INDIAN JOURNAL OF POPULATION AND DEVELOPMENT
ISSN: 2583-4827; Volume 4(1), January 2024: 31-46

Anaemia Prevalence in Children and Women Across India: Levels and Determinants, 2019-2021

Subhash C Gulati
Rajesh Raushan
William Joe

Abstract

The prevalence of anaemia in children and women in India and in most of the states/Union Territories and districts has increased between NFHS-4 (2015-2016) and NFHS-5 (2019-2021) despite focused efforts since 1970. Anaemia prevalence varies across India primarily because of sociocultural variations, food habits, utilisation of antenatal care (ANC) services, institutional deliveries, and other anaemia alleviation factors. This study explores patterns and determinants of anaemia prevalence across 36 states/Union Territories and 706 districts based on data from NFHS-5. The indicators of the prevalence of anaemia in children aged 6-59 months, pregnant and non-pregnant women aged 15-49 years, and adolescent women aged 15-19 years depict highly significant and positive inter-correlations. Principal Component analysis has been used to construct a composite score of anaemia in children and women. Mapping of composite score facilitated identification of contiguous belts of high anaemia in children and women which would facilitate devising region-specific anaemia-alleviation strategies. The analysis reveals that education of women, age at marriage, prevalence of exclusive breastfeeding, utilisation of maternal and child health care, especially consumption of IFA tablets, and tobacco consumption among women are significantly correlated with anaemia in children and women. Strengthening IEC components and region-specific anaemia-alleviation strategies can lead to optimal results for anaemia-control in India.

Introduction

Anaemia and iron deficiency affect billions of people worldwide, especially women in reproductive age and young children. Prevalence of anaemia is discerned to be relatively higher in South Asia and Central and West Africa than in other regions of the world. The World Health Assembly, in 2012, adopted a resolution endorsing a comprehensive implementation plan on maternal, infant, and young child nutrition which specified six global nutrition targets to be achieved by the year 2025 including 50 per cent reduction in the prevalence of anaemia in women of reproductive age (WHO, 2012). The World Health Assembly also noted that causes of anaemia across countries were different but more than half of the cases of anaemia were due to iron deficiency among women of reproductive age. WHO also recommended interventions for prevention and control of anaemia which include

diet containing adequate amounts of bioavailable iron, malaria control, deworming, delayed cord clamping (not earlier than 1 min after delivery), and focussed attention on adolescent girls especially in areas with high adolescent birth rates and prevalence of marriage of females at a young age. In India, the National Nutritional Anaemia Control Programme was launched in 52 districts of 13 states of the country in 1970 which provisioned weekly iron–folic acid supplementation for adolescent girls. The programme reached both school-going and not school-going girls aged 10–19 years. An evaluation of the programme indicated reduction in the prevalence of anaemia by 24 per cent after 1 year of implementation (Government of India, 1991).

Anaemia is a condition in which the number and size of red blood cells, or the haemoglobin concentration, falls below an established cut-off value which leads to the impairment of the capacity of the blood to transport oxygen. Anaemia is an indicator of both poor nutrition and poor health (WHO, 2012). Both, anaemia, and iron deficiency reduce the wellbeing of individuals and lead to fatigue and lethargy, breathlessness, chest pain, and headache, and impairs physical capacity and work performance and hence productivity. The manifestations of anaemia vary by its severity and ranges from fatigue, weakness, dizziness, and drowsiness to impaired cognitive development of children and increased morbidity. Anaemia in pregnancy is associated with post-partum haemorrhage, neural tube defects, low birth weight, premature births, stillbirths, and maternal deaths.

