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Major Correlates of Anemia among Women (Age 15-49) in India and Spatial Variation, Evidence from National Family Health Survey-4

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Abstract

Background: In the developing countries like India, Anemia continues to remain a serious nutritional problem. The National Family Health Survey (2015-16) has reported a 53% prevalence of Anemia among women, a sluggish decline from 58% in NFHS-3.

Objective: The study determines the prevalence of anemia among women by several background characteristics. It also tries to examine the socio-economic inequality in anemia among women across Indian states and attempts to analyze the spatial correlation of anemia among women and its co-variates across 640 districts of India.

Methods: The data is taken from the IV round of National Family Health Survey (2015-2016) conducted by the International Institute for Population Sciences, Mumbai. Bivariate analysis and Binary Logistic Regression analysis were used to assess the effects of socio-economic characteristics. Concentration Index and Poor-Rich ratios have been calculated to understand the socio-economic inequality whereas spatial analysis was done to understand the spatial correlation among women and its covariates.

Results: Anemia is highly prevalent among women belonging to rural areas and lowest wealth quantiles. Some behavioral factors of women were found to be positively associated with anemia. The highest inequality is being observed in the north-eastern states like Manipur, Nagaland etc. Moran's I value depicts high auto correlation; the hotspots were found in the Eastern and Western regions of India.

Discussion: Despite slight improvements, hemoglobin concentrations remain low while anemia prevalence remains high in poorest parts of the world. The rich and poor gap seems to be a big matter of concern. Women in India are not only suffering from economic inequalities but also inequalities in terms of food and malnutrition. Wealth is the strongest determinant of anemia among women followed by education and caste.

Keywords: Women; Anemia; Inequalities; Logistic regression; Spatial analysis

Introduction

Nutritional anemia is one of the biggest problems of our country, specifically called as the third pillar of malnutrition. The National Nutritional Anemia Control Programme (NNACP), a centrally sponsored scheme, was launched in India in 1970 with an aim of reducing the prevalence and incidence of anemia in women in reproductive age group, but failed to make any significant impact. In the developing countries like India, anemia continues to remain a serious nutritional problem. The National Family Health Survey (NFHS 2015-16) has reported a 53% prevalence of anemia among women, a sluggish decline from 58% in NFHS-3. When over half of the women in the country suffer due to nutritional anemia, the idea of 'Health for All' seems to be an illusion. Several programmes have been running out in order to provide equal nourishment to each and every individual in the society. Improving the maternal and child health and their survival are central to the achievement of national health goals under the National Rural Health Mission (NRHM) as well as the Millennium Development Goals (MDG) 4 and 5 [1].

Anemia is a result of reduced hemoglobin level in the body. Various intermixed factors cause Anemia but poor intake of nutrients and fibrous food in diet seem to be the ultimate reason behind it. Anemia is known to have disastrous implications on the health of particular groups like children, adolescent girls and women of reproductive age group. Numerous women are living with this problem without even realizing its serious repercussions upon the overall development of wellbeing and its fatal outcomes in future. Anemia can have detrimental effects upon women, i.e. difficult for women to earn income, carry out daily tasks, and care for their families. Conservative estimates suggest anemia is the direct cause of 3% to 7% of maternal deaths worldwide. Other estimates suggest that it is the direct or indirect cause of 20% to 40% of maternal deaths [2]. The steps taken to eradicate malnutrition and anemia have not been accomplishing enough to overcome the pertaining situation.

Review of Literature

The prevalence of anemia as a public health problem is categorized as follows: <5%, no public health problem; 5%-19.9%, mild public health problem; 20%-39.9%, moderate public health problem; 40%, severe public health problem [3].

Literature on effects of anemia on women's health

Females had higher prevalence of anemia than males in virtually all regions, especially Central Asia (43.2% *vs.* 22.8%) and Asia Pacific, high income (19.4% *vs.* 10%) as stated through a study [4]. Deficient iron status or anemia among adolescent girls is a major cause of growth retardation, impaired physical and mental development, delayed menarche, morbidity and future poor reproductive outcomes [5]. The high rates of anemia among Indian women reflect their social and biological vulnerability both within society and the household [6]. A study by [4] revealed that much of the excess anemia in females at other ages was related to iron deficiency including gynecologic conditions that often present as iron deficiency.

Literature on anemia arising from socio-economic inequality

The fact that women are provided an unequal nutrition in the family has been well discussed in many studies. The existing literatures suggest that there is definitely a socio-economic inequality prevalent which proves to be an obstacle for women to obtain a healthy lifestyle. Symptoms of anemia are consistently attributed to a poor quality diet and lack of food due to poverty. Women in India specifically, mention dietary restrictions and 'eating last' or 'eating whatever is leftover' as reasons of inadequate diet [7].

