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Original Research Article

Nutrition status and socio-economic inequality among children (0-59 months) across different regions of Uttar Pradesh

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ABSTRACT

Background: The paper aims to explore the magnitude of the nutritional status and socio-economic inequality among children in various regions of Uttar Pradesh in rural-urban areas.
Methods: Fourth round of the National Family Health Survey (2015-16) data was used. Multivariate logistic regression and decomposition analysis were employed to understand the socio-economic inequality.
Results: Finding shows that the Bundelkhand region has the highest prevalence of underweight (45.4 per 100) and wasted (29.5 per 100) children while Purvanchal region has the majority of stunted (48.3 per 100) children. The rural area has the highest percentage of underweight (40.9 percent) children followed by stunted (48.4 percent) and wasted (17.9 percent) respectively. About half of the children are underweight (46.3 percent) whose mother has no schooling, with more than 55 percent of the stunted children, and approximately 18 percent of children are wasted. Other findings of the study are: wasted children have shown a very different trend compared to stunted and underweight, which has gone up between NFHS-3 and NFHS-4 rounds, in both rural-urban areas of Bundelkhand region, wasted children remain within a very narrow range, an unexplained trend was observed among wasted children where mothers from poorest quintile are with high BMI as compared to richest quintile, d) mother education appears to have little effect on the wasting levels.
Conclusions: Adequate regional health planning in child health and nutritional development could be a proper approach that reduces geographical differences as well as the socio-economic disparity in child health and malnutrition.

Keywords: Malnutrition, Inequality, Uttar Pradesh's regions, Decomposition, Poor And marginalized people

INTRODUCTION

Child malnutrition refers to deficiencies, excesses, or imbalances in a child's intake of energy or nutrients.[1] Huge inequality is found across different socio-economic groups which have led to uneven and sluggish child nutritional development.[2,3] Socio-economic inequalities remain major barriers in achieving Sustainable Development Goals (SDGs) in recognition of the challenges in nutrition, health, and hygiene/sanitation in India.[4] Previous studies have identified that various factors such as social identity, mother's education, and poverty affect child's health and growth development among those who belong to marginalized and disadvantaged communities.[5,6] However, very few studies have focused on child health and nutrition development with geographical factors and regional diversity.

Globally nearly 6.9 million children under the age of five died from preventable causes in 2011, from those 45 percent of deaths are attributed to under-nutrition.[7] India is also experiencing heavy child mortality and it is caused by under-nutrition.[8,9] In India, massive state-wise variations

in child malnutrition show that there are multi-level factors responsible for it.[10] Poor child nutritional outcomes are the consequence of poor coverage of essential child care services such as different types of vaccination and child nutrition programs like ICDS (Integrated child development scheme). Various studies have highlighted that a huge child population, especially from lower socio-economic strata, remained outside the fold of needy services.[11,12] Lack of community health workers and overpopulation per facility are also responsible for low coverage of essential health care and nutritional services in the community.[8,13,14]

Despite numerous child health policies and programs were launched in India for example, the integrated child development scheme (ICDS), the national food security mission, Universal Immunization Programme, and the multi-strategic programme intervention policy, and National Rural Health Mission (NRHM), still India falls at the bottom of the various child health, growth, and nutritional development indicators among developing countries.[10,15,16] Indeed, the child health indicator is one of the most influential development indicators in any society or country.[17] In India, the socio-economic inequalities and regional disparities in child healthcare and nutritional development have widened in the last decade i.e. from 2005-06 to 2015-16.[18] Previous studies have shown that the large economic inequalities prevailed in the health status of children and the use of integrated child development scheme (ICDS) services in India.[11,18–20] The burden of malnutrition was inexplicably concentrated among poor and lower caste groups.[21] Thus, making it necessary to investigate the malnutrition and socio-economic inequality across the regions.