Common causes of anaemia worldwide are inadequate dietary iron intake and absorption. The need of iron is higher in women because of blood loss during menstruation. The need of iron is also higher in pregnant women because of dual requirement for their own health and for the growth of the foetus. Causative factors of anaemia also include infectious diseases, especially malaria, and nutritional deficiencies, especially folate and vitamins B_{12}, A and C. Genetic conditions including sickle cell disease, thalassaemia - inherited blood disorder - and chronic inflammation also lead to anaemia (Mayo Clinic, 2022). The complex interaction between nutrition, infectious diseases, and other factors presents a challenge to effectively address the problem of anaemia (Balarjan et al, 2013). Anaemia is disproportionately concentrated in low socioeconomic groups, and maternal anaemia is strongly associated with child anaemia (Government of India, 2022). Anaemia in children is possibly linked with nutritional deficiency, characterised by stunting, wasting and underweight, and with adolescent fertility resulting in low birth weight babies. Anaemia among women in their childbearing age, especially pregnant women is also a cause of low birth weight among newborn, and, therefore, higher neonatal and perinatal mortality and higher prevalence of diseases in later life. Furthermore, food habits like lack of millets in the diet due to overdependence on rice and wheat, insufficient consumption of green and leafy vegetables, and dominance of packaged and processed foods which are lacking in certain vitamins and minerals and thus low in nutrition could also be the reason behind the high prevalence of anaemia.

The National Nutritional Anaemia Control Programme launched in 1970 in the country has now been evolved as the Anaemia Mukt Bharat (AMB) Programme in 2018 with innovative strategies and budgetary provisions. The Programme is being implemented in all districts of the country through the existing delivery platforms as envisaged in the National Iron Plus Initiative (Kapil et al, 2019) and Weekly Iron and Folic Acid Supplementation

Programme for Adolescents (Government of India, 2012). The Government of India has also launched the National Nutrition Mission in 2018 with renewed budget and targets for reducing the prevalence of stunting, undernutrition, and anaemia among children, and prevalence of anaemia in women and adolescent girls and to reduce the incidence of low birth weight babies (Government of India, 2018). The Mission is now renamed as *Poshan Abhiyan* (Government of India, 2023). The Integrated Child Development Services (ICDS) launched in 1975 also provides health and nutrition services to children below 6 years of age and to pregnant women and lactating mothers (Kumar, 1999).

Despite all these focused efforts, the prevalence of anaemia in children, adolescent girls and women, especially pregnant women and adolescent mothers appears to have increased in recent years as revealed through the fourth (2015-2016) and fifth (2019-2021) rounds of the National Family Health Survey (Government of India, 2022). Across the 36 states/Unio Territories of the country, the prevalence of anaemia has gone up in 27 states/Union Territories which account for more than 84 per cent of the population of the country. The prevalence of anaemia in adolescent girls aged 15-19 years has increased in 25 states/Union Territories while the prevalence of anaemia in pregnant women has increased in 21 states/Union Territories. It is in this context that the present study attempts to delineate regions of high anaemia prevalence in India at state/Union Territory and district level. The study also purports to highlight determinants of anaemia using multivariate analytical techniques.

Data and Methods

The study is based on the data available through the fourth (2015-2016) the fifth (2019-2021) rounds of the National Family Health Survey (Government of India, 2017; 2022). The fifth round of the National Family Health Survey interviewed 724115 women aged 15-49 years and 101839 men aged 15-54 years (Government of India, 2022). The survey also elicited information on anaemia among children aged 6-59 months, adolescent women aged 15-19 years, pregnant and non-pregnant women aged 15-49 years, and men aged 15-54 years by haemoglobin testing using the capillary blood technique. A child was classified as anaemic is the haemoglobin level was less than 11 grams per decilitre (g/dl). A pregnant woman was classified as anaemic if the haemoglobin level was less than 12 g/dl. A non-pregnant woman was classified as anaemic if the haemoglobin level was less than 11 g/dl. Similarly, a man was classified as anaemic if the haemoglobin level was less than 13 g/dl. The same techniques and classification were used to classify children, pregnant women, non-pregnant women, and men as anaemic during the fourth (2015-2016) round of the National Family Health Survey. Based on these data, the prevalence of anaemia in children, non-pregnant women aged 15-49 years, pregnant women aged 15-49 years, all women aged 15-49 years, and women aged 15-19 years was estimated for the 706 districts and 36 States/Union-Territories of the country as they existed at the time of the fifth (2019-2021) round of the National Family Health Survey. These prevalence rates constituted the database for the present analysis. The list and the definition of indicators of anaemia employed in the present study are given in table 1. Descriptive statistics of the variation in the selected indicators of anaemia in children and women across the state/Union Territories

and districts of the country are provided in tables 2 and 3 respectively. Principal component analysis has been used to construct a composite score of anaemia in children and women based on the five indicators of anaemia in children and women and multivariate regression analysis have been used to analyse the variation in the composite score of anaemia in children and women across 706 districts of the country.