There is evidence that when poorer households gain more money to spend on food, they prefer to buy more expensive, yet not necessarily more nutritious food, such as sugar, salt and processed food [8]. A study conducted in Mumbai by suggests that the problem of under nutrition generally started much earlier in life, with gender discrimination resulting in under nutrition of girls (16-18), which was exacerbated by menstrual iron losses after menarche [9].

NFHS-4 being such a large scale survey provides estimates for several key indicators of health and nutrition. This study tries to undertake the problem of anemia by understanding it through several dimensions, especially focusing upon the socio-economic inequality in the nutritional status of women. Moreover, spatial analysis is important to understand the geographical clustering of anemia among women in India and to understand its spatial variation.

The study determines the prevalence of anemia among women with respect to several background characteristics. It also tries to examine the socio-economic inequality in anemia among women across Indian states and attempts to analyze the spatial correlation of anemia among women and its co-variants across 640 districts of India.

Data and Methodology

The data used in the study has been taken from the IV round of NFHS (2015-2016) conducted by the International Institute for Population Sciences, Mumbai. It provides nationally representative survey data on women's hemoglobin level and other nutritional aspects. The hemoglobin testing was conducted among women age 15-49 using a portable battery operated device called HemoCue Hb 201+ analyzer after the consent was taken.

The analysis is limited to non-pregnant woman age 15-49. Pregnant women have been excluded due to biological reason of them being anemic and hence the sample can get influenced which ultimately affects the results up to a certain extent. The final sample size for women after restricting it only to non-pregnant women was 667,258 cases.

The dependent variable taken for the study is 'anemia among women' which is dichotomous having 0 as "No anemia" and 1 as "yes anemia". For the bivariate analysis, three main levels of anemia were considered, i.e., mild, moderate and severe. Among background characteristics, age of the women, residence, religion, caste, wealth quantile, regions were taken.

Characteristics of women included education of women, Women's nutritional status, parity of women, place of delivery, sanitation facility, tobacco and alcohol consumption food intake categorized as vegetarian food and non-vegetarian food indicating the dietary habits.

Bivariate analysis was used to know the prevalence of anemia among women age 15-49 by some selected background characteristics and Binary Logistic regression analysis was used to assess the effects of socio-economic characteristics. It consists of two models; Model 1 in which only background characteristics were controlled and Model 2, in which background characteristics were controlled along with some peculiar characteristics of women.

Concentration Index and Poor-Rich ratios have been used to understand how socio-economic inequality persists in terms of nutrition of women in society and examine the magnitude of socio-economic inequality in any health outcome. Concentration Index (CI) is employed to study the extent of inequity in anemia across all 37 states of India [10]. The value of concentration index ranges from-1 to +1. When the outcome value is 0, it implies no socio-economic inequality. It is defined as, CI=2 covW (Yi, Ri).

Where Yi is the health status if the 'i'th individual and Ri is the fractional rank of the 'i'th individual (for weighted data) in terms of the value of the household economic status; μ is the (weighted) unconditional mean of the health variable of the sample and 'covW' denoted the weighted covariance.

As the wealth quantile is arranged from the lowest to highest quantile, a negative value indicates the concentration of relevant health variable, e.g. anemia in the lowest wealth quantiles and vice versa for the positive value of +1. The poor-rich ratio, defined as the ratio of the poorest to the richest wealth quintile is used to measure the gap in malnutrition among women in India. The poor-rich ratios are also being calculated for the states of India.

Lastly, the paper intends to analyze the spatial correlation between anemia among women and 640 districts of India. Univariate and bivariate Moran's I statistic was computed with the help of GeoDa, a spatial analysis software. Moran's I is the measure of spatial autocorrelation. It is a generalization of Pearson's correlation coefficient [11].

Spatial autocorrelation indicates the degree to which values are similar or dissimilar to their respective spatial neighbors. Spatial ordinary least square (OLS), the spatial lag model (SLM) and the spatial error model (SEM) have been computed to see the spatial correlation between independent and dependent variables.

Results

Table 1a show that mild anemia was significantly high among women of age 15-24 along with moderate anemia in the same age group. The prevalence of mild, moderate and severe anemia is higher in the rural areas than the urban counterparts. Among castes, scheduled tribes present the highest prevalence of mild, moderate and severe anemia followed by scheduled castes (SCs) and other backward class (OBC).

The people belonging to the lowest wealth quantile (poorest) have the highest prevalence of mild, moderate and severe anemia followed by poorer and middle income groups. The highest prevalence of severe and moderate anemia is found among north, central and southern regions of India whereas mild anemia is more found among eastern, central, northern and southern regions respectively (Tables 1a).