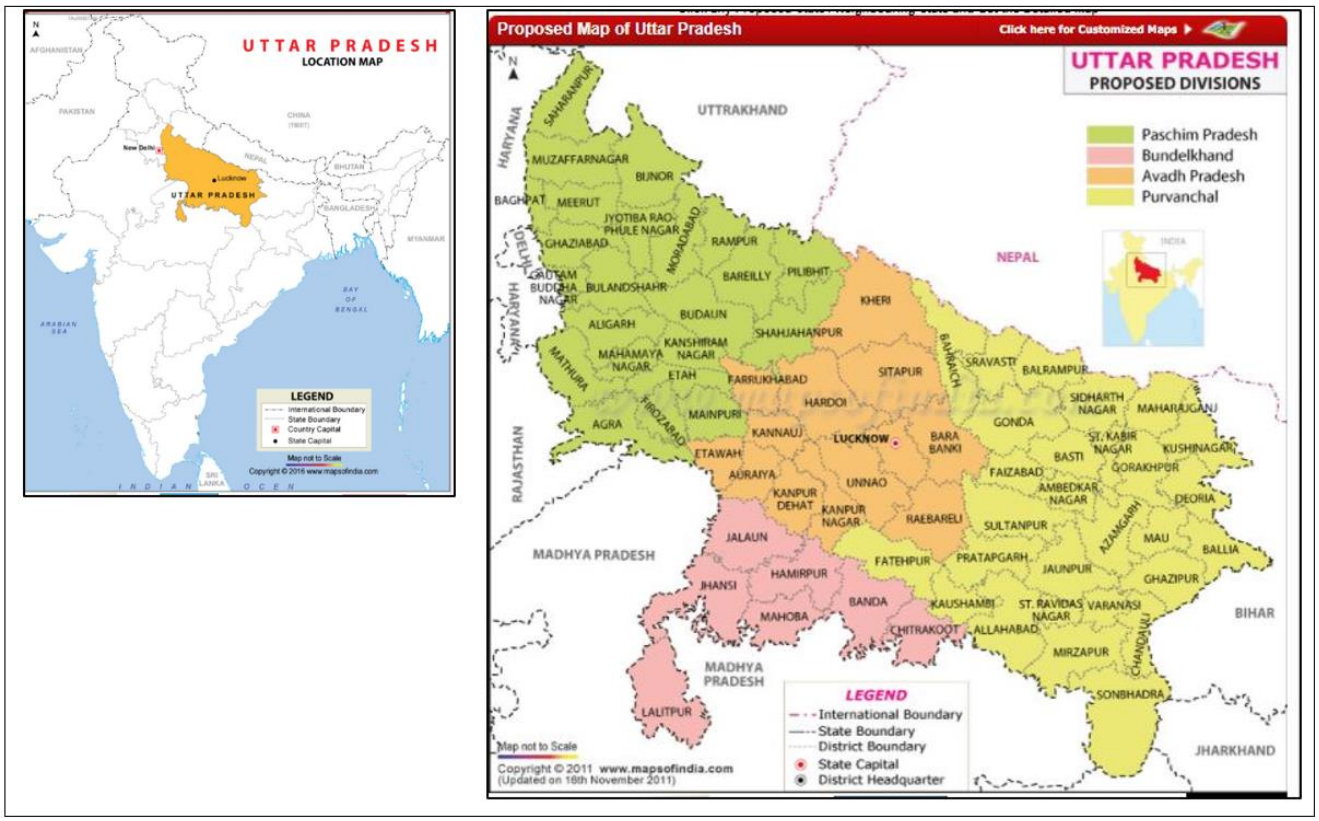

Figure 1: Location map and proposed division maps of Uttar Pradesh.
Source: https://www.mapsofindia.com/maps/uttarpradesh/uttarpradeshlocation.htm

Lacks of effectiveness, efficiency, and integration in service coverage all these programs may have resulted in poor health outcomes in India as a whole and Uttar Pradesh particularly (location map and proposed division maps of Uttar Pradesh shown in Figure 1). Uttar Pradesh is one of the top three states in India and has the highest child mortality and morbidity rates in the country.[4,10,22,19] The state is facing severe under-nutrition among women and children.[19,23] Poor socio-economic development, low women's education and empowerment are major contributors to high child malnutrition in the state.[4,24,25] Evidence supported that there exist inequality and inequity in delivering the services across different groups.[4,23–26] Unprecedented rapid population growth and political engagement have an indirect impact on malnutrition. It becomes necessary to understand the inequity and inequality distributed across different clusters of the geographical regions and socio-economic groups in the state.

Poor and unhealthy food quality, insufficient food intake, unsafe drinking water, poor and unhygienic practices have

caused several severe and repeated childhood diseases like diarrhea, cholera, and an acute respiratory infection.[24] In addition, lack of mother's exclusive breastfeeding practices and poor nutritious diets have also pushed children into severe malnutrition conditions such as underweight, stunted, and wasted.[3,27] Improving child health and nutritional development require a multi-faceted response from multi-sectoral areas to fight for the occurrence of malnutrition among children.[4] However, despite this, the poor resource setting areas or under-development regions with complex socio-demographic factors might also be responsible for malnourishment among children.[11,28] Thus, given the lack of research on the topic, the current study uses the fourth round of the National Family Health Survey-4 (NFHS-4) data that was conducted in 2015–16, as the latest Comprehensive National Nutrition Survey (CNNS) conducted in 2016-18 data is not available in the public domain (only factsheet is available).[29] The study aimed to investigate how geographical factors, socio-demographical and socioeconomic disparities in childhood malnutrition influence the healthcare and nutritional practices among children across various regions of Uttar Pradesh.

METHODS

Study type

The study used cross-sectional secondary data. The fourth round of NFHS-4 conducted in 2015-16 surveyed 572,000 households in 640 districts of India (as per the 2011 Census).

Study period

Data was collected between January, 2015 and December, 2016; 699,686 women (aged 15-49) and 122,051 men (aged 15-54) were interviewed.

Study setting

The present study was conducted among the eligible women to investigate the malnutrition and socio-economic inequality across the regions of Uttar Pradesh. For the first time, district level information has been estimated on reproductive and child healthcare services.

Sampling procedure

NFHS-4 adopted two-stage sample design in rural areas, and three-stage sample design in urban areas. The response rates of the survey were about 90% to 98%The detail description is given elsewhere.[30]

Ethical approval and statistical analysis

Our study is based on a secondary dataset with no identifiable information on the survey participants. This dataset is available in public domain on Demographic and Health Survey (DHS) forum website for research use and hence, no approval was required from any institutional review board.

Three indices were used to measure the nutritional status of children (0-59 months) which is used as a dependent variable, and these indices are weight for age (underweight [WAZ]), height for age (stunted [HAZ]), weight for height (wasted [WHZ]). In the present study, Z-scores were used to assess the status of malnourishment and the box plot is shown in Figure 2. The values of the Z-scores were dichotomized after adjusting for outliers, and used as the binary response for underweight, stunted, and wasted respectively. Based on the few literature reviews conducted in India and other countries, several socio-economic and demographic variables such as the age of the mother, age at first birth, birth order, caste, region, education, media exposure, place of residence, religion, and sex of the child were included as the predictor variables in the study.[31–33]

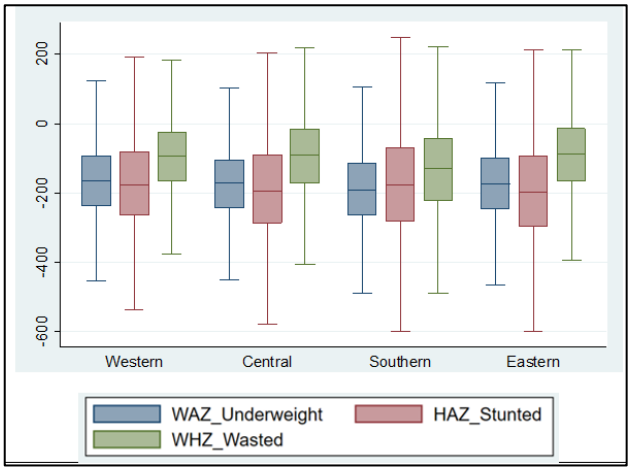

Figure 2: Box plot of underweight, stunted and wasted children in Uttar Pradesh excluding outliers, India, NFHS-4.