Table 1: Description of indicators of anaemia and other indicators used in the analysis.

Indicator	Definition of indicator
	Anaemia-Prevalence Indicators
Y_1	Per cent of children ages 6-59 months who are anaemic (<11.0 g/dl)
Y_2	Per cent of non-pregnant women aged 15-49 years who are anaemic (<12.0 g/dl)
Y_3	Per cent of pregnant women aged 15-49 years who are anaemic (<11.0 g/dl)
Y_4	Per cent of all women aged 15-49 years who are anaemic
Y_5	Per cent of women aged 15-19 years who are anaemic
	Other Socioeconomic and MCH Indicators
X_1	Per cent of women literate
X_2	Per cent of women with at least 10 years of schooling
X_3	Per cent of Women aged 20-24 married before reaching 18 years of age
X_4	Per cent of pregnant women aged 15-49 years who had 4 ANC checkups
X_5	Per cent of pregnant women aged 15-49 years who had consumed 100 IFA Tablets
X_6	Per cent of institutional deliveries
X_7	Per cent of children aged 12-23 months fully immunised
X_8	Per cent of children aged 6 months exclusively breastfed
X_9	Per cent of women who were consuming tobacco
X_{10}	Per cent of women who were consuming alcohol

Source: Government of India (2022)

Prevalence of Anaemia

The prevalence of anaemia in children and women in India and in its states/Union Territories is presented in the appendix table for the period 2015-2016 and 2019-2021. Summary measures of the variation in the prevalence of anaemia across states/Union Territories and districts are presented in table 2. The prevalence of anaemia in children and women in the country has increased during the period 2015-2021 despite all efforts to reduce the prevalence of anaemia in children and women. The prevalence of anaemia in children aged 6-59 months increased in 27 out of 36 states/Union Territories of the country. These 27 states/Union Territories account for 84 per cent population of the country. The prevalence of anaemia in children increased in 6 of the 8 Empowered Action Group (EAG) states, in 11 of the 13 other large states and in 10 of the 5 smaller states/Union Territories (Table 3). Similarly, the prevalence of anaemia increased in 24 states/Union Territories in women aged 15-49 years; in 21 states/Union Territories in pregnant women aged 15-49 years; in 24 states/Union Territories in non-pregnant women aged 15-49 years; and in 25

states/Union Territories in women aged 15-19 years. The states/Union Territories in which the prevalence of anaemia in different groups of women increased during 2015-2021 relative to the period 2015-2016 accounts respectively for 68 per cent, 54 per cent, 68 per cent and 66 per cent population of the country. On the other hand, identification of the districts where the prevalence of anaemia increased during 2019-2021 relative to 2015-2016 is not possible because the number of districts increased between 2015-2016 and 2019-2021.

Table 2: Summary measures of the distribution of different indicators of the prevalence of anaemia in women and children across states/Union Territories and districts in India, 2019-2021.

	States/Union Territories				Districts			
	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Y_1	39.4	92.5	62.1	12.2	25.0	95.0	65.8	12.1
Y_2	26.0	93.7	54.2	13.7	16.0	95.0	56.2	12.0
Y_3	22.2	78.1	49.2	11.2	2.0	88.0	50.2	13.6
Y_4	25.8	92.8	54.0	13.6	15.0	94.0	55.9	12.0
Y_5	27.9	96.9	55.7	14.0	18.0	97.0	58.2	12.9

Source: Authors

Reasons for the increase in the prevalence of anaemia in children and women in are not known. The prevalence of anaemia in children and women has not increased in all states/Union Territories. There are states and Union Territories where the prevalence of anaemia in children and women has decreased. The analysis of the trend in the prevalence of anaemia in children and women in the districts could not be possible as the number of districts in the country at the fourth round (2015-2016) of the National Family Health Survey are different from the number of districts in the country at the fifth (2019-2021) round of the survey. Moreover, for the trend in different indicators of anaemia in children and women has been different in different states/Union Territories as may be seen from table 3.