Background characteristics	Severe	Moderate	Mild
Age of women			
15-19	1	11.49	41.65
20-24	0.92	11.85	41.13
25-29	0.83	11.6	40.64
30-34	0.98	11.6	39.49
35 and above	1.2	12.2	39.57
Type of residence			
Urban	0.93	11.19	38.89
Rural	1.08	12.18	41.1
Religion			
Hindu	1.07	12.14	40.58
Muslim	0.88	10.35	39.46
Christian	0.87	11.89	35.24
Others	0.71	10.61	41.83
Caste			
Scheduled caste	1.16	13.24	41.59
Scheduled tribe	1.29	14.1	44.58
Obc	1.08	11.62	39.65
Others	0.76	10.29	39.04
Wealth Quantile			
Poorest	1.17	13.23	44.31
Poorer	1.14	12.33	41.73
Middle	1.14	12.52	39.71
Richer	1.02	11.54	38.64
Richest	0.7	9.82	38.03
Regions			
North	1.06	12.21	38.69
Central	1.02	11.26	39.68
East	0.73	12.21	47.39
North East	0.67	8.17	36.33

West	0.97	10.71	38.45
South	1.4	13.15	37.02
Women characteristics			
Education			
No education	1.59	14.44	42.82
Primary	0.96	11.6	40.64
Secondary	0.62	9.54	36.85
Higher	0.49	9.9	36.77
Women's nutritional status			
Below 18.5 (U-weight)	1.59	14.44	42.82
18.5-24.99(normal)	0.96	11.6	40.64
25- 30+(overweight)	0.59	9.63	36.83
Parity			
1	0.79	11.01	40.63
2 to 3	1.03	12.33	40.26
4 and above	1.1	11.64	40.33
Tobacco consumption			
No	0.99	11.71	40.3
Yes	1.63	13.79	41.02
Alcohol consumption			
Never/occasionally	1.14	12.41	40.06
Daily	0.87	13.81	40.92
Place of delivery			
Home delivery	1.44	14.65	44.69
Institutional delivery	0.79	12.08	42.5
Sanitation facility			
Improved	0.89	11.03	39.19
Unimproved	1.03	12.05	40.08
Open defecation	1.24	13.04	42.16
Food Intake (vegetarian food)			
Daily/occasionally	1.05	12.02	40.46
Never	0.77	9.91	39.19
Food Intake (Non-vegetarian food)			
Never/occasionally	1	11.72	40.17
Daily	1.26	12.96	42.01

Table 1a: Percentage of Women age (15-49) with different levels of Anemia by some selected background Characteristics.

Among the religions, Muslims have 8% while Christians have 33% significantly less likely to get anemia when compared to Hindus. Scheduled tribes (STs) are 22% significantly more likely to have anemia when compared to the SCs. Poorer people are 7% significantly less likely to be anemic; and the prevalence of anemia goes down as the wealth quantile increases.

When compared to north region, central region had 4%; north-eastern region had 41% less likelihood of anemia prevalence. Women with primary education are 5% significantly less likely to be anemic than uneducated ones.

In model 2, background variables are controlled along with some selected characteristics of women. When compared with the underweight, the women with a normal body mass index had 19% lower likelihood of being anemic whereas women who were overweight had 35% lower likelihood of having anemia. The chances of women being anemic grew with the increasing parity, i.e. women with 2 to 3 parities had 1% and 4 and above parities had 11% more likelihood of being anemic. However, both alcohol and tobacco consumption were negatively associated with anemia. Women gone for institutional delivery were 4% less likely to be anemic; women using an unimproved sanitation facility had 12% more likelihood to be anemic. When it comes to food and dietary practices, it was found that women who never consumed vegetarian food had 1% less likely to be anemic whereas women who consumed non-veg food daily had 7% lower likelihood to be anemic (Table 1b).

Women with no or little education have a high prevalence of all levels of anemia in which mild anemia leads the chart. Mild and moderate anemia is more prevalent among women who are underweight or normal whereas it is less prevalent among the overweight women. The highest prevalence of mild, moderate and severe anemia is found among women having one or two parities; which eventually decrease as the parity of women increases.

Among the women who consume alcohol and tobacco, all three levels of anemia have highest prevalence. Highest prevalence of anemia is observed among women who hadn't gone for institutional deliveries as well as in those who do not have an improved source of sanitation. Highest prevalence of anemia is seen among women who consume vegetarian food and non-vegetarian food daily/occasionally.

Multiple logistic regressions have been used in the study consisting of two models-Model 1 controlling only background characteristics and Model 2 controlling both background and peculiar characteristics of women. After controlling for various background variables in model 1, it is evident that age of women, place of residence, religion, caste, wealth quantile, regions and education of women significantly affects the likelihood of suffering from anemia in India. It is clear from the table those women age groups 20-24 have 4% higher likelihood of getting anemic. Rural areas had 2% more likelihood of anemia prevalence than the urban counterparts (Table 1b).