The basic assumptions that need to be checked before running a statistical model were carried out in order for our study to be valid. Bivariate and multivariate analysis has been done to understand the association between health parameters and related determinants. A simple chi-square test was conducted to test the association and, further binary logistic regression analysis was done to analyze this association. To understand the inequality aspect among children's nutritional health status, concentration curve, concentration index, and decomposition techniques have been used to measure the degree of inequality across regions of Uttar Pradesh. All statistical analysis was performed using STATA SE version 14.

Concentration indices are used to compare one variable's distribution to another's distribution. A concentration index shows the magnitude of inequality by measuring the area between the concentration curve and line of perfect equality. Concentration indices are an especially common option for evaluating socio-economic inequalities in

health. The CI has the advantages of correctly reflecting income-related disparities in a health variable's distribution while still being simple to measure. A regression-based decomposition technique was used to decompose the concentration index. The contribution of each predictor variable depends on how wealth is distributed in society and how the distribution of wealth affects the child's health. Some variables play a significant role at the individual, household, and community levels. Details description is given elsewhere.[32,34,35]

RESULTS

The percentage of malnutrition among under-five children in Uttar Pradesh from different sources i.e. NFHS-3 (2005-06), NFHS-4 (2015-16), and CNNS surveys are shown in Figure 3 (NFHS-3; NFHS-4, CNNS). Figure 3 shows that underweight has decreased from 42 percent in 2005-06 to 37 percent by 2016–18 with stunted from 52 percent (2005-06) to 39 percent (2016-18) respectively. The percentage of wasted had decreased from NFHS-3 to NFHS-4 but had gone up between NFHS-4 and CNNS survey data. One possible reason could be that wasted is a reflection of short-term episodic past while stunted reflects a cumulative long-term outcome, so the time of data collection may be the reason.

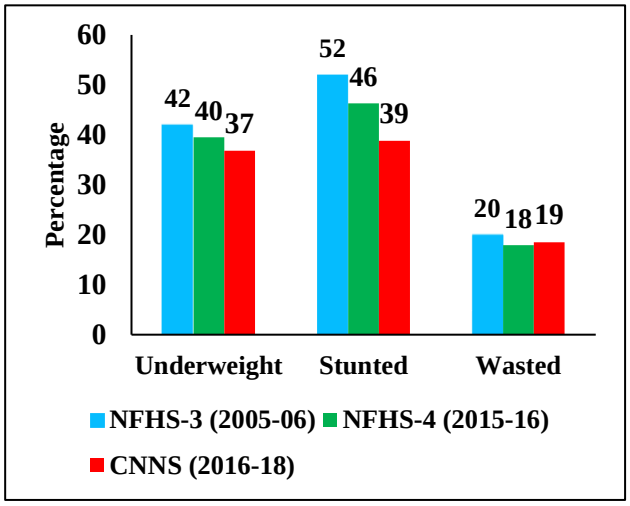

Figure 3: Percentage of malnutrition among children under five years of age in Uttar Pradesh as per NFHS-3 (2005-06), NFHS-4 (2015-16), and CNNS (2016-18) survey data.

The findings show that children who belong to the Purvanchal region suffer multiple vulnerabilities followed by the Avadh region. Similarly, through the inequality approach i.e., concentration curve and decomposition analysis, a huge inequality exists across the regions. Our finding is consistent with the study conducted in Uttar Pradesh, which also found a huge difference across regions in maternal and child healthcare.[36] Figure 4, shows that overall, 39.5 percent of children under five years of age are underweight, 46.3 percent are stunted and about 18 percent are wasted respectively.

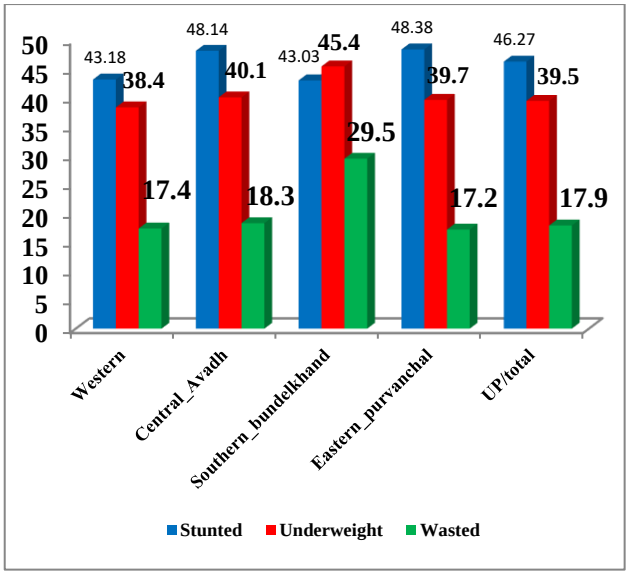

Figure 4: Region-wise prevalence of child malnutrition in Uttar Pradesh, India, NFHS-4 (2015-16).

The regional variation shows that 48.4 percent of children are stunted in the Purvanchal region (highest) followed by the Avadh (central) region (48.1 percent), and the lowest in the Bundelkhand region (43.2 percent). Among underweight children, the Bundelkhand region is the highest with 45.4 percent followed by the Avadhregion (40 percent) and the lowest in the western region (38.4 percent). In the case of wasted children, the Bundelkhand comes first with 29.5 percent followed by the Avadhregion (18.4 percent). The Bundelkhand region is a drought-prone region and has several factors associated with socio-ecological and environmental that cause more wasted children compared to other regions.

