Trends and Status of Multidimensional Child Deprivation in India from 2005-06 to 2019-21: A Comparative Analysis Using NFHS Data

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Abstract

Child deprivation remains a critical issue in India, where many children under five lack access to basic necessities like healthcare, nutrition, and sanitation. Addressing this challenge is essential for achieving sustainable development goals and ensuring the well-being of future generations. The present study uses unit-level data from the last three rounds of the National Family Health Survey (NFHS) (2005-06, 2015-16, and 2019-21) to develop the Multidimensional Child Deprivation Index (MCDI) in India. The MCDI includes health care, nutritional status, and hygiene, measured using the Alkire-Foster (2010) methodology. Our analysis shows that health care deprivation is the most significant contributor to MCDI, followed by nutritional status and hygiene. More than a third of Indian children remained multidimensionally deprived in 2019-21, despite a significant reduction of 19.5 percentage points since 2005-06. Rural areas witnessed a larger decline in MCDI, though disparities persist across caste and religious groups. The study identifies significant geographical variations in child deprivation, with states like Bihar, Jharkhand, Nagaland, and Meghalaya remaining at relatively high levels of deprivation. The study concludes that addressing multidimensional child deprivation requires targeted policies focusing on health care, nutrition, and hygiene, especially among rural, marginalized, and economically disadvantaged groups. Further research should focus on analyzing the long-term impact of specific policy measures on reducing multidimensional child deprivation in India.

Keywords: *Child deprivation, Health care, Nutritional status, Hygiene, NFHS*

JEL Classifications: *I15, I18, I38,*

1. Introduction

In India, where many children under the age of five lack access to basic necessities like food, clean water, healthcare, and education, child deprivation remains a critical issue. Despite significant improvements in recent years, the country continues to grapple with high rates of child poverty, leading to millions of children suffering from disease, malnutrition, and other forms of deprivation. A multifaceted approach that includes financial contributions to social protection, healthcare, education, and nutrition is needed to address child deprivation. The root causes of poverty and inequality, such as exclusion and discrimination, must also be addressed. Additionally, it is important to promote the rights and wellbeing of all children, regardless of their circumstances or background. The children are the foundation of a nation. But a sizable portion of them is identified as being among society's most vulnerable individuals (Ferrone and Chzhen 2016). The detrimental effects of child poverty are now widely acknowledged (Fonta et al. 2020), both at the time it is experienced and over the course of a child's lifetime (Corak 2006; Esping-Andersen and Myles 2009). A short-term reduction in food intake or education

has a long-term effect on the development of children (UNICEF and World Bank Group 2016; Dutta 2021). As a result, the United Nations Convention on the Rights of the Child (CRC) has made it abundantly clear that every child has the non-negotiable rights to survival, health, nutrition, education, protection, and participation. Children are more at risk when there are poor socioeconomic conditions because this stunts their development, denies them access to healthy food and shelter, weakens their physical health, and exposes them to high mortality rates (Ogwumike and Ozughalu 2018). Consequently, children become underweight, stunted, and wasted, and the mortality rate rises, which has a detrimental effect on economic growth (Sen 2009). The improvement of children is a priority for the sustainable development goals (SDGs). Therefore, a thorough examination of children's levels of deprivation is essential for the nation's sustainable human development. According to critics, the one-dimensional approach misses the unique needs of children in different age groups, which are different from those of adults (Roelen et al. 2009; White et al. 2003). Therefore, researchers and academics generally approve of using a multidimensional approach to measure multidimensional child deprivation through welfare dimensions and indicators (Fonta et al. 2020; Chzhen and Ferrone 2016).

Literature Review

Numerous studies have investigated various aspects of child poverty and deprivation. Trani et al. (2013) analysed the multidimensional poverty among children in Afghanistan using the Alkire-Foster methodology. Dreze et al. (2007a; 2012b) explored the structural causes of child deprivation and put light on the issue of wellbeing among children under the age of six. Dutta (2021) studied the multidimensional poverty among children in India and Bangladesh and suggested age-centric, region and dimension-specific social policies for improving the status of children. Alkire et al (2015) provided a systematic outline of the Alkire-Foster multidimensional methodology and also postulated the procedure for identifying the poor using the dual cut-off approach. Sachdev & Dasgupta (2011) and Bhatia et al. (2006) concluded that basic important services like Complementary Health Services, Growth Monitoring Promotion, and Non-Formal & Pre-School Education must be provided for the betterment of the children. Mishra & Ray (2013) explored that among stunted children, the health dimension was the most significant source of deprivation in both rural and urban areas. Winter and Connolly (2005), analysed the relationship between deprivation and child abuse in the UK and found a strong relationship between them and they argued that more quantitative research has to be done so as to identify and understand the influence of structural factors on issues related to family and childcare. Kakwani (1984) presents a relative deprivation curve which can represent the size distribution of income and wealth which is shown using the Australian Household Expenditure Survey 1975-1976. Chzhen and Ferrone (2016) reported that children belonging to the consumption-poor household were found to be more deprived in more than one dimension analysed separately and in more than one dimension at once. Ogwumike and Ozughalu (2018) showed that 23.2 per cent of the children in Nigeria were in extreme child poverty whereas 70.3 per cent of the children were in overall child poverty. Kumar et al. (2021) determined the multilevel analysis of the impact of socio-economic factors on malnutrition among tribal children.

While significant research has been conducted on multidimensional child poverty, several gaps persist. Most studies focus on individual rounds of data or specific dimensions without comparing trends over time. Regional disparities in child deprivation are underexplored in the literature, and the complex relationship of socioeconomic factors influencing multidimensional child deprivation remains inadequately studied. In this background, the present study aims to analyze the multidimensional aspects of child deprivation in India and analyse its changes over time. Specifically, the study seeks to measure the Multidimensional Child Deprivation Index

(MCDI) using NFHS data, identify trends across NFHS-III (2005-06), NFHS-IV (2015-16), and NFHS-V (2019-21), and examine the socioeconomic factors influencing child deprivation. Additionally, it aims to assess geographical variations in child deprivation levels and identify their policy implications. Understanding multidimensional child deprivation is essential for designing effective policies to improve child health and well-being. This study provides comprehensive insights into the status and trends of child deprivation across India, highlighting disparities in respect of location, social castes, religion, wealth class and states. By exploring the socioeconomic factors influencing child deprivation, policymakers can formulate targeted strategies to address the needs of marginalized communities. The remainder of this paper is organized as follows. Section 2 describes the data and methodology used to analyze child deprivation. Section 3 presents the results and analysis, including trends and geographical variations. Section 4 provides a comprehensive econometric analysis of child deprivation. Section 5 offers the concluding observations, emphasizing specific policy recommendations.

2. Data base and Methodology

2.1 Data Base

This study utilizes unit-level data from the last three rounds of the National Family Health Survey (NFHS): NFHS-III (2005-06), NFHS-IV (2015-16), and NFHS-V (2019-21). Conducted by the International Institute for Population Sciences (IIPS), these surveys provide comprehensive information on India's health and demographic landscape. They are widely regarded as a reliable source for assessing national and regional health trends, especially in child and maternal health. The NFHS has established a consistent sample design across national, state/union territory, and district levels. Two stages of cluster sampling were used in the methodology. Primary sampling units were chosen in the first phase by applying the probability proportional to size technique. NFHS-V provides state-level estimates for various important indicators, similar to NFHS-III and NFHS-IV, ensuring continuity across NFHS rounds. To facilitate comparisons over time, data collected in NFHS-V is compatible with that of NFHS-IV and NFHS-III. This consistency in methodology and data collection enables researchers and policymakers to analyse trends and changes in key indicators related to population health, demographics, and social determinants over successive survey periods, helping in evidence-based decision-making and program planning. The study focuses on children under five years of age for each survey round. After data cleaning and processing, the final analytical sample includes 48,084 children from NFHS-III, 243,284 children from NFHS-IV, and 211,088 children from NFHS-V.