Background characteristics	Any anemia (%)	Model 1	Model 2
Age of women			
15-19®	54.13	1	1
20-24	53.9	1.04*(1.02,1.06)	0.86*(0.81,0.92)
25-29	53.07	0.99(0.98,1.01)	0.79*(0.75,0.85)
30-34	52.06	0.92*(0.9,0.93)	0.77*(0.72,0.83)
35 and above	52.97	0.92*(0.91,0.94)	0.8*(0.75,0.86)
Type of residence			
Urban®	51.02	1	1
Rural	54.36	1.02*(1,1.03)	1(0.97,1.03)
Religion			
Hindu®	53.79	1	1
Muslim	50.68	0.92*(0.91,0.94)	0.93*(0.9,0.96)
Christian	48.01	0.67*(0.66,0.69)	0.67*(0.64,0.7)
Others	53.15	0.99(0.97,1.02)	0.98(0.93,1.03)
Caste			
Scheduled caste®	56	1	1
Scheduled tribe	59.97	1.22*(1.19,1.24)	1.23*(1.19,1.28)
OBC	52.35	0.91*(0.9,0.93)	0.93*(0.9,0.95)
Others	50.09	0.86*(0.85,0.87)	0.87*(0.84,0.9)

Wealth Quantile			
Poorest®	58.72	1	1
Poorer	55.2	0.93*(0.91,0.94)	0.97*(0.94,1)
Middle	53.37	0.89*(0.88,0.91)	0.95*(0.92,0.98)
Richer	51.2	0.87*(0.85,0.89)	0.91*(0.87,0.95)
Richest	48.55	0.85*(0.83,0.87)	0.9*(0.86,0.95)
Regions			
North®	51.96	1	1
Central	51.96	0.96*(0.95,0.98)	0.97*(0.94,1)
East	60.33	1.3*(1.27,1.32)	1.24*(1.2,1.29)
North East	45.16	0.59*(0.57,0.6)	0.59*(0.56,0.61)
West	50.14	0.95*(0.93,0.97)	0.92*(0.88,0.96)
South	51.57	0.99(0.97,1)	0.92*(0.88,0.96)
Women characteristics			
Education			
No education®	56.35	1	1
Primary	54.64	0.95*(0.94,0.97)	0.94*(0.91,0.97)
Secondary	52.34	0.9*(0.89,0.91)	0.91*(0.88,0.93)
Higher	48.09	0.8*(0.78,0.82)	0.85*(0.81,0.89)
Women's nutritional status			
Below 18.5 (U-weight)®	58.85		1
18.5-24.99(normal)	53.2		0.81*(0.79,0.83)
25- 30+(overweight)	47.04		0.65*(0.63,0.67)
Parity			
1®	52.43		1
2 to 3	53.62		1.1*(1.07,1.13)
4 and above	53.07		1.11*(1.07,1.16)
Tobacco consumption			
No®	52.99		1
Yes	56.44		1.03(1,1.07)
Alcohol consumption			
Never/occasionally®	53.61		1
Daily	55.6		0.92(0.76,1.1)
Place of delivery			
Home delivery®	60.78		1
Institutional delivery	55.37		0.96*(0.93,0.99)

Sanitation facility			
Improved®	51.12		1
Unimproved	53.15		1.12*(1.08,1.16)
Open defecation	56.43		0.98(0.95,1.01)
Food Intake (vegetarian food)			
Daily/occasionally®	52.89		1
Never	56.23		0.99(0.96,1.02)
Non-vegetarian food consumption			
Never/occasionally®	53.53		1
Daily	49.87		0.93*(0.9,0.97)
®Reference category; P<0.05*			

Table 1b: Odds ratio of Anemia among women in India by some selected background and Women Characteristics.

Table 2 represents the values of CI regarding anemia among women in India as well as separately for urban and rural areas. The results are depicting a negative value which means there is an unequal distribution of anemia among women in the population. In India, the six major states showing highest negative values for women anemia are Mizoram, Nagaland, Rajasthan, Odisha, Chhattisgarh and Goa respectively. It shows that anemia among women is more concentrated and more robust in the poor population in these states. It is also evident that women anemia is also seen among the urban poor in the states like Nagaland, Mizoram, Rajasthan, Odisha and Chhattisgarh. Whereas, anemia in women is more prevalent among the rural poor in states like Goa, Mizoram, Nagaland, Rajasthan, Odisha and Chhattisgarh.