Table 3: Number of states/Union Territories and districts in which prevalence of different indicators of anaemia increased during 2015-2021.

State/Union Territory/District	Y_1	Y_2	Y_3	Y_4	Y_5
All states and Union Territories N=36	27	24	21	24	25
EAG states (N=8)	6	6	2	6	6
Other large states (N=13)	11	10	11	10	9
Small states and Union Territories (N=15)	10	8	8	8	10

Source: Authors

The inter-state/Union Territory and inter-district variation in the five indicators of anaemia in children and women has been found to be highly correlated as may be seen from the simple zero order correlation coefficients between the variables based on either state/Union Territory level data or based on district level data (Table 4). Since the five indicators of anaemia in children and women are highly correlated, we have combined the five indicators into a signle composite score of anaemia in children and women through the

application of the principal component analysis technique. The composite score of anaelia in children and women generated through the application of the principal component analysis has been used for ranking states/Union Territories and districts within the country to reflect the problem of anaemia in children and women. The principal component analysis was carried out separately for the states/Union Territories and for the districts of the country for the period 2019-2021 so that the composite score of anaemia in children and women was estimated separately for the states/Union Territories and for the districts of the country.

Table 4: Simple zero order correlation coefficient among the five indicators of anaemia in children and women, 2019-2021.

	States/Union Territories				Districts			
	Y_2	Y_3	Y_4	Y_5	Y_2	Y_3	Y_4	Y_5
Y_1	0.778	0.668	0.778	0.868	0.647	0.504	0.650	0.677
Y_2		0.804	1.000	0.964		0.716	0.996	0.909
Y_3			0.810	0.770			0.738	0.621
Y_4				0.961				0.905

Source: Authors

Results of the application of the principal component analysis to state/Union Territory and districts level data separately are presented in table 5. Application of the principal component analysis using the data from states/Union Territories has revealed that the first principal component accounted for more than 87 per cent of the inter-state/Union Territory variation in the five indicators of anaemia in children and women. On the other hand, the principal component analysis using the district level data has revealed that the first principal component accounted for almost 80 per cent of the variation in the five indicators of anaemia in children and women across the districts of the country. Results of the principal component analysis suggest that the first principal component obtained from the application of the principal component analysis technique accounts for most of the variation in the five indicators of anaemia in children and women across the states/Union Territories as well as across the districts within the country. The component score of the first principal component, therefore, may be taken as the composite index that reflects the variation across states/Union Territories and across districts in the five indicators of anaemia in children and women used in the present analysis. It may be noted that the component score obtained from the principal component analysis is standardised score with mean 0 and standard deviation 1.

We have taken the component score of the first principal component as the composite index of anaemia in children and women. Since the component score is standardised, the composite index takes both negative and positive values and the higher the component score the more serious the problem of anaemia in children and women. The composite index is determined by the prevalence of anaemia in children aged 6-59 months, in all women aged 15-49 years; in non-pregnant women aged 15-49 years; in pregnant women aged 15-49 years; and in women aged 15-19 years. If there is a change in any of the five indicators, the value of the index will change. The index, therefore, can be used for ranking the states/Union Territories or districts in terms of the anaemia in children and women as reflected by the five indicators of anaemia in children and women.

Table 5: Results of the principal component analysis.

Particulars	State/Union Territory level analysis	District level analysis
Eigen value of the first principal component	4.373	3.979
Variance explained by first principal component	87.45	79.58
Component score coefficient of the indicators		
Y1	0.873	0.193
Y2	0.976	0.243
Y3	0.863	0.200
Y4	0.977	0.244
Y5	0.979	0.234