2.2 Methodology

The methodology involves two key components: the Alkire-Foster (AF) methodology for developing the MCDI and the Heckman two-step model for identifying the socioeconomic determinants of multidimensional child deprivation.

A) Alkire-Foster Methodology

We have considered the Alkire-Foster Methodology for measuring the Multidimensional Child Deprivation Index (MCDI) which can be expressed as the product of CDR and ICD. This method has been widely used to measure Multidimensional Poverty Index (Alkire et al.2015; Das and Paria 2018; UNDP 2019; Das et al. 2021a; Das et al. 2021b; Kumbhakar et al. 2022).

Achievement Matrix: *Let X is* $\boldsymbol{n \times d}$ dimensional achievement matrix, where $\boldsymbol{x_{ij}}$ is the achievement of child $\boldsymbol{i}$ in dimension $\boldsymbol{j}$. ***Deprivation Cut-off:*** A threshold $\boldsymbol{z_j}$ is defined as the

minimum required in order to be non- deprived. If $x_{ij} < z_j$, the child is said to be deprived in that dimension. ***Deprivation Matrix:*** We obtain a deprivation matrix b^0 such that

$b_{ij}^0 = 1$ *when* $x_{ij} < z_j$ $= 0$ *otherwise,* for all $z = 1, \ldots, d$ *and* $i = 1, \ldots n$

Weights and Deprivation Score: A vector $w = (w_1, \ldots, w_d)$ of weights is used to indicate the relative important of child deprivation in each dimension. The weight attached to dimension j is denoted by $w_j > 0$. Three-dimensional weight is again equally distributed among the indicators of particular dimension. The child deprivation score is given by $s_i = \sum_{j=1}^{d} w_j b_{ij}^0$. The score ($s_i$) varies between 0 and 1. The child deprivation reach its maximum i.e., 1 when the child is deprived in all dimensions. $s_i = 1$ if the i-th child is deprived in all dimensions $s_i = 0$ if the i-th households is not deprived in any dimensions. The child is multidimensionally deprived if he or she is deprived in at least one dimension. Since the weight of a particular dimension is 33.33, therefore the deprivation score for being multidimensionally child deprived is at least 33.33. Here, $\rho_k(xi.; z) = 1$ ***if*** $s_i \geq k$ ***and*** $\rho_k(xi.; z) = 0$ ***otherwise.*** Where, k = 33.33.

Multidimensional CDR, ICD and MCDI: *Child Deprivation Ratio (CDR)* is the proportion of the child population who are multidimensionally deprived and CDR = c / n, where c is the number of children who are multidimensionally deprived and n is the total population of child. *Intensity of child deprivation (ICD)* reflects the proportion of the weighted component indicators in which, on an average, multidimensionally deprived children are deprived in different indicator. $ICD = \frac{1}{c}\sum_{i=1}^{c} s_i(k)$ where s_i is the score based on the deprivation experienced by the children in all the considered indicators. MCDI is calculated as $MCDI = CDR \times ICD$

B) The Dimensions and Indicators of Multidimensional Child Deprivation

The MCDI comprises three core dimensions: health care, nutritional status, and hygiene. Each dimension contains specific indicators based on data availability in NFHS. ***Health Care*** dimension consists of three indicators namely antenatal care, child health check-up before and after discharge and immunizations. ***Nutritional Status*** dimension is organized by three indicators which are stunted, underweight and wasted child which will indicate undernutrition level of children. ***Hygiene*** domain of deprivation consists with two indicators namely sanitation facility and safe drinking water. If the household has not acquired safe intake water facility and improved sanitation system then the child of that household is considered to be deprived. The indicators corresponding to these three dimensions are given in the Table 1. The dimensions and indicators are measured in the availability of NFHS information.

Table 1 Dimensions, Indicators and Deprivation Cut-offs to measure Child deprivation

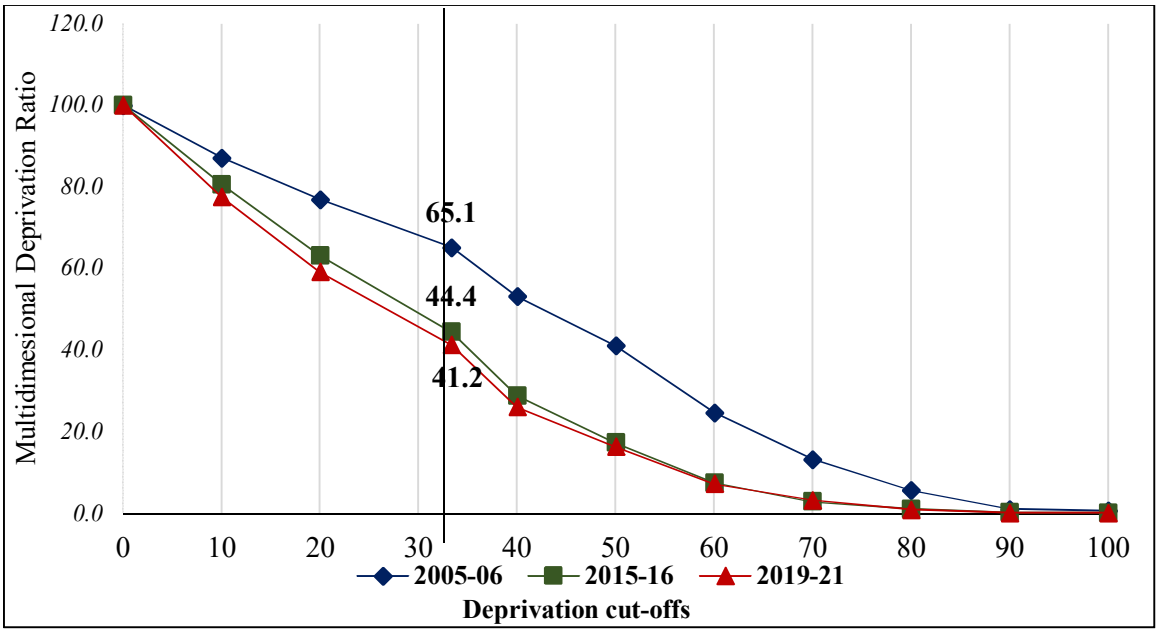
Dimension (Weight)	*Indicators (Weight)*	*Deprivation Cut-off*
Health Care (1/3)	Antenatal care (1/9)	• Pregnancy care not-received from skilled providers, that is, doctors, auxiliary nurse midwives (ANMs), nurses, midwives, and lady health visitors.
	Health check-ups (1/9)	• New-born who does not receive the first check-up before and after discharge from the hospital
	Immunizations (1/9)	• Children aged 12-23 months who are not fully immunized consist of BCG, 3 doses of polio, DPT and Measles Vaccinations
Nutritional Status (1/3)	Stunted (1/9)	• Height-for-age Z-score is below minus two standard deviations (-2 SD)
	Wasted (1/9)	• Weight-for-height Z-score is below minus two standard deviations (-2 SD)
	Under-Weighted (1/9)	• Weight-for-age Z-score is below minus two standard deviations (-2 SD)
Hygiene (1/3)	Toilet (1/6)	• If the household's sanitation facility is not improved
	Safe Drinking Water (1/6)	• Sources of drinking water are located more than 30 minutes away by walking

Sources: As in figure 1

C) Robustness of Measurement of Multidimensional Child Deprivation:

A set of parameters are specified in order to estimate MCDI, so it's critical to assess how robust the estimation is to changes in the parameters (Alkire and Santos 2014; Alkire et al. 2015).