The poor-rich ratio, defined as the ratio of the poorest to the richest wealth quintile has been calculated for women having anemia. Among women, the highest poor-rich ratios are found in the states like Goa (350), Rajasthan (148 poor/100 rich), Nagaland (198/100 rich), Mizoram (184/100 rich), Meghalaya (159/100 rich), Chhattisgarh (149/100 rich), and Kerala (137/100 rich). Goa has the highest ratio for the urban area also with 357 poor per 100 rich having anemia. For the urban areas, Nagaland and Himachal Pradesh are showing highest poor-rich ratios (Table 2).

State	Total			Rural			Urban		
	C.I.	S.E.	P/R	C.I.	S.E.	P/R	C.I.	S.E.	P/R
Andhra Pradesh	-0.032***	0.005	1.26	-0.027***	0.006	1.21	-0.017*	0.009	1.30
Arunachal Pradesh	-0.036***	0.006	1.02	-0.039***	0.006	1.03	0.006	0.013	1.20
Assam	-0.028***	0.004	1.11	-0.031***	0.004	1.10	0.004	0.011	1.00
Bihar	-0.016***	0.002	1.10	-0.014***	0.002	1.14	-0.021***	0.006	1.14
Chhattisgarh	-0.064***	0.004	1.49	-0.059***	0.005	1.52	-0.060***	0.008	1.45
Goa	-0.067***	0.021	3.50	-0.119***	0.029	3.57	-0.038	0.030	0.00
Gujarat	-0.038***	0.004	1.23	-0.022***	0.004	1.25	-0.028***	0.006	1.19
Haryana	-0.024***	0.003	1.06	-0.019***	0.004	1.04	-0.024***	0.005	1.03
Himachal Pradesh	0.004	0.006	0.98	0.001	0.006	0.97	0.041**	0.021	1.86
Jammu and Kashmir	-0.020***	0.004	1.07	-0.022***	0.004	1.08	-0.045***	0.009	1.36
Jharkhand	-0.039***	0.003	1.25	-0.020***	0.003	1.10	-0.045***	0.006	1.29
Karnataka	-0.039***	0.004	1.23	-0.032***	0.005	1.25	-0.033***	0.007	1.20
Kerala	-0.002	0.008	1.37	-0.013	0.010	1.50	-0.006	0.012	0.91

Madhya Pradesh	-0.042***	0.002	1.24	-0.035***	0.003	1.22	-0.044***	0.004	1.25
Maharashtra	-0.021***	0.004	1.14	-0.026***	0.005	1.13	-0.033***	0.006	1.08
Manipur	-0.023***	0.009	1.25	-0.017*	0.011	1.28	-0.037***	0.014	1.17
Meghalaya	-0.060***	0.005	1.59	-0.032***	0.006	1.27	-0.042***	0.015	1.60
Mizoram	-0.134***	0.009	1.84	-0.112***	0.012	1.73	0.087***	0.014	1.03
Nagaland	-0.110***	0.009	1.98	-0.097***	0.011	1.99	0.124***	0.017	1.89
Delhi	-0.018**	0.007	0.66	0.01	0.037	0.00	-0.019**	0.008	0.67
Odisha	-0.070***	0.003	1.32	-0.069***	0.003	1.44	-0.069***	0.008	1.31
Punjab	-0.033***	0.003	0.95	-0.029***	0.005	1.09	-0.034***	0.007	0.75
Rajasthan	-0.082***	0.003	1.48	-0.073***	0.003	1.44	-0.059***	0.007	1.15
Sikkim	-0.022**	0.011	1.24	-0.036***	0.013	1.21	0.028	0.022	1.41
Tamil Nadu	-0.030***	0.003	1.14	-0.023***	0.004	1.11	-0.029***	0.005	1.18
Tripura	0.014*	0.007	0.89	0.014	0.009	1.02	0.018	0.014	0.89
Uttar Pradesh	0.002	0.001	1.04	0.006***	0.002	0.98	-0.023***	0.003	1.12
Uttarakhand	-0.026***	0.005	0.99	-0.010*	0.006	0.97	-0.043***	0.009	1.38
West Bengal	-0.042***	0.003	1.27	-0.034***	0.004	1.20	-0.030***	0.007	1.23
Telangana	-0.025***	0.006	1.23	-0.025***	0.007	1.12	-0.018*	0.011	1.44
P<0.10 *P<0.05**P<0.01***									

Table 2: Poor-Rich ratio and Concentration Index depicting socio-economic inequality in Anemia among women across Indian states.

Bivariate LISA (Local Indicators of Spatial Association) maps for women

Figure 1 presents a bivariate LISA map which depicts the spatial association between women anemia and selected independent variables. LISA maps help us to understand the spatial correlation at a very local level.

In Map A, younger woman (age 15-19) have a spatial correlation with anemia in 57 districts of eastern, some districts of Orissa, parts of Rajasthan, Gujarat and some districts of north Indian region.

