Title: Understanding the Contours of Children Undernourished in India: An Odisha Case Study

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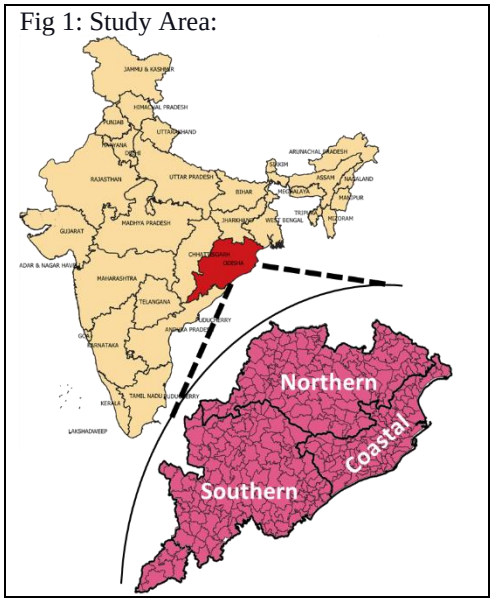
Extended Abstract

Background: Child malnutrition is of serious concern with alarmingly high rates in low- and middle-income countries, including in India. During the past few decades, India has made considerable efforts to understand the determinants and factors associated with child malnutrition. However, the availability of data and its analysis at the micro-level pose a challenge. There is a strong need for micro-level data and integration of Geographic information system tools to identify pockets of low and high levels of malnutrition and understand malnutrition in a nuanced way. These tools have a greater role to play by providing novel ways to understand the problem and fetch solutions at all levels. While at macro level it can contribute in developing bigger strategies, at meso and micro level it will help to reach the unreached. Analysis at the micro-level will enable customized and evidence-based planning to produce malnutrition free enclaves with consequent ripple effect. Hence, the purpose of the study is to conduct a region-specific analysis for an Indian state having high rates of undernutrition in children. So far research studies have used the conventional method for understanding the geographic patterns of prevalence and trends in child malnutrition. Using a sub-district level data for the first time and a micro level approach, this study is aimed at exploring the spatial heterogeneity of undernutrition in children at the micro-level. To study the same, the state of Odisha was selected, a state situated in Eastern part of India. Malnutrition levels in Odisha are still high even though these levels have shown considerable reduction across the three NFHS rounds of NFHS-2 to NFHS-4 survey periods.

Fig 1: Study Area:



Data & Methods: Data from the Concurrent Monitoring (round-II, March 2014- February 2015) survey at the sub-district level for Odisha was used. Spatial analysis methods- Moran's I statistics and LISA maps were applied to understand spatial dependence and clustering of child malnutrition. Multiple regression, spatial lag and error models were used to examine the correlates of malnutrition at the micro (sub-district) level. In view of the emergence of clear clusters within the state of Odisha, a further analysis was done to evaluate the impact of various demographic, socio-economic and maternal factors, on the prevalence of malnutrition by three broad geographical regions of the state – based on a classification used by the National Sample Survey Organisation. This was done using the data from the fourth round of National Family Health Survey (2015-16). Bi-variate and multivariate analysis in the form of cross tabulations and binary logistic regressions applied. Poor-rich ratio and concentration indices, were also measured to understand the economic inequalities with respect to underweight in children.

Results:

(1) Spatial Heterogeneity of children underweight and its correlates, CCM II block-wise data

The univariate LISA statistics depicted significant clusters of high-high spatial association for children underweight in 55 blocks located in the southern and northern regions of the state, 70 blocks show significant low-low spatial association in the coastal region. Statistically significant Moran's I values were observed for all the selected variables. Moran's I value for children underweight was pretty strong at 0.73.