Table 1 shows the rural-urban differences in the distribution of child malnutrition across the regions of Uttar Pradesh. Underweight and stunted have reduced in both urban as well as rural areas from NFHS-3 to NFHS-4. However, wasted, which has gone up between NFHS-3 and NFHS-4 rounds shows a very different trend compared to underweight, and stunted children, probably wasted is a reflection of short-term episodic past while stunted reflects a cumulative long term outcome. Overall, the underweight (40.98 percent) and stunted (48.47 percent) are more in rural areas compared to urban areas where underweight is 33.83 percent while stunted is 37.93 percent respectively. The rural-urban difference appeared strong among underweight children in Bundelkhand (southern) region followed by the Purvanchal (eastern) region among stunted children respectively. However, in the Bundelkhand region, wasting levels remain in a very narrow range in both rural and urban settings. This is due to its socio-ecological and environmental factors. Compared to the other three regions, the Bundelkhand region is very different in terms of socio-economic, ecological, and environmental factors.[37] It is a full drought-prone region.

Table 1: Rural-urban differences of child malnutrition in Uttar Pradesh, India from NFHS.

Overall	Underweight		Stunted		Wasted	
	Urban	Rural	Urban	Rural	Urban	Rural
NFHS-3 (2005-06)	34.95	44.09	50.21	57.99	13	15.41
NFHS-4 (2015-16)	33.83	40.98	37.93	48.47	18.08	17.89
Regions wise (NFHS-4)						
Western region	33.49	40.79	37.55	45.96	16.74	17.72
Central (Avadh) region	35.69	41.21	40.33	50.11	19.37	18.07
Southern (Bundelkhand)	37.46	47.54	34.58	45.26	29.31	29.55
Eastern (Purvanchal) region	32.8	40.52	37.72	49.7	18.65	17.04

Source: Author's calculation from NFHS-4, 2015-16. Rural-urban differences by regions wise have been given only for NFHS-4, as this was the first time that the survey collected data at the district level.

Table 2: Percentage distribution and adjusted logistic regression (odds ratio) of underweight, stunted, and wasted children by selected background characteristics in Uttar Pradesh, India, NFHS-4 (2015-16).

Variables	Under-weight	AO.R (95% C.I)	Stunted	AO.R (95 % CI)	Wasteed	AO.R (95 % C.I)
Age of Mother						
15-24®	37.61	1	42.09	1	20.09	1
25-34	39.51	1.03 (0.96 -1.10)	46.61	1.1***(1.03 -1.17)	17.29	0.83***(0.77-0.90)
35 and above	43.5	0.97 (0.86 -1.08)	53.72	1.12**(1.01-1.24)	16.39	0.73***(0.64-0.85)
Place of Residence* **						
Rural	40.98	1	48.47	1	17.89	1
Urban	33.83	0.88***(0.80 -0.96)	37.93	0.89***(0.82-0.97)	18.08	0.88**(0.79-0.98)
Mother Education* **						
No Education	46.39	1	55.1	1	17.99	1
Primary	42.10	0.93*(0.85 -1.00)	49.91	0.93*(0.86-1.00)	18.07	1.02 (0.91-1.13)
Secondary	34.45	0.79***(0.74 -0.85)	39.92	0.75***(0.70-0.80)	17.83	1.05 (0.95-1.15)
Higher	23.36	0.59***(0.53 -0.67)	24.88	0.48***(0.43-0.54)	17.79	1.14*(0.99-1.32)
Religion						
Hindu®	39.54	1	46.25	1	18.12	1
Muslim	39.56	1.06 (0.98 -1.16)	46.63	1.04 (0.97-1.13)	17.27	1.04 (0.94-1.15)
Other	14.97	0.41**(0.20 -0.84)	17.34	0.43***(0.23-0.80)	8.96	0.53 (0.25-1.14)
Social groups* **						
Scheduled Castes/Scheduled Tribes (SCs/STs)®	46.02	1	52.21	1	20.6	1
Other Backward Class	40.12	0.94*(0.88 -1.00)	46.5	0.94*(0.88-1.00)	17.99	0.94*(0.88-1.00)
Other	29.74	0.73***(0.66- 0.80)	36.26	0.77***(0.70-0.84)	16.42	0.91 (0.81-1.03)
Birth order						
One®	35.2	1	40.27	1	18.23	1
2-3	38.31	1.01 (0.95 -1.08)	45.17	1.03 (0.96-1.09)	17.13	1.02 (0.94-1.11)
4+	46.92	1.2***(1.1 -1.31)	55.63	1.16***(1.07-1.26)	19.02	1.28***(1.14-1.43)
BMI* **						
Underweight	50.47	1	54.28	1	22.03	1
Normal	38.57	0.71***(0.66 -0.76)	45.79	0.81***(0.75-0.86)	17.87	0.84***(0.78-0.92)
Overweight/ Obese	24.2	0.46***(0.41 -0.51)	32.24	0.64***(0.58-0.71)	10.2	0.51***(0.45-0.59)
Wealth Quintile* **						
Poorest	48.95	1	57.31	1	19.57	1
Poor	41.95	0.85***(0.78 -0.91)	50.49	0.88***(0.82-0.94)	17.06	0.88***(0.80-0.96)
Middle	35.49	0.71***(0.65 -0.78)	42.75	0.72***(0.66-0.79)	17.47	0.95 (0.85-1.06)
Rich	32.17	0.67***(0.60-0.75)	36.29	0.59***(0.53-0.66)	16.54	0.95 (0.82-1.09)

Continued.