Source: Authors

Ranking of States/Union Territories

Ranking of States and Union Territories in terms of the composite index for the period 2019-2021 is presented in table 5. The composite index of anaemia in children and women is found to be the highest in Ladakh but the lowest in Nagaland. The composite index has also been found to be very high in West Bengal, Gujarat, Dadra & Nagar Haveli, and Tripura, but very low in Manipur, Kerala, Mizoram, and Lakshadweep. The composite index has also been found to be quite low in Himachal Pradesh and Tamil Nadu. Interestingly, in none of the EAG states, the composite index of anaemia in children and women is found to be either very low or very high. Among the EAG states, the composite index of anaemia in children and women is found to be relatively the lowest in Uttarakhand, but relatively the highest in Bihar. The composite index of anaemia in children and women is also found to be relatively very low in Uttar Pradesh but relatively very high in Jharkhand, Odisha, and Chhattisgarh. The four states – Bihar, Jharkhand, Odisha, and Chhattisgarh – where the composite index of anaemia in children and women is found to be very high are geographically continuous. A unique common feature of these states is that a high proportion of the population of these states is Scheduled Tribes population.

Ranking of Districts

We have also ranked 706 districts of the country as they existed at the fifth (2019-2021) round of the National Family Health Survey in terms of the composite index of anaemia in children and women as obtained through the principal component analysis. The inter-district variation in the composite index of anaemia in children and women is depicted in figure 1. The districts have been classified in five categories based on the composite index of anaemia in children and women – very low (VL); low (L); medium (M); high (H); and very high (VH) based on the composite index of anaemia in children and women. The distribution of districts by the level of the composite index of anaemia in children and women in different states and Union Territories of the country during 2019-2021 is presented in table 7.

Table 6: Ranking of states/Union Territories of India by the composite index of anaemia in children and women, 2019-2021.

States/Union Territories	Indicators of anaemia in children and women					Composite index	Rank
	Y_1	Y_2	Y_3	Y_4	Y_5		
EAG States							
Bihar	69.4	63.6	63.1	63.5	65.7	0.833	6
Uttar Pradesh	66.4	50.6	45.9	50.4	52.9	-0.150	21
Madhya Pradesh	72.7	54.7	52.9	54.7	58.1	0.294	16
Rajasthan	71.5	54.7	46.3	54.4	59.4	0.174	17
Jharkhand	67.5	65.7	56.8	65.3	65.8	0.754	9
Uttarakhand	58.8	42.4	46.4	42.6	40.9	-0.721	28
Chhattisgarh	67.2	61.2	51.8	60.8	61.4	0.446	13
Odisha	64.2	64.4	61.8	64.3	65.5	0.747	10
Other Large States							
Assam	68.4	66.4	54.2	65.9	67.0	0.764	8
West Bengal	69.0	71.7	62.3	71.4	70.8	1.155	2
Punjab	71.1	58.8	51.7	58.7	60.3	0.416	14
Haryana	70.4	60.6	56.5	60.4	62.3	0.577	11
Jammu & Kashmir	72.7	67.3	44.1	65.9	76.2	0.818	7
Himachal Pradesh	55.4	53.4	42.2	53.0	53.2	-0.305	24
Gujarat	79.7	65.1	62.6	65.0	69.0	1.093	3
Maharashtra	68.9	54.5	45.7	54.2	57.2	0.080	19
Karnataka	65.5	47.8	45.7	47.8	49.4	-0.314	25
Andhra Pradesh	63.2	59.0	53.7	58.8	60.1	0.324	15
Telangana	70.0	57.8	53.2	57.6	64.7	0.459	12
Tamil Nadu	57.4	53.6	48.3	53.4	52.9	-0.159	22
Kerala	39.4	36.5	31.4	36.3	32.5	-1.636	34
Small States/Union Territories							
National Capital Territory of Delhi	69.2	50.2	42.2	49.9	51.6	-0.209	23
Chandigarh	54.6	60.1	52.2	60.3	57.7	0.159	18
Goa	53.2	38.9	52.2	39.0	44.5	-0.771	29
Lakshadweep	43.1	26.0	52.2	25.8	31.4	-1.574	33
Puducherry	64.0	55.5	42.5	55.1	58.4	-0.004	20
Andaman & Nicobar Islands	40.0	57.6	52.2	57.5	44.9	-0.370	26
Dadra & Nagar Haveli	75.8	62.6	60.7	62.5	63.9	0.833	5
Sikkim	56.4	42.1	40.7	42.1	46.7	-0.782	30
Tripura	64.3	67.4	61.5	67.2	67.9	0.877	4
Mizoram	46.4	34.8	34.0	34.8	34.9	-1.491	32
Manipur	42.8	29.3	32.4	29.4	27.9	-1.869	35
Meghalaya	45.1	54.4	45.0	53.8	52.5	-0.405	27
Arunachal Pradesh	56.6	40.8	27.9	40.3	48.5	-1.028	31
Nagaland	42.7	29.3	22.2	28.9	33.9	-1.963	36
Ladakh	92.5	93.7	78.1	92.8	96.9	2.946	1

Source: Authors

Table 7: Distribution of districts across states and Union Territories by the level of the composite index of anaemia in children and women, 2019-2021.