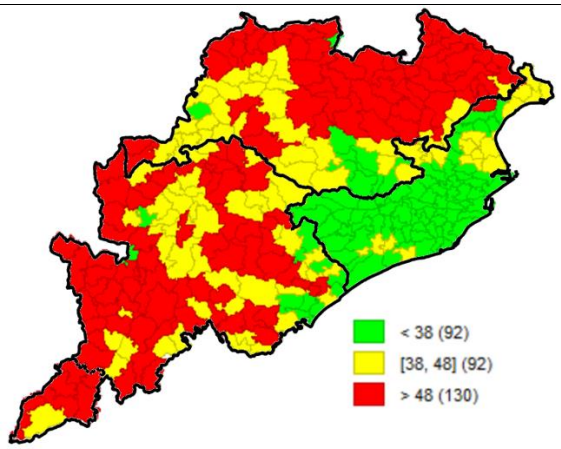


Fig 2a: Prevalence of children underweight, block-wise, CCM II, Odisha

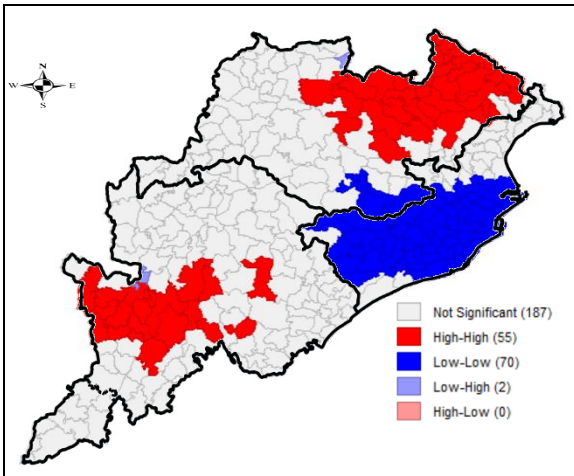


Fig 2 b: Univariate LISA cluster map for children underweight, block-wise, Odisha CCM II

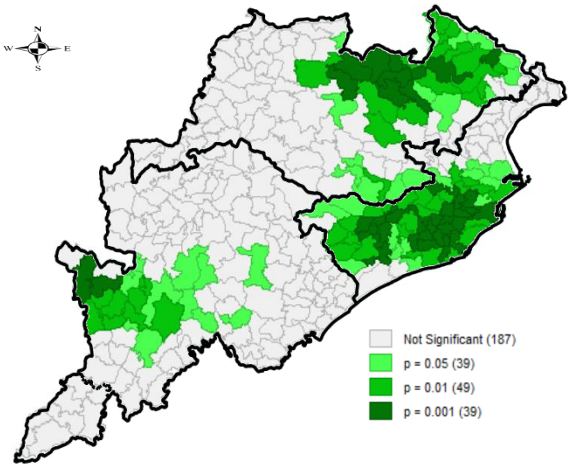


Fig 2 c: Univariate LISA significance map for children underweight, block-wise, Odisha CCM II

Statistically significant clusters falling in the three NSSO regions of the state indicated that overall, the coastal region performed well with respect to all the variables studied, and the northern and southern performed very poor.

Findings from the bivariate LISA analysis indicated statistically significant spatial clustering of children underweight were mainly found in those geographical hotspots where sanitation was poor, pregnancy before 19 years of age was high, institutional delivery and skilled births were low, and antenatal and postnatal check-ups were low

The results of the spatial regression-error model indicated that with respect to children underweight, the largest statistically significant coefficient was for household sanitation (β= -0.33) followed by women having first pregnancy before 19 years of age and ANC visits (β=−0.11).

Table 1 Results- Spatial regression models: OLS, Spatial Lag & Spatial error model; to assess the association of child malnutrition (underweight) and its correlates, CCM II

Block-level Correlates	OLS		Spatial Lag Model		Spatial Error Model	
	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
Institutional Delivery	-0.137	0.610	0.025	0.899	0.130	0.530
First pregnancy ≤19 years of age	0.165	**0.000**	0.058	0.048	0.116	0.003
Skilled births	0.235	0.406	0.062	0.767	-0.124	0.554
Households having improved Sanitation	-0.652	**0.000**	-0.315	**0.000**	-0.332	**0.000**
More than 4 ANCs	-0.094	**0.000**	-0.073	**0.000**	-0.114	**0.000**
Women receiving a postnatal check within 48 hours of delivery	-0.036	0.763	-0.049	0.581	0.003	0.969
R- squared value	0.579		0.765		0.777	
Adjusted R square	0.570					
Lambda Value (Lag Coefficient)					0.773	0.000
Rho Value (Lag coefficient)			0.629	0.000		
Log likelihood			-988.602		-989.036	
AIC value	2141.37		1987.20		1986.07	
No. of blocks	314		314		314	

(2) *Differences across NSS regions of Odisha (NSSO region wise Analysis), NFHS 4*

Three NSS regions of the state- southern, northern and coastal regions, showed statistically significant effect on the prevalence of underweight in children. When all factors were controlled, it was seen that the children below five years of age from the coastal region are less likely to be stunted, wasted as well as underweight, than the children from the southern and northern regions of the state.