Variables	Under-weight	AO.R (95% C.I)	Stunted	AO.R (95 % CI)	Wasteed	AO.R (95 % C.I)
Richest	23.48	0.53***(0.47- 0.61)	24.81	0.43***(0.38-0.48)	17.58	1.08 (0.92-1.27)
Breast Feeding* **						
No	39.54	1	48.96	1	14.26	1
Yes	38.18	1.01 (0.95 -1.07)	43.26	0.89***(0.84-0.94)	20.20	1.34***(1.24-1.45)
Sex of Child						
Male	39.48	1	46.34	1	19.12	1
Female	39.51	0.98 (0.93-1.03)	46.18	0.98 (0.93-1.03)	16.61	0.84***(0.79- 0.90)
Mass Media exposure						
No®	44.72	1	53.21	1	18.52	1
Yes	34.16	1 (0.94-1.07)	39.2	0.95*(0.89-1.01)	17.32	0.98 (0.91-1.07)
UP Regions* **						
Western	38.37	1	43.18	1	17.40	1
Avadh (Centre)	40.1	0.93 (0.85-1.03)	48.14	1 (0.91-1.10)	18.33	1.06 (0.93-1.20)
Bundelkhand (South)	45.44	1.16**(1.03-1.31)	43.03	0.85***(0.75-0.96)	29.50	1.9***(1.65-2.18)
Purvanchal (East)	39.67	0.92**(0.86-0.98)	48.38	1.05 (0.99-1.13)	17.21	0.99 (0.91-1.08)
Benefits from ICDS center in the last one year						
No®	38.65	1	45.62	1	17.07	1
Yes	40.64	1.02 (0.96-1.08)	47.14	1.01 (0.96-1.07)	18.75	1.05 (0.98-1.13)
Total/UP	39.49		46.27		17.8	

Source: Author's calculation from NFHS-4, 2015-16, Note: At significant level, ***p < 0.01, **p < 0.05, *p < 0.1

Table 2 represents the nutritional status of children aged 0-59 months with background characteristics. Approximately, 40 percent of children are underweight, 46 percent are stunted and 18 percent wasted. Women who belong to the higher age groups 35 and above, their children are more severely underweight and stunted children respectively. On one hand, increasing mother's age and mother living in rural areas have led to children more underweight and stunted respectively. On the other hand, a mother's education does not seem to make any difference to wasting levels. This is a matter of concern apart from being counterintuitive. Both Hindu and Muslim have almost similar percentage while SC/ST and birth order 4+ has higher percentage of underweight, stunted and, wasted children respectively. Table 2 also shows an unexpected trend in wasting which is very low for mothers with high BMI (overweight and obese) yet not in the rich and richest quintile. In the wealth quintile, more children (19.6 percent) are wasted compared to the richest quintile (17.6 percent). The same holds for children not breastfed. High wasting among tribals should be qualified with a caveat that the tribal population in UP is insignificant. Moreover, children's malnutrition has shown huge variations across the regions in the state. In the case of underweight, 45.5 percent of children belong to the Bundelkhand region followed by Avadh (40 percent) and Purvanchal (39.7 percent), while in case of stunted, Purvanchal region stands highest with 48.4 percent followed by Avadh 48.2 percent respectively. Similarly to underweight children, the Bundelkhand region (29.5 percent) is the highest with wasted children followed by the Avadh region (18.3 percent).

Table 2 also represents the adjusted logistic regression (odds ratio) of underweight, stunted, and wasted children by selected background characteristics. Children are less likely to be underweight, stunted, and wasted in urban areas (aO.R=0.9 approximately for all) as compared to their rural counterparts. Women with higher education are less likely to have their children underweight compared to illiterate women. Mother's education has a direct impact on child nutritional practices and the result is also consistent with previous studies that identify that the odds of undernourishment have declined proportionally with the increase in maternal education.[32,38,39] Children who belong to SCs/STs are more likely to be underweight and stunted as compared to other groups. Women with birth order 4+ are more likely to have their children underweight, stunted and wasted. A significant relationship is observed between the mother's BMI and child malnutrition. The findings clearly show that as we move from the poorest to the richest, the odds of underweight and stunted children are less likely with statistically significant. It means children have appropriate nutritional status as compared to the poorest quintile, and the finding is consistent with the study based on NFHS data.[40]

The details concentration index across the regions and districts with concentration curve of underweight, stunted, and wasted children are shown in Table 3, Figure 5, and Figure 6 respectively. The negative value of the concentration index indicates that society is characterized by pro-rich inequalities rather than pro-poor. The concentration curve graph in Figure 6 shows that inequality is highly prevalent in the western region compared to the other three regions. The southern region

(Bundelkhand) shows that children belong to this region are relatively poor and therefore it has low inequality overall. The region which has a high socio-economic disparity led to high inequality in child nutrition development indicators as well. For example, the western region is more socio-economically unequal and therefore it has shown a high CI value in child wasting indicator as compared to other regions. Further, the negative sign indicates that it is disproportionate to the poor groups. Figure 4 presents the district-wise concentration index scenario which also supports the concentration curve that lies above the line of equality that means a disproportionate concentration among the poor (Figure 5).