State/Union Territory	Number of districts in which composite index is					Total
	Very low	Low	Medium	High	Very high	
EAG States						
Bihar	0	2	5	12	18	37
Uttar Pradesh	22	29	14	9	1	75
Madhya Pradesh	4	16	13	11	7	51
Rajasthan	3	9	7	12	2	33
Jharkhand	0	0	6	8	10	24
Uttarakhand	9	3	0	1	0	13
Chhattisgarh	1	4	11	4	7	27
Odisha	0	2	7	6	15	30
Other Large States						
Assam	0	3	5	13	12	33
West Bengal	0	0	1	5	14	20
Punjab	0	5	7	8	2	22
Haryana	1	1	6	10	4	22
Jammu & Kashmir	0	2	4	4	10	20
Himachal Pradesh	3	7	1	0	1	12
Gujarat	0	5	5	2	21	33
Maharashtra	3	12	12	6	3	36
Karnataka	13	9	6	2	0	30
Andhra Pradesh	0	2	6	5	0	13
Telangana	0	2	15	9	5	31
Tamil Nadu	8	12	6	6	0	32
Kerala	14	0	0	0	0	14
Small States/Union Territories						
National Capital Territory of Delhi	2	7	2	0	0	11
Chandigarh	0	0	1	0	0	1
Goa	2	0	0	0	0	2
Lakshadweep	1	0	0	0	0	1
Puducherry	2	0	2	0	0	4
Andaman & Nicobar Islands	1	2	0	0	0	3
Dadra & Nagar Haveli	0	1	0	1	1	3
Sikkim	4	0	0	0	0	4
Tripura	0	0	0	4	4	8
Mizoram	7	1	0	0	0	8
Manipur	9	0	0	0	0	9
Meghalaya	4	4	3	0	0	11
Arunachal Pradesh	16	0	1	2	1	20
Nagaland	11	0	0	0	0	11
Ladakh	0	0	0	0	2	2
India	140	140	146	140	140	706