Figure 1 Robustness of Multidimensional Child deprivation Ratio by different deprivation Cut-offs



Sources: Designed by Authors from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

Since the multidimensional child deprivation ratio (CDR) measurement is sensitive to the multidimensional deprivation cut-off, we have shown various multidimensional CDR by using varied multidimensional deprivation cut-offs in Figure 1. It was observed that there were no multidimensional deprived in 2005-2006, 2015-2016 or 2019-21 using the intersection method, which demands that the aggregate deprivation score be equal to 100. MCDI is considered to be robust if altering the multidimensional deprivation cut-offs. i.e., higher the deprivation cut-of, lower the share of multidimensional deprived which implies that the individual children on an average are deprived in more indicators or dimensions. The result in figure 1 shows that MCDI is highly robust in deferent years during 2005-06 to 20219-21 in deferent value of CDR.

D) Heckman two steps model Econometrics

Heckman Two-Step Estimation

To identify the socioeconomic determinants of multidimensional child deprivation, this study employs the Heckman two-step model. The model takes into account the two variables MCD_{it} and $IMCD_{it}$, where MCD_{it} represents the incidence of multidimensional deprivation and $IMCD_{it}$ represents the inadequacy score of the i-th child who is multidimensionally deprived at time t. Only when the latent variable s_{it}, or inadequacy score, is greater than or equal to 33.33. Only if MCD_{it} is 1 can the value of the variable $IMCD_{it}$ be observed. Standard probit and linear regression model estimation are steps in Heckman's two-step process. Here is a two-step process are as follow.

Step 1, implements the Maximum Likelihood Estimation (MLE) with the complete set of observations in the standard probit model to examine the impact of children's socioeconomic characteristics on MCD_{it} i.e.,

$$MCD_{it} = \beta_o + \sum_{k=1}^{K} \beta_k X_{it,k} + v_{it} \quad \ldots\ldots (I)$$

Where, $MCD_{it} = 1$, if i-th child experiences inadequacies and 0 otherwise; X_{it} are the control factors representing socio-economic characteristics of the women.

Step 2, In order to determine $IMCD_{it}$, we estimate the regression equation with Inverse Mills Ratio (λ_{it}) as an additional variable.

$$IMCD_{it} = \beta_o + \sum_{k=1}^{K} \beta_k X_{it,k} + \beta_{\lambda} \lambda_{it} + \varepsilon_{it} \quad \ldots\ldots (II)$$

The OLS regression yields β, β_λ, δ_ε and thus the correlation $\rho = \beta_\lambda / \delta_\varepsilon$. The error terms v_{it} and ε_{it} are independently (across observations) and jointly normally distributed with covariance ρ δ_ε.

The location, social castes, religions, levels of education of the women, employment status, as well as household wealth are the socioeconomic characteristics of the children that we have taken into consideration for the analysis.

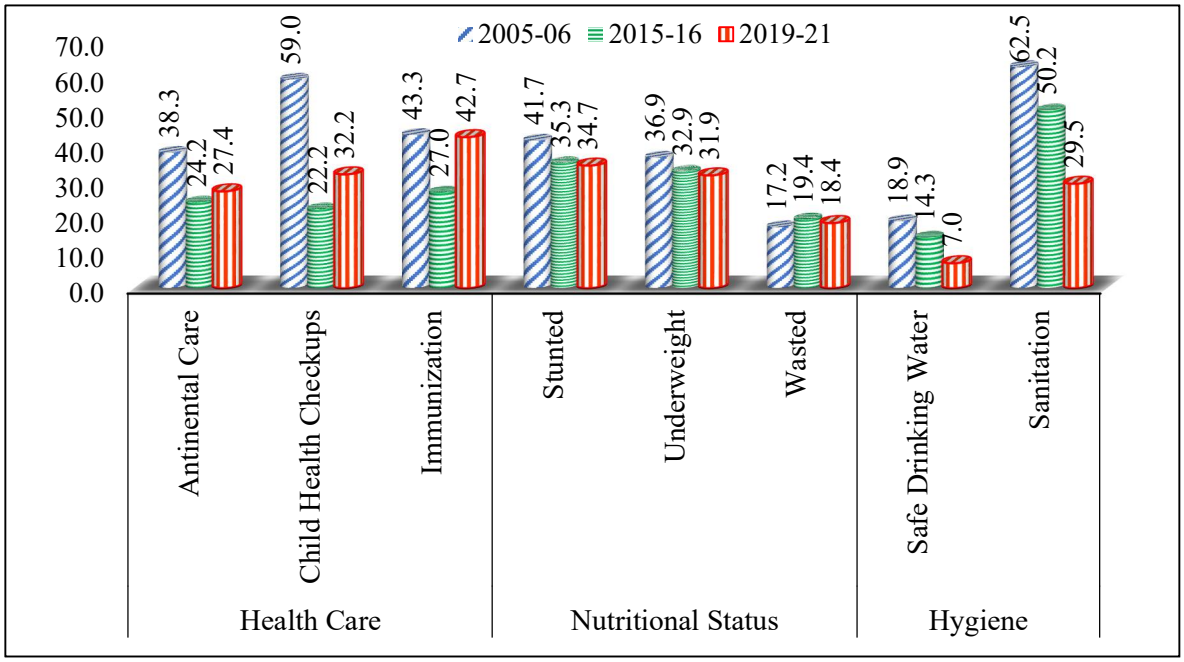
3. Trend of Multidimensional Chid deprivation in India 2005-06 to 2019-21

3.1 Status of Multidimensional child deprivation across indicators

This section provides a comprehensive analysis of trends in multidimensional child deprivation in India from 2005-06 to 2019-21. Figure 2 provides the percentage of deprived children across indicators for each of these three dimensions. In the health care dimension, antenatal care deprivation fluctuated between 19.2% and 29.2% over the years, while child health check-up deprivation ranged from 22.2% to 34.5%. Immunization deprivation, however, showed a

notable increase from 27% in 2015-16 to 42.7% in 2019-21, highlighting a critical gap in preventive health services for children. Within the nutritional status dimension, the prevalence of stunted children remained high but exhibited a decline from 41.69% in 2005-06 to 34.65% in 2019-21. Similarly, the percentage of underweight children reduced from 36.88% in 2005-06 to 31.89% in 2019-21, while the prevalence of wasted children remained relatively stable. In the hygiene dimension, deprivation in access to safe drinking water decreased significantly from 21.4% in 2005-06 to 8.5% in 2019-21. Sanitation deprivation also showed a remarkable reduction from 76.1% in 2005-06 to 35.6% in 2019-21, reflecting progress in improving household sanitation facilities. Despite these improvements, persistent disparities across socioeconomic and regional lines emphasize the need for targeted interventions.

Figure 2 Percentage Share of Deprived Children across indicators in India, 2005-06 to 2019-21