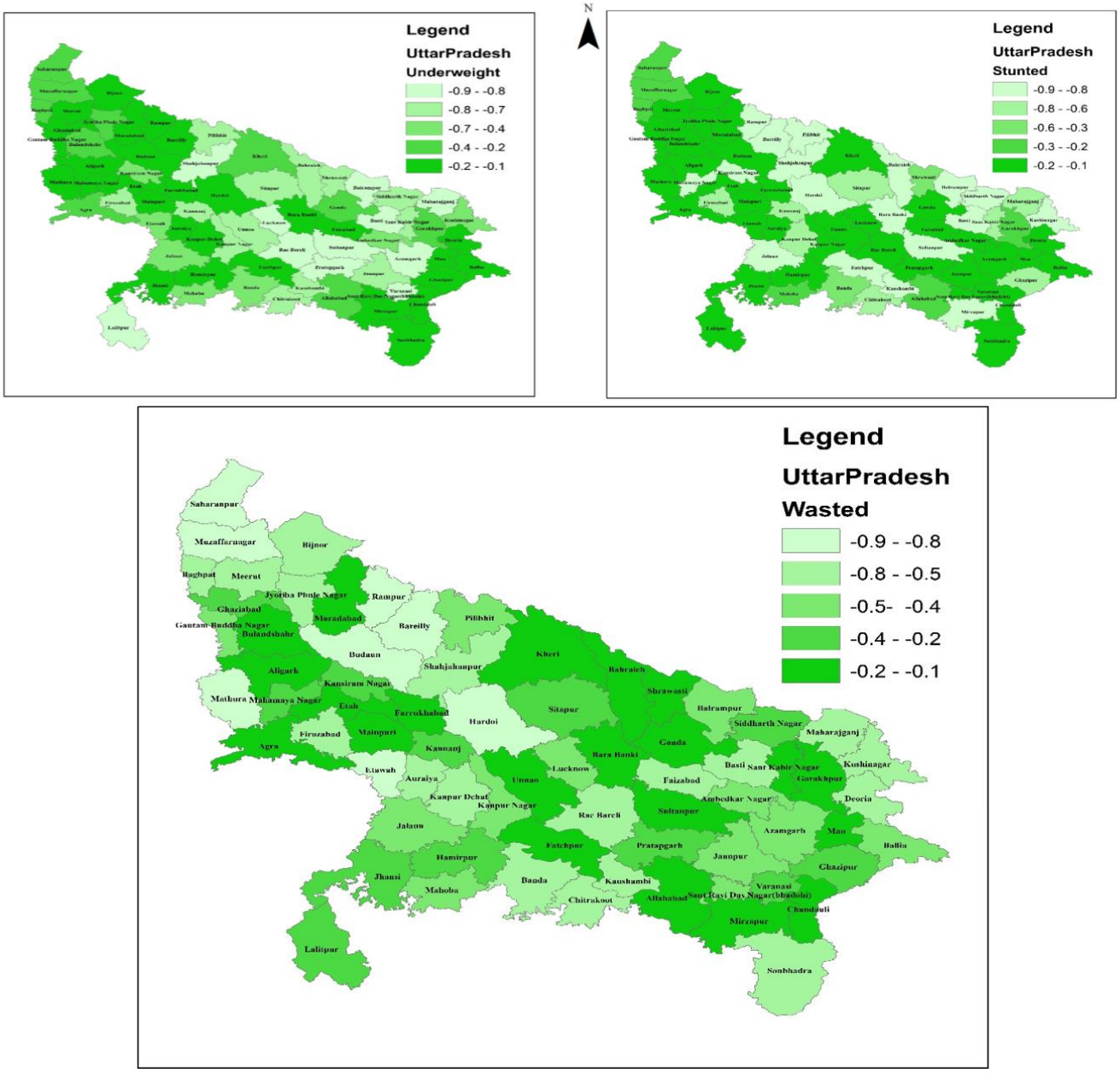

Figure 5: Districts-wise concentration index values for underweight, stunted, and wasted in Uttar Pradesh, India, NFHS-4 (2015-16).

Source: Author's calculation from NFHS-4, 2015-16.

Fairlie decomposition result is showed in Table 4. The findings suggest that the variables explained very well and influenced child health, growth, and nutritional development practices. Due to endowment factors, children's health and nutritional indicators i.e., stunted, underweight, and wasted are explained by 62.2 percent, 65 percent, and 16 percent respectively.[37] The remaining unexplained percentage indicates that there is a wide gap differential in child nutrition and growth development practices between poor and non-poor. There is inequality in child nutritional indicators between these two groups. It is also reflected in the national health mission programme report on child health and nutritional development.10 Further, table 6 shows how differences in the distribution

of each determinant contributed separately to the first part of the gap (endowment effect). In particular, mother education, caste, mother BMI status, exposure to mass media were the most important contributors explaining the gap in average coefficients of underweight and stunted among children between the poor and non-poor. Mother education contributed the highest, at 41 percent of the gap for stunted, followed by 41 percent of the gap for underweight among poor and non-poor. Whereas, for wasted children, the birth order shows a 69 percent gap between poor and non-poor groups. Further, mother's health status (BMI) made disadvantaged between the poor and non-poor in terms of underweight, stunted, wasted children and its contributed effects are found as about 27 percent, 15 percent, and 69 percent respectively, and the gap is increasing between these two groups. It means that children who belong to poor households have a greater chance to be malnourished, including mothers. Mother and child pair in nutritional statuses remained wide and persistent.[33] Uttar Pradesh also faces poor development in the WASH indicators that has a sufficient role in child malnourishment.[37] Social groups (caste) also play a major role in defining child health and well-being in the state. By caste, the gap was found between poor and non-poor children across stunting, underweight, and wasting as 11 percent, 13 percent, and about 7 percent respectively. Regional variations in the child nutritional indicators are seen as effective in the state.