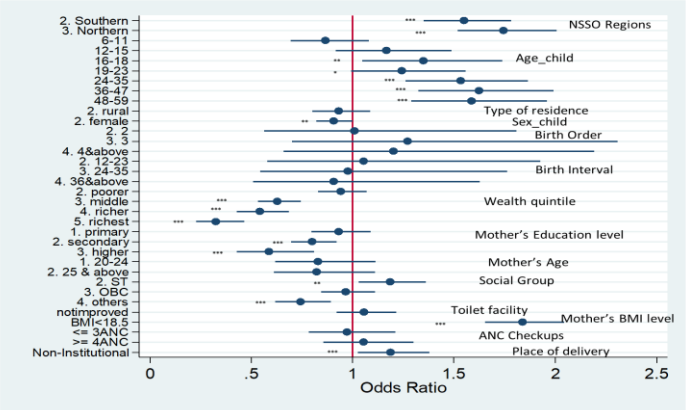


Fig 3 Model 1: Impact of NSSO regions, along with socioeconomic background characteristics, on children underweight, for Odisha, assessed by logistic regression.

** P<0.10; ** P<0.05 & *** P<0.01 level of significance*

(3) *Inequalities across different economic groups of Odisha, by the three NSS natural regions*

The trends and patterns of economic inequalities, revealed the massive economic disparities in child malnutrition across the districts of Odisha. Results indicated the disproportionate concentration of child malnutrition among the poor across the districts, but majorly in the districts of the coastal region. The developed districts in the coastal region of the state recorded higher economic inequalities with respect to child malnutrition compared to their northern and southern counterparts.

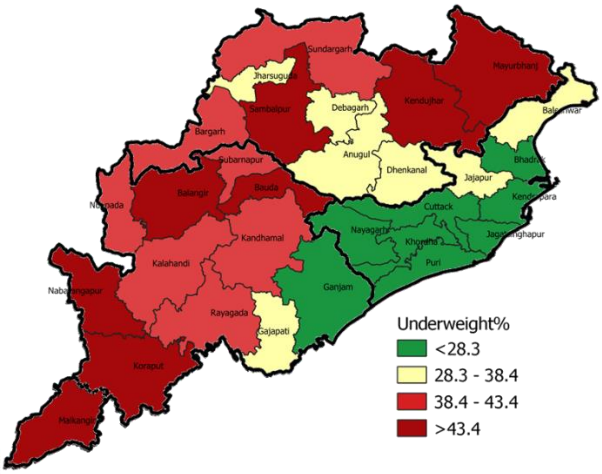


Fig 4 a: Prevalence of children Underweight, across the districts of Odisha, NFHS 4

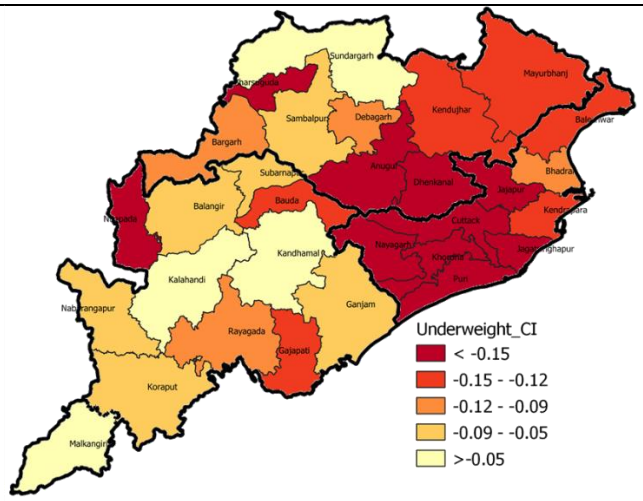


Fig 4 b: Spatial pattern of concentration index for Underweight, across the districts of Odisha

Conclusion

This Odisha analysis can be used as a model for other Indian states and low-resource setting countries, making the solution impactful globally through multiple and synergistic interventions embedded in true multisectoral programs.

The study findings could be beneficial for customised and evidence-based planning of focussed intervention programmes and schemes in eradicating child malnutrition from the state. The spatial clustering of child malnutrition in the specific geographic pockets with high prevalence of poverty, low literacy among women, high undernutrition among women indicates the impact of these determinants on child malnutrition and hence reinforces the strong need for inter-sectoral coordination and targeted intervention in these areas. The findings also suggest multi-sectoral and integrated efforts in addressing the issues of poverty, hygiene and sanitation, maternal health and nutrition which are inter-connected and these will help reduce child malnutrition at state level.

Given the sheer regional diversity in India, there is a strong need to develop a region-specific evidence-base at the micro level to develop a plan of action for eliminating child malnutrition. The findings will thus help to create more strategic investments in effectively addressing the problem at lower administrative level and enriching the sustainable development goals for India.