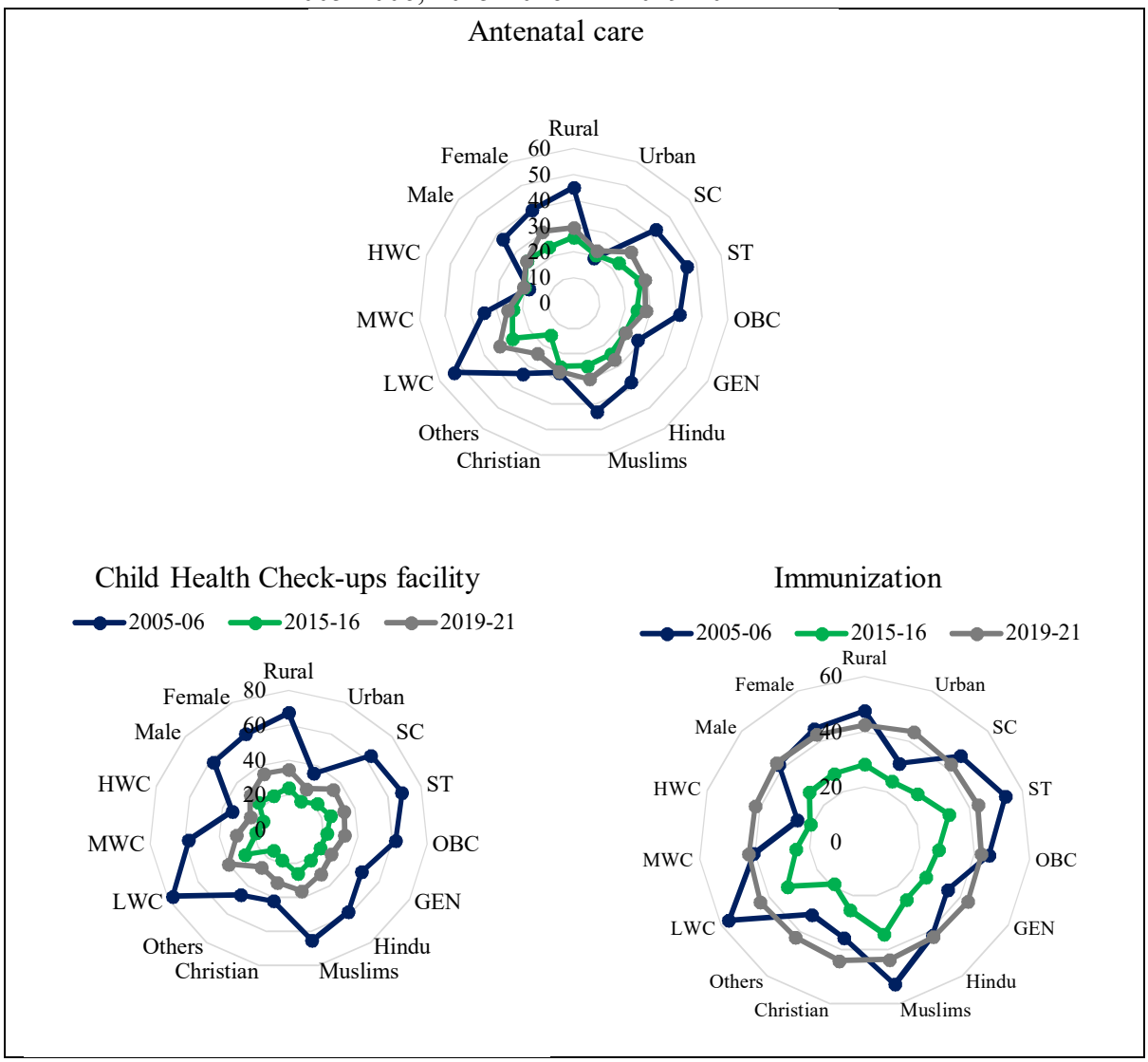


Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

3.2 Socio-economics cluster across indicators in India, 2005-06 to 2019-21

Figure 3 shows the percentage share of child deprived of health care across a range of household characteristics in India from 2005–06 to 2019–21. Health care dimension be made up of with four indicators namely antenatal care, health check-ups and immunizations. In rural areas, the reduction in the share of deprived children was the highest in health check-ups (67.2 to 34.5 per cent) followed by child and immunization (47.5 to 42.4 per cent) during 2005-06 to 2019-21. In urban areas, the share of deprived children has increased in child immunization (31.1 per cent to 47.3 per cent) during 2005-06 to 2019-21. Although there has been significant increasing in the share of deprived children in terms of immunization across each social caste but was relatively the highest among the STs but still 43.2 per cent of the ST children were deprived of immunization in 2019-21. Across religion, Muslims were more deprived as compared to other religions group in each of the indicators of health care and the reduction was the highest in child immunization (52.8 to 43.6 per cent). Female children were observed to face higher deprivation in each indicator of health care in the year of 2005-06 to 2019-21.

Figure 3 Percentage Share of Deprived in Health Care Indicators across socio-economic characteristics in India 2005-2006, 2015-2016 and 2019-2021



Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

Figure 4 depicts the percentage of children in India who fall into the three nutritional status dimension indicators of stunted, underweight, and wasted children. Among these indicators, the share of wasted children has increased across all household characteristics over the considered period. In the case of stunted and underweight children, the increase in the share of deprived children happened among urban residents and OBCs. The percentage share of deprived children is depicted in the indicators depicting nutritional status in India, which consist of three indicators specifically: stunted, underweight, and wasted children. Among these indicators, the share of wasted children has increased across all household characteristics over the considered period. In the case of stunted and underweight children, the increase in the share of deprived children happened among urban residents and OBCs.

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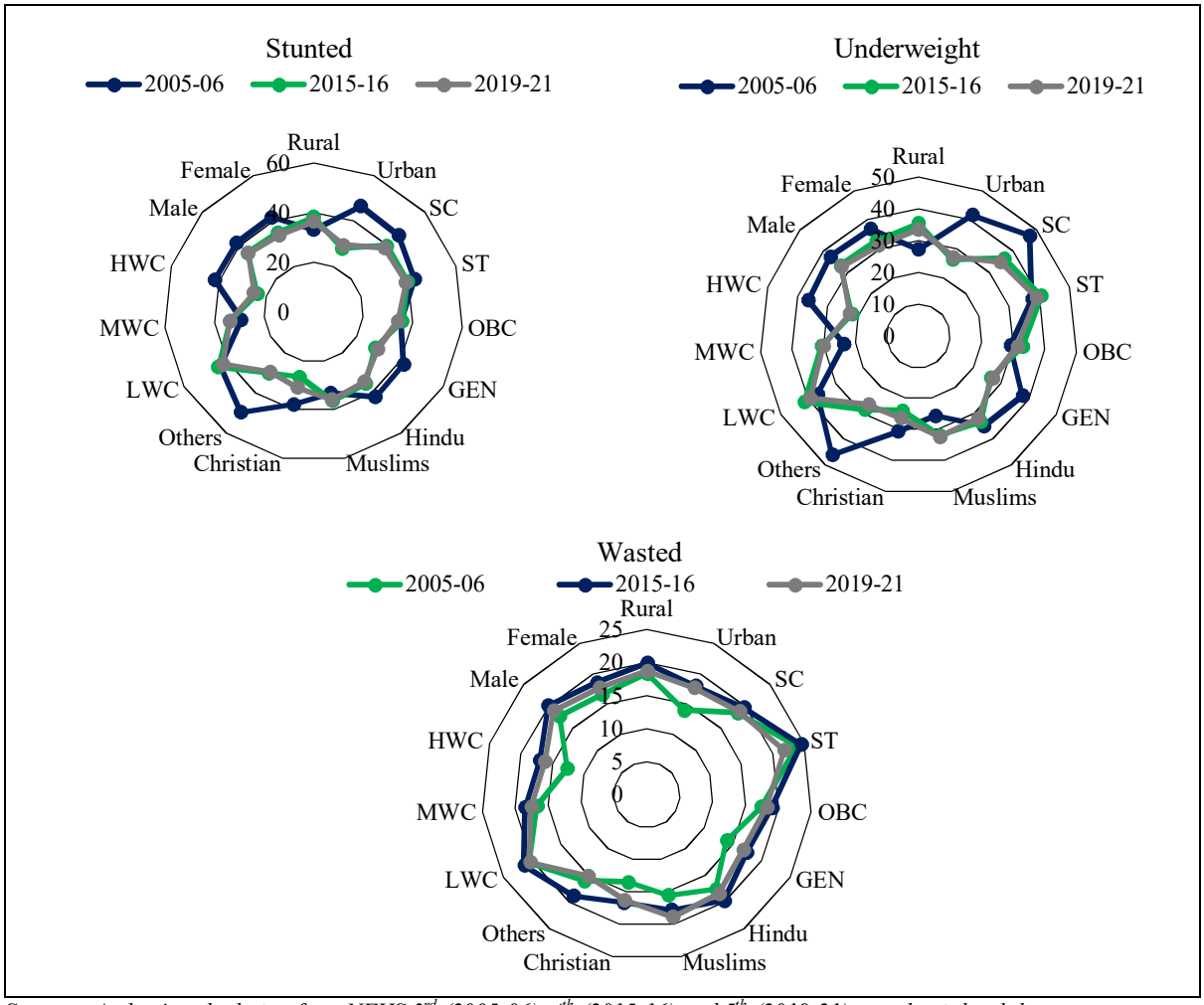
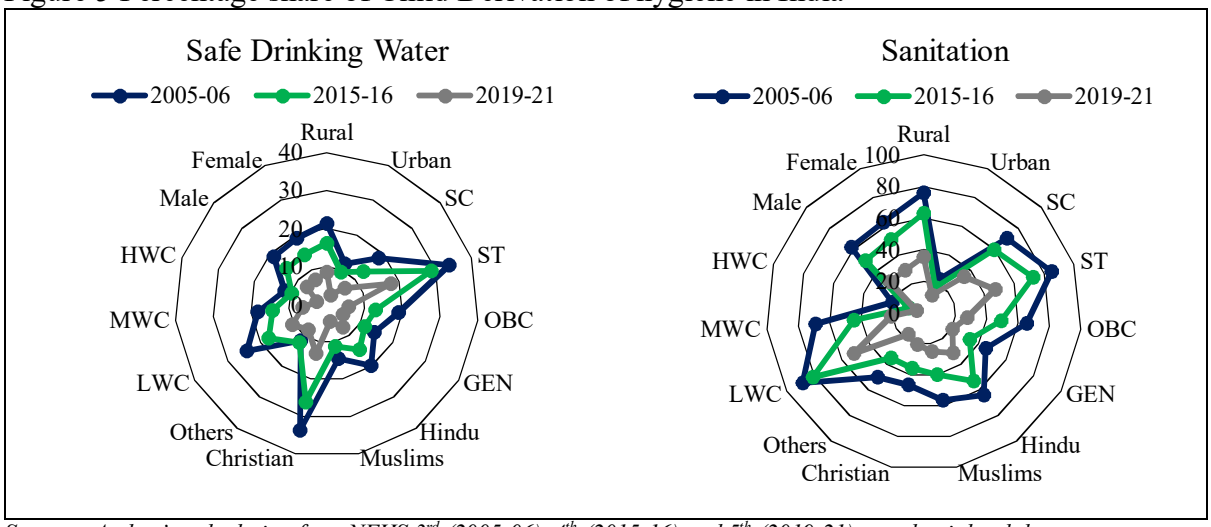
Figure 4 Percentage share of child derivation of nutritional status in India



Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

Figure 5 presents the percentage of child deprivation in the hygiene dimension as reflected by safe drinking water and sanitation in India from 2005–06 to 2019–21. Across household characteristics, there has been a significant reduction in the share of deprived children with access to safe drinking water. While in the case of sanitation, the share of deprived children has also decreased across household characteristics. However, rural areas continue to lag behind urban areas in terms of sanitation facilities in 2019-21. Among social caste STs (47 per cent), a higher share experienced deprivation in 2019–21. According to household wealth class, 51.4 per cent of children are still deprived in recent times. Female children were observed to face higher deprivation in each indicator of hygiene dimension from 2005–06 to 2019–21.

Figure 5 Percentage share of Child Derivation of hygiene in India

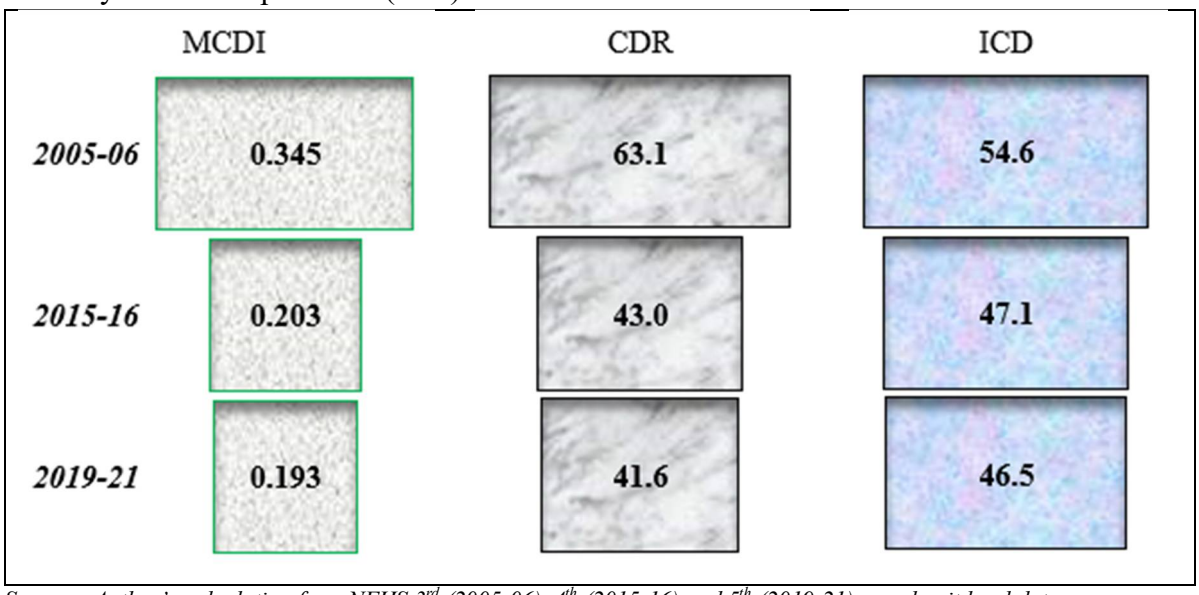


Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

3.3 MCDI, ICD and CDR

Between 2005–2006 and 2019–21, every component of the multidimensional deprivation measurement decreased. In India, the multidimensional CDR declined from 63.1 per cent in 2005-06 to 46.5 per cent in 2019-21.

Figure 6 Multidimensional child deprivation (CDI), Child deprivation ratio (CDR) and Intensity of child deprivation (ICD) in India



Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

It was determined that this decrease was statistically significant. From 2005–06 to 2019–21, the intensity of multidimensional deprivation (ICD) significantly decreased from 55.3 per cent to 47.5 per cent. Multidimensional child deprivation index (MCDI) also significantly declined from 0.345 in 2005-06 to 0.193 in 2019-21 in India. In table 2 represent the trend of MCDI, CDR and ICD in India, whereas, across socio-economics groups of this measurement are in figure 6.

Table 2: MCDI, ICD and CDR across socio-economics characters in India, 2005-06 to 2019-21

	2005-06			2015-16			2019-21		
	MCDI	**CDR**	**ICD**	**MCDI**	**CDR**	**ICD**	**MCDI**	**CDR**	**ICD**
Location									
Urban	0.163	33.8	48.3	0.107	25.3	42.4	0.132	31.0	42.6
Rural	0.408	73.4	55.7	0.240	50.0	48.1	0.215	45.4	47.4
Social Caste									
SC	0.389	70.3	55.3	0.223	47.4	47.2	0.214	45.4	47.2
ST	0.481	81.7	58.8	0.313	61.9	50.6	0.266	53.4	49.7
OBC	0.363	66.3	54.8	0.197	42.2	46.7	0.189	40.8	46.2
GEN	0.238	46.5	51.2	0.140	31.1	45.0	0.152	33.0	46.1
Religion									
Hindu	0.349	63.6	54.9	0.208	44.0	47.3	0.195	41.8	46.8
Muslim	0.349	65.0	53.8	0.190	41.2	46.1	0.193	42.3	45.6
Christian	0.258	47.7	54.1	0.166	36.0	46.2	0.177	38.8	45.5
Others	0.260	49.1	52.9	0.140	29.9	46.9	0.151	33.8	44.7
Economic (Wealth Class)									
LWC	0.495	85.2	58.0	0.307	62.3	49.3	0.273	55.3	49.3
MWC	0.135	30.0	45.1	0.170	38.1	44.6	0.164	37.0	44.2
HWC	0.340	66.0	51.5	0.075	18.8	40.1	0.132	33.0	40.0
Sex									
Male	0.340	62.4	54.4	0.200	42.7	46.9	0.187	40.6	46.1
Female	0.351	63.9	54.9	0.205	43.2	47.3	0.200	42.7	46.9

Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

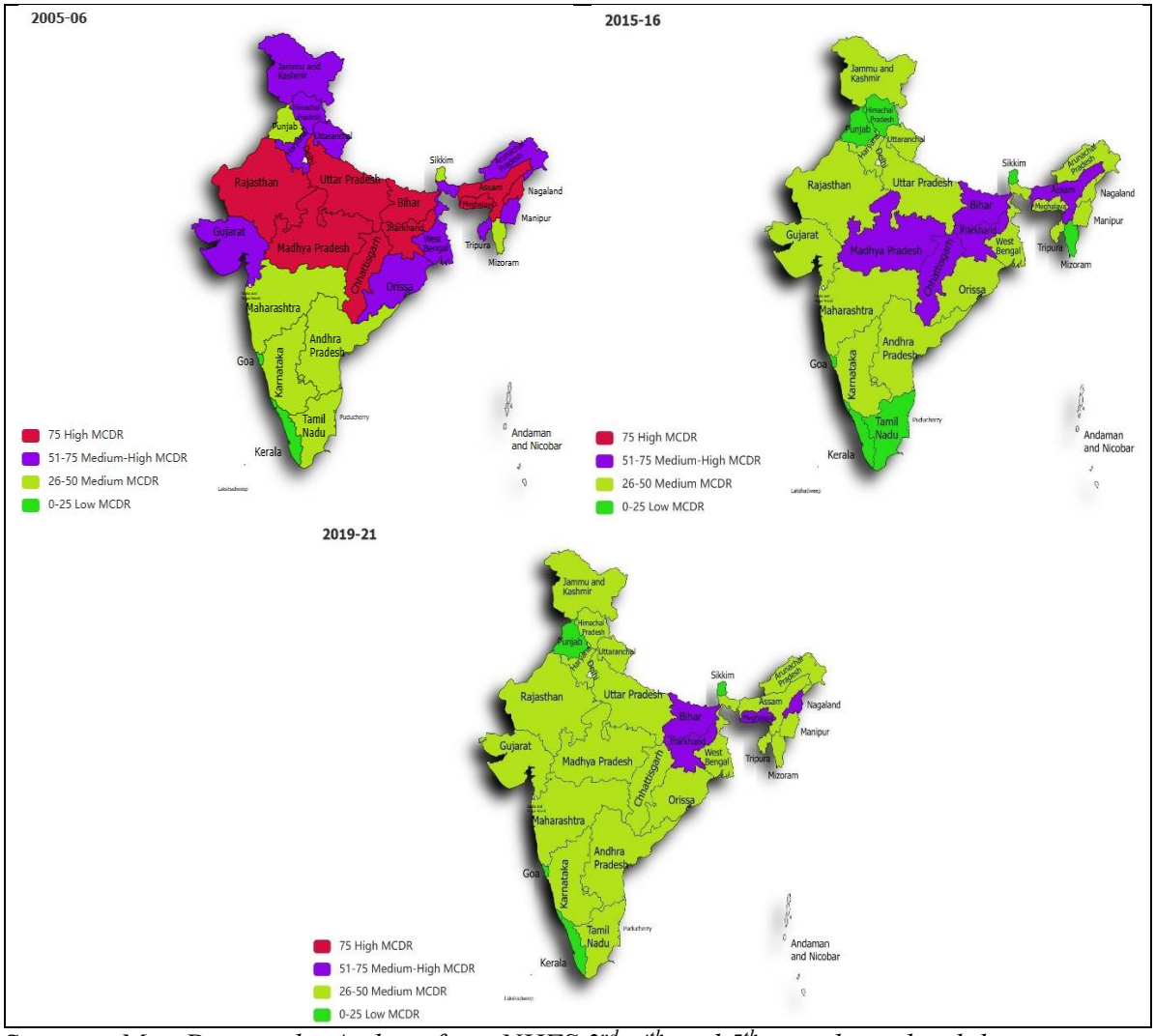
The CDR was significantly higher in rural areas than in urban areas. In the rural areas, as many as 73.4 per cent of children were multidimensionally deprived in 2005-06 while this share reduced to 50.0 per cent in 2015-16 and now it was 45.4 per cent in the years 2019-21. In the urban area, it was found to be an ups and downs scenario for the child derivation ratio during this period. It declined from 33.8 per cent in 2005-06 to 25.3 per cent in 2015-16 but in 2019-21 it increased to 31.0 per cent. Across the social caste, it is evident that both CDR and ICD have significantly declined during this time. The maximum reduction in MCDI was observed in the case of STs. Where it has declined from 0.502 in 2005-06 to 0.262 in 22019-21. But, still, STs have occupied a higher share of CDR in recent years. Across religion, the deprivation ratio and MCDI is consistently higher in Muslim followed by Hindu, Others and Christians. It is clear that when it comes to different wealth classes, the children from the lower economies experience a higher rate of deprivation. Both CDR and ICD are lowest in the row in higher wealth class families followed by medium and low wealth class. Based on the child's sex, it has been found that both male and female children have experienced a significant decline in MCDI, but the male children experienced a relatively greater decline than their female counterparts. MCDI was 0.200 for female children and 0.187 for male children in 2019–21 in Table 2.

3.4 Multidimensional Child Deprivation Mapping in Indian States

Map 1 illustrates the change in multidimensional child deprivation across Indian states from 2005-06 to 2019-21. There's a noticeable decrease in child deprivation during this period. In 2005-06, nine states had a very high rate of child deprivation, with over 75 per cent of children affected: Jharkhand, Bihar, Uttar Pradesh, Nagaland, Madhya Pradesh, Assam, Chhattisgarh,

Rajasthan, and Meghalaya. Additionally, ten states, including Orissa, Arunachal Pradesh, Tripura, West Bengal, Manipur, Uttaranchal, Jammu and Kashmir, Haryana, Himachal Pradesh, and Gujarat, were in the medium-high range, with over 50 but less than 75 per cent of children affected. In 2019-21, only four states namely Bihar, Jharkhand, Nagaland, and Meghalaya remained in the medium-high range, with more than 50 per cent but less than 75 per cent of children affected. This indicates an improvement, as no states showed a higher range of child deprivation in recent years. The findings suggest successful efforts to alleviate child deprivation across many Indian states.

Map 1: Multidimensional Child Deprivation Ratio mapping across States in India, 2005-06 to 2019-21