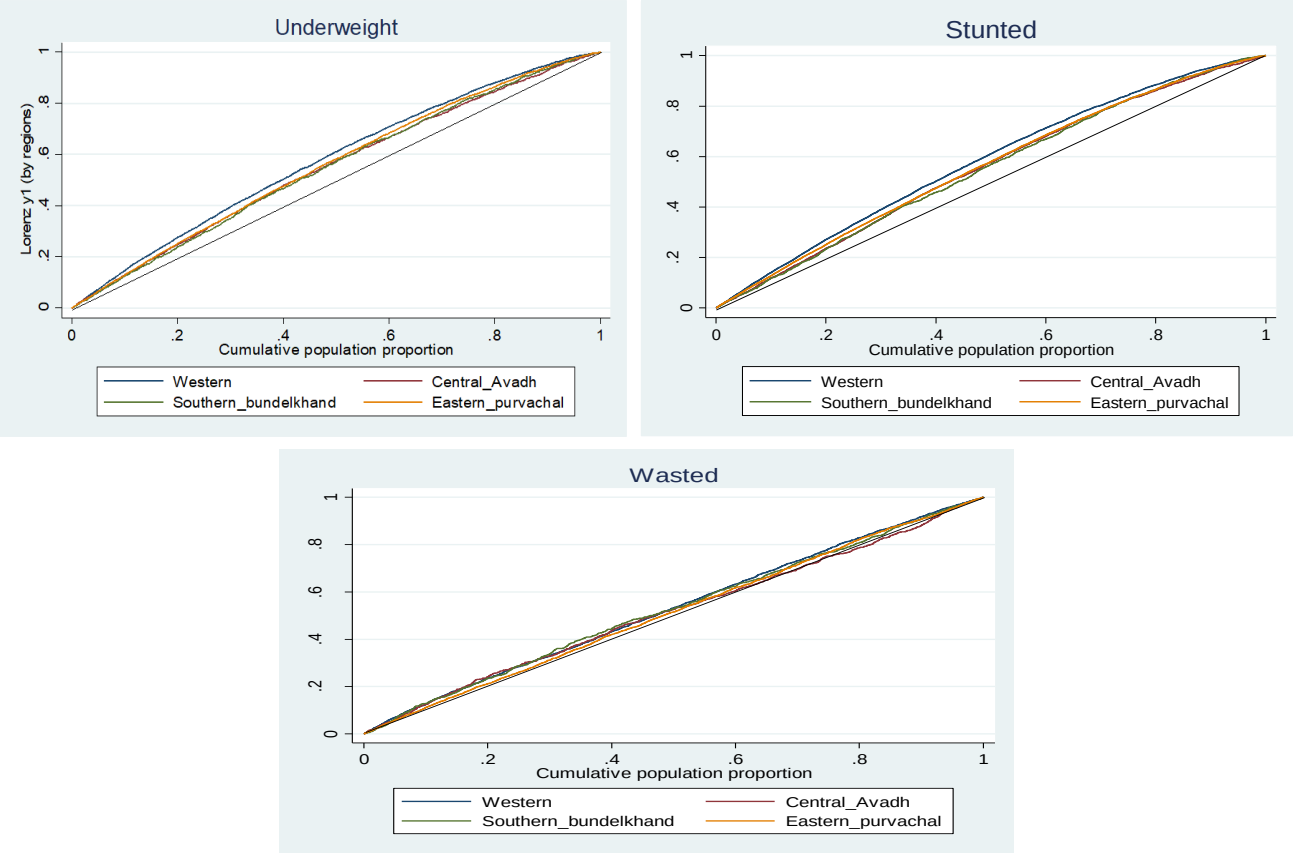

Figure 6: Region-wise Concentration curve of underweight, stunted, and wasted in Uttar Pradesh, India, NFHS-4 (2015-16).

Source: Author's calculation from NFHS-4, 2015-16.

Table 3 Concentration index values for underweight, stunted and wasted across different regions of Uttar Pradesh with rural-urban, India, NFHS-4 (2015-16).

Uttar Pradesh regions	Underweight			Stunted			Wasted		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
Western	-0.1302	-0.1388	-0.1481	-0.1560	-0.1284	-0.1484	-0.0008	-0.0610	-0.4516
Central (Avadh)	-0.0922	-0.0801	-0.0870	-0.1399	-0.0855	-0.1050	0.0906	-0.0292	-0.0025
Southern (Bundelkhand)	-0.1033	-0.0636	-0.0875	-0.1557	-0.0482	-0.0881	0.0464	-0.0459	-0.0222
Eastern (Purvanchal)	-0.1657	-0.1026	-0.1131	-0.1731	-0.0979	-0.1137	-0.0265	-0.0320	-0.0238
Total	-0.1302	-0.1052	-0.1183	-0.1560	-0.1041	-0.1263	0.0071	-0.0417	-0.0287

Source: Author's calculation from NFHS-4, 2015-16.

Table 4: Contribution of each determinant in poor and non-poor differentials in stunted, underweight and wasted children in Uttar Pradesh, India.

Covariates	Underweight		Stunted		Wasted	
	Coefficient	% Contributions	Coefficient	% Contributions	Coefficient	% Contributions
Mother's age	0.001	-1.38	0.002*	-1.77	0.002**	-8.42
Mother education	-0.038***	40.56	-0.050***	43.75	-0.002	8.57
Husband education	-0.004***	4.30	-0.003**	2.37	-0.002**	9.89
Birth order	0.009**	-9.64	0.013***	-11.63	-0.013***	69.46
Religion	0.001*	-1.59	0.000	-0.26	0.002***	-9.46
Caste	-0.012***	13.12	-0.013***	11.41	-0.001	6.83
Place of residence	0.006**	-6.62	0.004*	-3.41	0.004**	-20.96
Benefits from ICDS or Aganwadicentre in last one year	0.000	0.30	0.003***	-2.43	-0.004***	19.79
Exposure to mass media	-0.002	2.60	-0.013***	11.37	0.003	-13.24
Mother BMI status	-0.025***	26.76	-0.017***	14.67	-0.013***	69.23
UP's regions	-0.007***	7.77	-0.011***	9.85	-0.005***	25.49
Summary of Fairlie decomposition (expressed in per 100)				**Underweight**	**Stunted**	**Wasted**
Mean prediction of Non-poor				0.310	0.359	0.169
Mean prediction of poor				0.455	0.542	0.186
Row differentials				-0.145	-0.183	-0.017
Total explained				-0.094	-0.114	-0.015
% explained gap in wasted/stunted/underweight children between poor and non-poor				64.94	62.24	83.93
% unexplained gap in wasted/stunted/underweight children between poor and non-poor				35.06	37.76	16.06
Total Observation				36465	36465	36465

Note: At level of Significant ***p<0.01, **p<0.05, *p<0.1.