In Map B, the clustering is even high having 83 districts who have a spatial correlated between anemia and Hindu women concentrated in the regions of south-eastern India, eastern India, parts of Madhya Pradesh, Gujarat and Rajasthan and in some parts of upper north India.

In map C, it is evident that 39 districts of eastern, south-eastern and western regions are spatially correlated in terms of women belong to STs Population and their anemic status.

Map D shows a correlation among states having women in the poorest quantile and anemia in the regions of south-eastern, eastern and western part of India.

Map E shows a significant relation between the highest percentage of uneducated women and anemia in 70 districts of eastern, south-eastern, parts of western India and in Jammu and Kashmir region.

Map F shows that women who are underweight are significantly correlated with anemia in 69 districts of western, eastern and south-eastern regions.

About 60 districts of south-eastern India, Eastern India and some parts of north and western India are statistically correlated with high prevalence of home deliveries and women anemia as depicted in Map G.

In Map H, 64 districts of south-eastern, eastern and western part of India are showing spatial association between women going for open defecation and anemia.

In Map I, clustering can be seen among eastern south-eastern, western and northern part is high for women anemia and respondents who never consume non-veg food.

In Map J, clustering can be seen among 24 districts of south-eastern region where there is a high correlation of women consuming any form of tobacco and anemia.