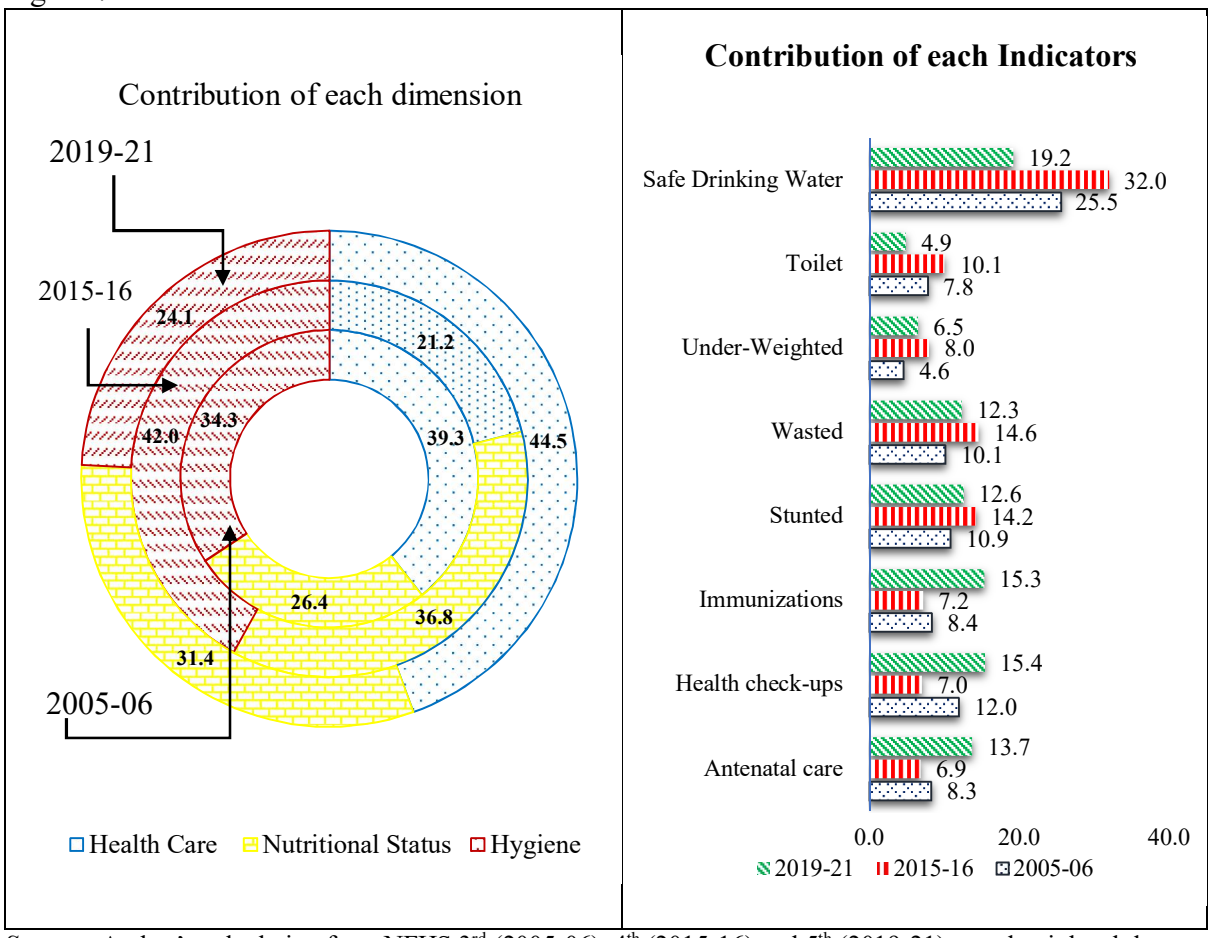
Sources: *Map Desigen by Authers from NHFS 3rd, 4th and 5th round unit level data*

3.5 Contribution of each dimension and Indicators

As shown in the figure, we have examined how various dimensions and indicators contributed to the MCDI in India from 2005–2006 to 2019–21. In the year of 2019-21 the contribution of health care (44.5 per cent) to MCDI was the highest followed by nutritional status (31.4 per cent) and hygiene (24.1 per cent). In 2015-16, contribution share is higher in hygiene dimension (42 per cent) followed by nutritional status (36.8 per cent) and health care (21.2 per cent). While in 2005-06, the contribution of health care dimension (39.3 per cent) was the

highest followed by hygiene (34.3 per cent) and nutritional status (26.4 per cent). Across indicators, safe drinking water contributed constantly the most to MCDI during this same time. Whereas, the least contribution to the MCDI was improved toilet facility 4.8 per cent in 2019-21 followed by underweight (6.3 per cent), antenatal care (10.1 per cent) and so on.

Figure 7 Contribution of each dimension and Indicators

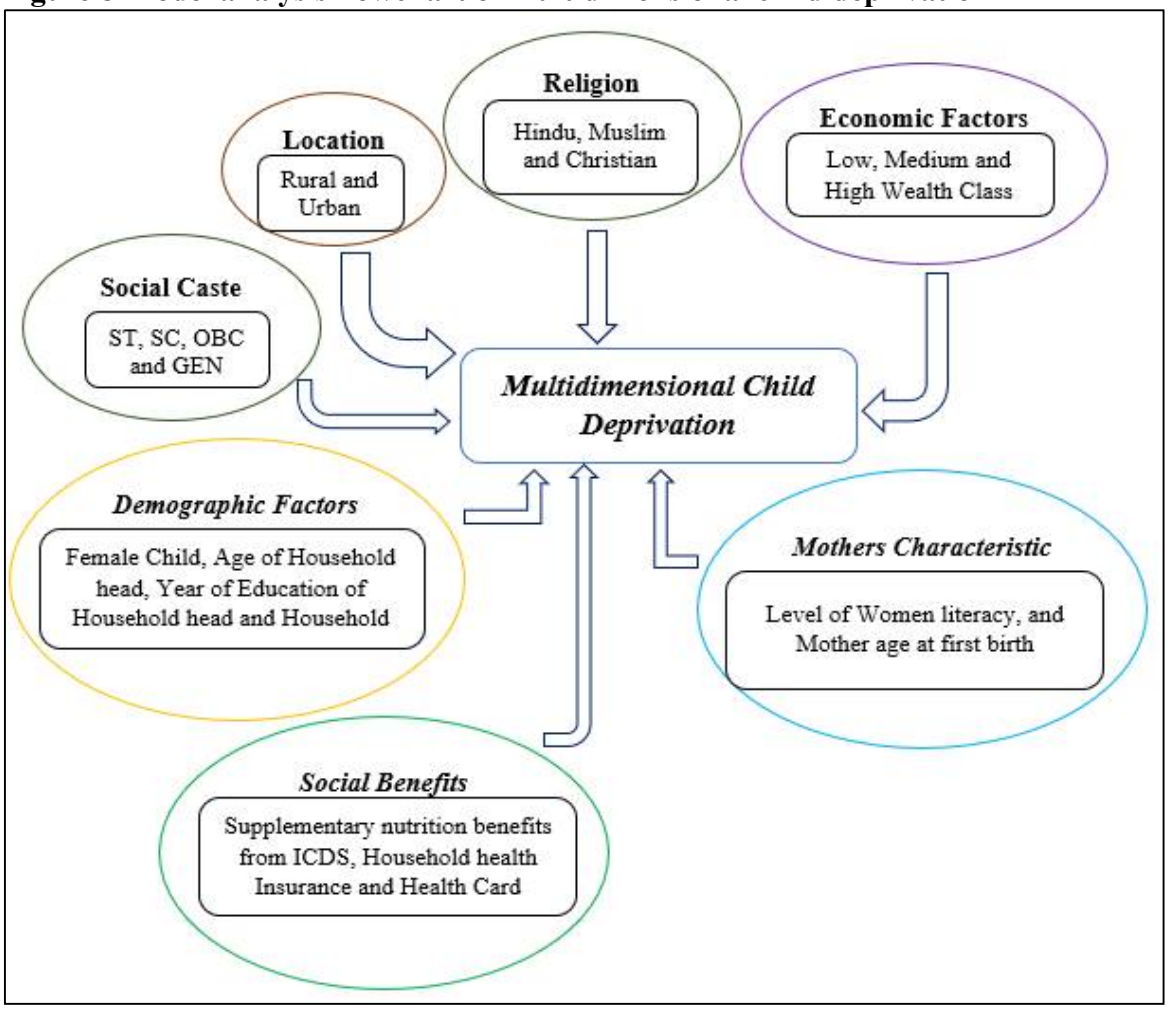


Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data

4. Econometrics analysis of multidimensional child deprivation

This section employs econometric methods to identify the socioeconomic determinants of multidimensional child deprivation in India. To analyse the status of child derivation we have considered several explanatory variables. These variables are as follows: Location of the households (rural =1, 0=otherwise), Religion of the household are Hindu (Yes=1, 0= No), Muslim (Yes=1, 0= No), Christian (Yes=1, 0= otherwise). Social caste of the household ST (Yes=1, 0= No), SC (Yes=1, 0=No) and OBC (Yes=1, 0= No), Economics Factors of the household are medium wealth class (MWC) (Yes=1, 0=No), Demographic factors of the household like a female child (FCHILD) (Yes=1, 0=No), age of household head (AOFHHEAD) and household size (HSIZE) and the year of education of the household head(YOEDU), Mother characteristic like level of women literacy (LWL), and Mother age at first birth (MAFB) and Social benefits like SNFICDS (received supplementary nutrition from ICDS =1, 0= otherwise), the household had insurance or not (Yes=1, 0=No) and HCARD (household having health card = 1, 0=No) as in the following figure 8.