DISCUSSION

The present study showed that some regions are more vulnerable to child stunting and underweight than wasting which is clearly identified through this analysis. Purvanchal region faces multiple burdens in childcare and nutritional development indicators followed by Bundelkhand and Avadh regions. Although the progress of child nutritional indicators has improved, huge disparity across socio-economic groups and spatial-regional levels could be seen. The western region of India had among the highest concentration index values among different child nutritional indicators. Previous studies have shown that regions which are in lesser coverage of healthcare services have a lower inequality.[36]

Table 2 reveals an unexplained trend in wasting, which is very poor for mothers with a high BMI (obese and overweight), but not in the richest quintile. The same is true for infants who have not been breastfed, and mother's education appears to have little effect on the wasting levels. Compared to stunting and underweight, wasting have shown a very different trend, which has gone up between NFHS-3 and NFHS-4 rounds, in both rural and urban areas of Bundelkhand region, wasting levels remain within a very narrow range. The possible reasons could be: wasting is a reflection of short term episodic past while stunting reflects a cumulative long term outcome, socio-economic, ecological, and environmental factors affecting wasting levels in Bundelkhand region, the proportion of wasted children in Uttar Pradesh has increased during the decade of economic development, which is perplexing. Stunting has decreased over time, despite the fact that it is a more "chronic" disease that is more dependent on macro factors. Factors that cause stunting, can also affect wasting. Also, there could be other causal factors that are affecting wasting which need to be identified. Hence, these huge disparities can be easily seen through the lens of agricultural, socio-economic and environmental factors in the state.

The concentration index and decomposition analysis have also shown that the high concentration of child malnourishment such as stunting, underweight, and wasting is shown in lower socio-economic groups. For individuals level contributing factors such as mother's education and caste and childbirth order are significantly associated with poor child nutrition outcomes in the state. Although recently, a survey in collaboration with UNICEF and Population Council found that the prevalence of child malnutrition in the age group of 0-19 years has drastically come down across states, however, the inequality

remained same across socio-Economic groups and rural-urban.[29]

Child growth, nutrition, and development in the state requires attention and political willpower to enhance child health and nutritional development indicators through adequate policy interventions. Rural and remote areas are suffering a lot from low access and under-utilization of child health care services and they also face nutritional deficiency that is shown in the analysis. A need-based allocation of resources is required to trickle down the issues in these areas. New approach is required from CSR (corporate social responsibility) to intervene and give priority to the health nutritional sector for holistic development in the state.[41] Poshan Abhiyan is working to boost maternal and child health and nutritional practices across India and its states. Government funding and budget allocation especially for childcare, education, and nutrition seem to be proportionally inappropriate in the state.[42–44] Identifying the inequalities at the district level would be helpful to help and build new interventions for those specific districts that are underprivileged.[32,45,46]

Socio-economic, geographic, nutritional and environmental factors plays a significant role in determining the health and nutritional status of children in the state of Uttar Pradesh. Lack of understanding of these factors poses a serious concern over Sustainable Development Goals (SDGs) in India as a whole, especially goal 3 - eliminating hunger and malnutrition. A study conducted by Pandey in the state of Uttar Pradesh found that receiving health services depend on the individual, household, and community-level factors.[47] A lack of strategic interventions of health and nutrition-related policies and programs has made a loophole in the overall child's development. The western region emerged as high in accessing and utilizing healthcare services across the groups.[48] Lack of knowledge, practices related to infant and young and child feeding practices in the state made more vulnerable to children those who belonged to the poor and marginalized community. In India, the level and pattern of child growth and nutritional health indicators are one of the worst in the world.[7,49,50] For improving child health and nutritional development a multi-sectoral policy is therefore required to combat multi-faceted issues that emerged at an individual, household, and community levels in accessing and utilizing childcare services.

Limitations

Firstly, results should be interpreted cautiously as we did not have a direct indicator of household income or expenditure (household wealth index was used as proxy) to examine child nutritional status. Secondly, we could not establish a causal relationship between socio-economic and demographic variables, as the data we analysed was cross-sectional in nature. Lastly, we do not include climatic factors that might lead to differences in the availability of different types of grains which might affect differences in the rates of malnutrition.

CONCLUSION

The prevalence of malnutrition in children under the age of five is relatively high, and it varies widely depending on the measurement technique used. The current study explored the socioeconomic inequalities in childhood malnutrition at the regional level in Uttar Pradesh using data from the fourth round of the NFHS. It found that childhood malnutrition was concentrated predominantly in the state as a whole, and varied significantly across regions. The prerequisites for tackling malnutrition among under-five children in India are strengthening public health strategies for mild malnutrition cases among vulnerable groups and research on overweight, obesity, and its etiological factors. More broadly, policies to provide better water and sanitation to the general population, as well as female literacy, should be maintained. It's important to note that both infrastructure and more general economic development benefits are distributed more uniformly across the regions.

Recommendations

Although we have NRHM (National Rural Health Mission) launched in 2005 (in 2013, thereafter named as National Health Mission), a multi-sectoral health programme aimed to provide maternal and child health care and nutritional services. We had a separate programme on women and child nutrition as Nutritional Health Mission now it is the Poshan Abhiyan (2018 thereafter) which acts as a multi-sectoral response in providing nutritional services. The new Poshan Abhiyan (Nutrition Movement) can become a catalyzer to fill up the gaps that emerged in child health and nutritional development if people do participate in the programme. It is a holistic approach to direct the problems of nutrition in the country by addressing intersectional convergence for better services, use ICT. The programme is aimed to reduce stunting, under-nutrition, and anaemia (among young children, women, and adolescent girls) and the low-birth-weight which adversely affects health, growth, and development. Based on our analysis it is a targeted approach is needed to meet the SDGs, and which can further reduce socio-economic inequality and regional disparity in child health and nutritional outcomes indicators where still, a large segment of the population is devoid of basic services in the community.

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