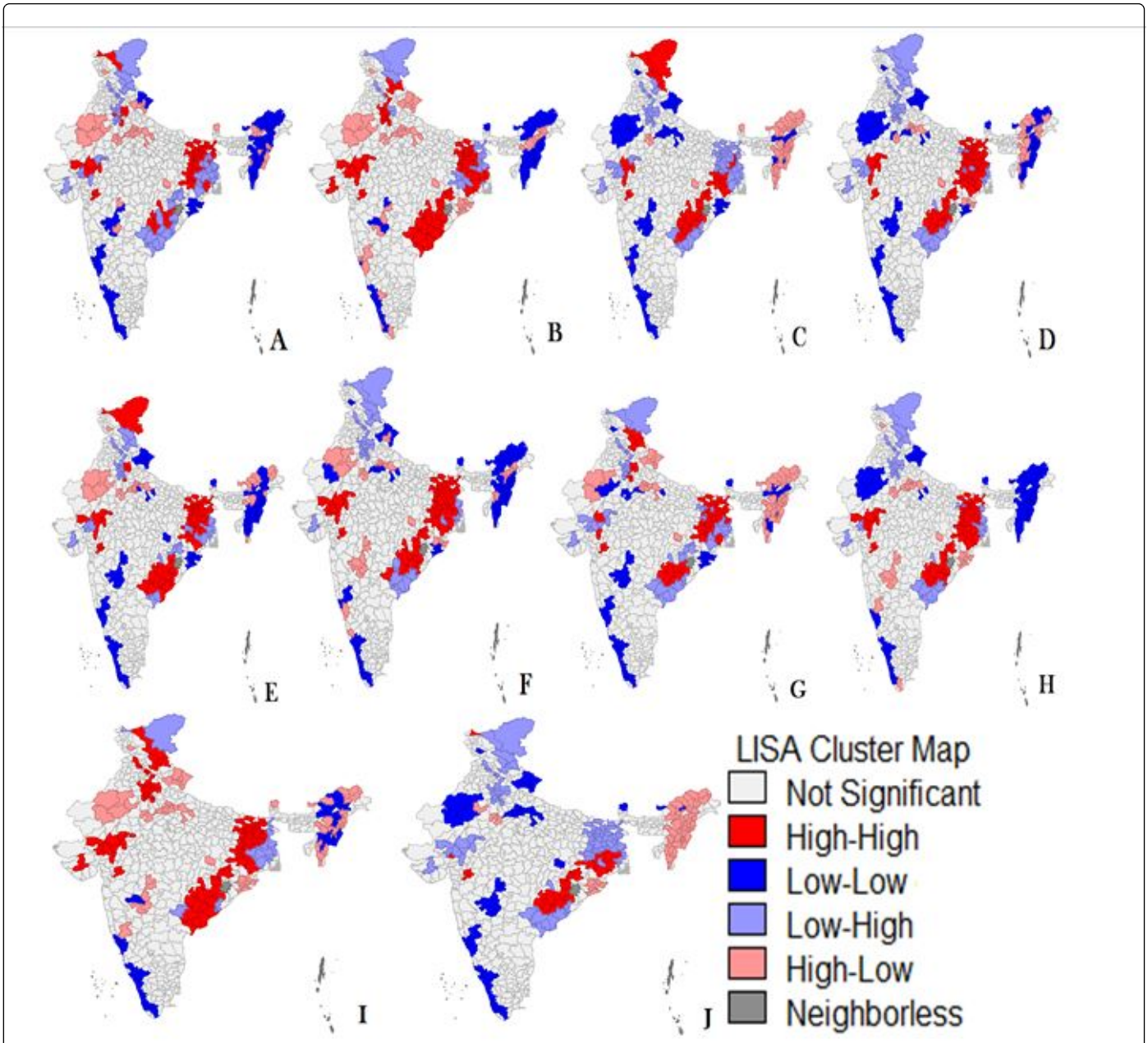

Figure 1: Depicting bivariate LISA maps showing spatial correlation between anemia among women and its co-variates. Note: A: Anemia among women and women aged 15-19 proportion; B: Anemia among women and Hindu women; C: Anemia among women and ST proportion; D: Anemia among women and poorest quantile, E: Anemia among women and no education; F: Anemia among women and under-weight women; G: Anemia among women and home delivery; H: Anemia among women and open defecation; I: Anemia among women and no non-veg. consumption; J: Anemia among women and tobacco consumption [**Note:** The map of India has been altered in the state of Jammu and Kashmir due to unavailability of the data in certain region].

An effort has been made to investigate the regional determinants and influential factors which affect the level of anemia among women in India. After establishing the significant bivariate spatial association between the dependent and independent variables, an OLS model was fitted (Table 3a). After this, SLM and SEM were fitted as per the convenience.

Tables 3a and 3b shows similar patterns observed with reference to regional determinants and drivers of women anemia in India. To carry out spatial analysis, firstly an OLS model was fitted.

Variables	MORAN'S I	P-value	Bi- MORAN'S I	P-value
% Women Anaemia	0.589	0.001	-	-
% Age of women (15-19)	0.699	0.001	0.084	0.001
% Residence (urban)	0.413	0.001	-	-
% Hindu Women	0.753	0.001	0.246	0.001
% Caste (ST)	0.697	0.001	0.164	0.001
% Wealth quantile (poorest)	0.746	0.001	0.218	0.001
% No education	0.714	0.001	0.283	0.001
% Underweight (mother)	0.697	0.001	0.277	0.001
% Place of delivery (Home)	0.66	0.001	0.082	0.001
% Open defecation	0.791	0.001	0.268	0.001
% Tobacco consumption	0.808	0.001	0.293	0.001
% Non-veg Food intake (Never or Occasionally)	0.667	0.001	0.177	0.001

Table 3a: Moran's I statistics showing spatial dependence of Anemia among women and different independent.

Afterwards, spatial lag and error models were computed to know the best fit model for the analysis (Table 3b).

Variables	OLS Model		Spatial Lag Model		Spatial Error Model	
Indicators	Coefficients	Sig. value	Coefficients	Sig. value	Coefficients	Sig. value
% 15-19 aged women	-0.402	0.01	-0.242	0.065	-0.226	0.151
% Hindu women	0.024	0.336	0.014	0.515	0.047	0.106
% St population	0.028	0.228	0.023	0.23	0.046	0.063
% Poorest quantile	0.216	0.001	0.107	0.007	0.007	0.896
% Uneducated women	0.226	0.001	0.143	0.001	0.164	0.008
% Underweight mothers	0.264	0.001	0.177	0.009	0.307	0.001
% Home delivery	-0.189	0.001	-0.123	0.001	-0.081	0.051
% Open defecation	-0.12		-0.066	0.021	-0.073	0.07
% Non-veg consumption daily	0.117	0.002	0.032	0.298	0.124	0.005
% Tobacco consumption	-0.24	0.001	-0.06	0.12	-0.006	0.923
% Alcohol consumption	-0.256	0.421	-0.163	0.541	-0.084	0.723
AIC	4847.05		4676.25		4566.5	
LAMBDA					0.757***	
RHO			0.537			
R-SQUARE	0.275		0.459		0.489	
ADJUSTED R-SQUARE	0.262					

Table 3b: OLS, Spatial Lag & Spatial error model to assess the association between prevalence of Anemia among women and some selected socio-economic factors in India, NFHS- (2015-16).

It was found Akaike Information Criterion (AIC) value was least for the spatial error model which is considered appropriate for the spatial analysis. For the women anemia, the value of lambda is 0.757 which shows the spatial autocorrelation among regions in India.

The spatial error model depicted that women anemia has a higher prevalence among the regions where there is a higher percentage of women who belong to Hindu religion, higher percentage of uneducated women, and higher percentage of women who are underweight, higher percentage of women who never consumed non-veg food.

Discussion

The results suggest that anemia is highly persistent among women of reproductive age group where more than half of the women are suffering from one or the other level of anemia. Eastern regions of India had the highest prevalence of both mild and moderate level of anemia among women. Anemia is highly prevalent among women belonging to rural areas which depict the amount of priority given to health of women in a rural setup. The higher prevalence of anemia in rural areas is likely related to lack of information about adequate nutrition during pregnancy, economic factors and inaccessibility of health care centers [12]. This study focusses on anemia among women with low background status; anemia was significantly associated with diseases like malaria and other plasmodium infections; it is difficult to say that anemia preceded the determining factors or vice-versa. The findings of our study show that women are more prone to be anemic when they are poor which means there is a disparity in the society regarding the type and quality of nutrition given to a woman.