Figure 8 Model analysis flowchart of multidimensional child deprivation



Sources: Designed by Authors

4.1 Heckman two steps model Econometrics Analysis

The outcome indicates that there is no selectivity bias in this estimation because the inverse Mills Ratio (λ_{it}) is insignificant. Among the socio-economic factors, rural, SC, ST, OBC, FCHILD and HSIZE are directly related, whereas Hindu, Muslim, Christian, MWC, AOFHHEAD, YOFEDU, LWL, MAFB, SNFICDS, HINS, and HCARD are inversely related to the incidence of multidimensional child deprivation and the inadequacies experienced by multidimensional child deprivation in following Table 3. Children who reside in rural regions are more likely to experience multidimensional deprivation, and their levels of inadequacy are higher than those of children who live in urban areas. When social castes are taken into account, SC, ST, and OBC are more likely than the general caste to experience multidimensional child deprivation. In addition, Hindus and Muslims experience higher levels of inadequacies and multidimensional child deprivation than people of other religions. In cases of economic factors, the MWC are less likely to be multidimensionally child-deprived. Demographic factors FCHILD and HSIZE make children more likely to be multidimensionally deprived. From the mother's characteristics of the estimated model, it is shown that mothers with a higher level of literacy (LWL) and a higher age of mother at first birth (AOFRSTBIRTH) are less likely to be multidimensionally deprived children. Impact of social benefits like supplementary nutrition from ICDS (SNFICDS), household having health insurance (HINS), and health card (HCARD)

on multidimensional child deprivation and inadequacies among multidimensionally deprived children are less likely to be deprived with lesser inadequacies.

Table 3 Results of Heckman Selection Model (Two-step)

	Step 1: Multidimensionally Child Deprived or Not		*Step 2: Extent of Inadequacies among Multidimensionally Deprived Child*	
	Coeff.	***z***	***Coeff.***	***z***
Location				
RURAL	0.420**	87.58	3.77**	21.94
Religion				
HINDU	-0.047**	-6.9	-0.995**	-9.9
MUSLIM	-0.039**	-5.13	-1.112**	-10.51
Christian	-0.108**	-17.13	-2.552**	-25.03
Social Caste				
SC	0.317**	19.49	4.201**	19.23
ST	0.490**	28.08	6.406**	27.71
OBC	0.135**	22.95	2.421**	24.74
Economic Factors				
MWC	-0.199**	-31.01	-	-
Demographic Factors				
FCHILD	0.078**	7.43	2.626**	19.84
AOFHHEAD	-0.004**	-29.76	-0.031**	-12.27
HSIZE	0.008**	10.59	0.013	1.19
YOEDU	-0.029**	-25.98	-0.255**	-13.62
Mothers Characteristic				
LWL	-0.132**	-82.18	-0.937**	-17.94
MAFB	-0.023**	-42.88	-0.157**	-14.02
Social Benefits				
SNFICDS	-0.255**	-64.69	-1.046**	-10.41
HINS	-0.074**	-15.13	-1.370**	-18.36
HCARD	-0.610**	-145.56	-2.645**	-13.6
Intercept	1.103**	80	53.846**	244.59
MILLS AMBDA	-1.044	-1.03		
RHO	-0.083			
SIGMA	12.598			
No. of Obs. = 502459 (48084 for 2005-06, 243284 for 2015-16, and 211088 for 2019-21), Wald chi2(16) = 3216.42, Prob > chi2 = 0.0000				

Sources: Author's calculation from NFHS 3rd (2005-06), 4th (2015-16) and 5th (2019-21) round unit level data
** implies significant at 1 per cent level and *implies significant at 5 per cent level.

Children who reside in rural regions are more likely to experience multidimensional deprivation, and their levels of inadequacy are higher than those of children who live in urban areas. When social castes are taken into account, SC, ST, and OBC are more likely than the general caste to experience multidimensional child deprivation. In addition, Hindus and Muslims experience higher levels of inadequacies and multidimensional child deprivation than people of other religions. In cases of economic factors, the MWC are less likely to be multidimensionally child-deprived. Demographic factors FCHILD and HSIZE make children more likely to be multidimensionally deprived. From the mother's characteristics of the estimated model, it is shown that mothers with a higher level of literacy (LWL) and a higher age of mother at first birth (AOFRSTBIRTH) are less likely to be multidimensionally deprived children. Impact of social benefits like supplementary nutrition from ICDS (SNFICDS),

household having health insurance (HINS), and health card (HCARD) on multidimensional child deprivation and inadequacies among multidimensionally deprived children are less likely to be deprived with lesser inadequacies.

5. Concluding Observations

The study meticulously analysis the status of child deprivation, reflecting upon the existing disparities in child health outcomes across different indicators within the dimensions of healthcare, nutritional status, and hygiene. This study systematically extends the measurement of the multidimensional child deprivation index. It is found that more than one third of children were multidimensionally deprived in 2019–21, despite the fact that the deprivation ratio had significantly decreased by 23.9 percentage points. These shares varied widely based on the characteristics of the households.

Vulnerability was significantly higher among rural residents, Muslims, STs, and female children. The percentage of deprived children has decreased significantly across all of these subgroups, but the phenomenon of convergence was evident in the case of location and social castes, with rural residents and STs experiencing the greatest decline. On the other hand, the phenomenon of divergence was apparent in the case of religion and sex of the child, with Hindus experiencing the greatest decline and male children experiencing the highest decline of more indicators. However, there were more inducements to reduce multidimensional child deprivation than there were for child deprivation intensity. This is accurate for all aspects of a household.

Among the three dimensions the highest contribution to MCDI in the years 2019–21 emerged from health care, followed by nutritional status and hygiene. Singh et al. (2021) also pointed out the similar scenario of the health care services related issue of Uttar Pradesh due to the Covid pandemic. Regarding the indicators, it has been revealed that the lack of access to child immunization was the highest child deprivation, followed by stunted children, child health check-ups and underweight child. Numerous studies have also indicated that these indicators contribute more significantly to child deprivation (Popoola and Adeoti, 2016).

The Heckman two steps econometrics model has illuminated that social benefit factors play a vital role toward reduces multidimensional child deprivation. That implies that households receiving supplementary nutrition from ICDS, and having insurance and health cards are the strength of childhood development in India. The result also clearly demonstrates the phenomenon of male preference, which is represented by the positive sign of the FCHILD coefficient. It is also shown that mothers with a higher level of literacy and higher age at first birth are important factors in controlling and minimising multidimensional child deprivation. less likely to be multidimensionally deprived children, whereas mothers with underage marriages are the most vulnerable reason for having a more deprived child, which can be reduced by the government awareness programmes.

Policy Recommendations

The findings of the study underscore the urgent need for targeted policy interventions focusing on healthcare, nutrition, and hygiene, particularly among rural, marginalized, economically disadvantaged groups and states. *First,* improving access to quality prenatal and postnatal care, with a specific focus on immunization coverage and child health check-ups, is crucial. *Second,* region-specific nutrition programs targeting stunted, wasted, and underweight children in rural areas should be implemented to address nutritional deficiencies. *Third,* scaling up hygiene and

sanitation programs in rural and marginalized urban areas is also needed to reducing deprivation in access to safe drinking water and improved sanitation facilities. *Fourth,* targeted policies addressing state-specific child deprivation challenges must be developed, with particular attention to high-deprivation states like Bihar, Jharkhand, Nagaland, and Meghalaya. Additionally, strengthening social protection schemes for marginalized groups, ensuring access to health cards and insurance for low-income families, and enhancing women's education and age at marriage are key steps toward achieving inclusive child development. Further research should focus on analyzing the long-term impact of specific policy measures to reduce multidimensional child deprivation in India.

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