeastern regions indicates spatial inequality in health outcomes. This pattern aligns with the concept of regional divergence, where historically disadvantaged regions continue to lag despite national-level progress.

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VII. CONCLUSION

This study highlights significant inter-state disparities in maternal and child health in India through the construction of a Composite Maternal and Child Health Index (MCHI) using NFHS-5 data. The findings reveal a persistent regional divide, with southern states consistently outperforming their northern and northeastern counterparts.

While India has made notable progress in improving maternal healthcare utilization and reducing mortality rates, the persistence of high levels of anaemia and child stunting underscores the need for a more integrated approach to public health. The results suggest that improvements in healthcare access alone are insufficient without parallel advancements in nutrition, education, and socio-economic conditions.

From a policy perspective, the findings call for region-specific strategies tailored to the unique challenges of each state. Strengthening primary healthcare systems, improving nutritional interventions, and addressing socio-economic inequalities should be central to future policy efforts. Special attention must be given to lagging states such as Bihar, Uttar Pradesh, and Meghalaya, where multiple deprivations intersect.

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