It is also clear that the highest burden of anemia is shared by the poorest people which increase their risk of getting affected to different types of diseases as well. Christians were significantly less likely to have any anemia, in comparison to Hindu's [8]. Though the study is based on repeated cross-sectional surveys, it is unable to differentiate between different types of anemia that may explain the changing pattern of inequalities. Anemia among women seemed to be increasing with number of parities while it started to decline with parity 4 and above. Behavioural factors associated with women anemia e.g. tobacco and alcohol consumption, open defecation was found to be positively associated with anemia. The negative values of CI reflect that inter-state inequality is prevalent in anemia among women in India. It clearly depicts that a disproportionate burden of anemia is being shared by the poor. Many studies reveal that there is a socio-economic inequality in anemia among poor households in India [10]. A study in Ghana reveals that stunting, underweight in under-five children, anemia in women and underweight in women [Body mass index (BMI) <18.5] show inequities that are to the disadvantage of the poorest [13]. Not only the disease risk is more in the poorest society, the benefits of the health care policies are enjoyed by the richest of society more than the poorest the current study reveals that the highest inequality is being observed in the north-eastern states like Manipur, Nagaland etc. Many studies have been done to analyze the prevalent inequality in terms of malnutrition and anemia in north east [14]. The above study clears the fact that the biggest reason of malnutrition among children in north-east is the malnourishment of their mothers. The characteristics of mothers are highly significant in determining the status of malnutrition among children in north-east. Thus, an improvement in only economic sphere will not help until an idea regarding inclusive growth is implemented in north-east. The poor-rich ratios presented in the present study also reveal the gap between rich and poor across north-eastern states; it also suggests the need of proper monitoring and coordination at household and community levels in order to improve the situation of malnutrition in north east. The poor-rich ratios depict the distribution pattern of anemia among poorest and richest category.

Our findings suggest that women belonging to the poorest socio-economic status have higher prevalence of worse anemic status. On contrary, the women belonging from the highest and most well-off households are associated with better nutritional status and were less vulnerable to get anemia. This proves the fact that socio-economic status becomes an important determinant of how anemia and malnutrition is distributed across the states. This socio-economic inequality widens the gap between rich and poor and acts as an important factor of improving or degrading the development of an individual in the society. Spatial analysis reveals a positive autocorrelation between anemia among women and its co-variates among the districts of India. Moran's I value is depicting high auto correlation which means that anemia among women has a spatial clustering across districts of India. The hotspots found in case of anemia among women with its co-variates were in the eastern regions and western regions of India particularly in the states like Andhra Pradesh, Bihar, West Bengal, Odisha, Chhattisgarh and some districts of Rajasthan, Gujarat and Madhya Pradesh.

Conclusion

The results of the study show that women with childbearing experiences are more anemic. A study by [9] also reveals that women without children had higher hemoglobin values than women with living children supports the view that childbirth, lactation, and childbearing tax a woman's nutritional condition; but as it only studied the women from poor backgrounds in Mumbai who probably had inadequate diets, we cannot generalize the results for all concerned women. The argument is furthermore made more valid through another study by [15] which presents that women of childbearing age are at high risk for negative iron balance because of blood loss during menstruation and the substantial iron demands of pregnancy. It suggests that additional research will be important for improving understanding of the distribution of nutritional deficiencies in populations and their risk relations. The standard of living and socio-economic status proved to be the two most important factors in determining anemia among women while the behavioral factors affecting the levels of anemia among women in the third place. It is clear from the spatial analysis that regional heterogeneity has been found in the levels of anemia among women. Bivariate LISA maps help us to understand the clustering of variables included in the study and to identify the districts/regions which need more attention. Despite it, the study cannot explain completely for the outliers existing at the end of the study. The findings of the study suggest more investment towards improving the conditions of women in the regions where anemia among women is high. It also suggests that the childbearing process should be made easier for women. It is a known fact that the nutritional status of women can have serious repercussions for child development and women's health; hence, it is important to develop control and prevention strategies that attend the inequality in terms of socio-economic status in the society. Moreover, all the other essential socioeconomic and demographic factors affecting the nutrition of women should be addressed carefully. Therefore, there is a call for reducing regional disparities and improving the socio-economic status of the poor women. Efforts should also be made to providing equal

opportunities of health and nutrition to all, improving women education and reducing higher order births, making childbearing easier and safe for women in order to eradicate the problem of anemia once and for all.

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