Source: Authors

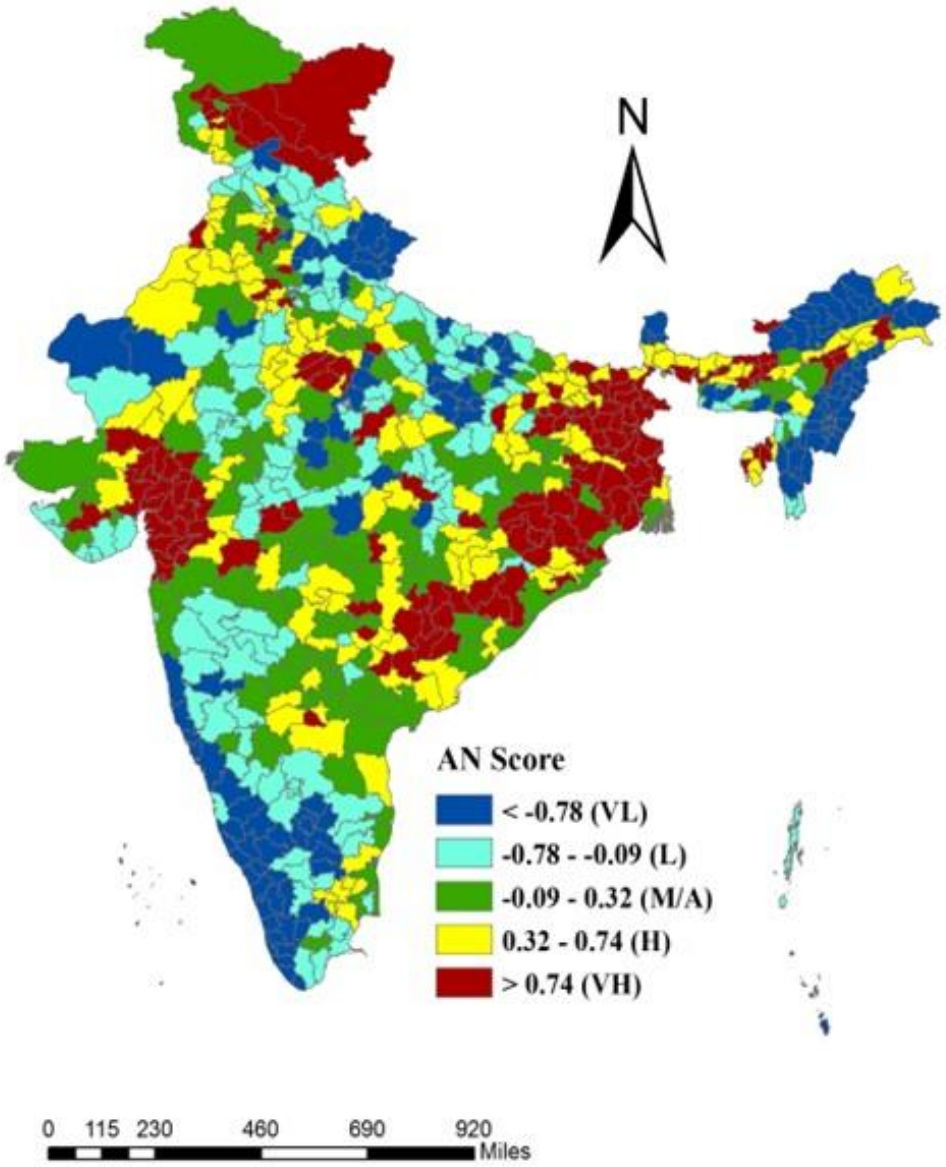

Figure 1: Inter-district variation in composite index of anaemia in children and women, 2019-2021.
Source: Authors

Table 7 reflects the concentration of districts with very high composite index of anaemia in children and women in selected states/Union Territories of the country. For example, the composite index of anaemia in children and women is found to be very high in 14 of the 20 districts in West Bengal and in 24 of the 33 districts in Gujarat. In Odisha, the composite index of anaemia in children and women is found to be very high in 15 of the 30 districts and in 10 of the 20 districts in Jammu & Kashmir. Similarly, the composite index of anaemia in children and women is found to be very high in 18 of the 37 districts in Bihar, 10 of the 24 districts in Jharkhand and 12 of the 33 districts in Assam. On the other hand, there is no district in Uttarakhand, Karnataka, Andhra Pradesh, Kerala, and Tamil Nadu where the composite index of anaemia in children and women is found to be very high. Among the small states and Union Territories, the composite index of anaemia in children and women is found to be very high in both the districts of Ladakh and in 4 of the 8 districts in Tripura.

At the other extreme, Kerala is the only state in the country where the composite index of anaemia in children and women is found to be very low in all the 14 districts of the state. In Uttarakhand, the composite index of anaemia in children and women is found to be very low in 9 of the 13 districts whereas the composite index of anaemia in children and women is found to be very low in 13 of the 30 districts of the state. Among the EAG states, the composite index of anaemia in children and women is found to be very low in 22 of the 75 districts in Uttar Pradesh and a small number of districts in Madhya Pradesh and Rajasthan. In Bihar, Jharkhand and Odisha, there is no district where the composite index of anaemia in children and women is found to be very low according to the fifth round of the National Family Health Survey. Among other large states of the country, the composite index of anaemia in children and women is found to be very low in only 1 district in 3 districts in Himachal Pradesh as well as in Haryana. In Assam, West Bengal, Punjab, Jammu & Kashmir, Gujarat, Andhra Pradesh and Telangana, there is not a single district where the composite index of anaemia in children and women is found to be very low.

Among small states and Union Territories, the composite index of anaemia in child and women is found to be very low in all districts of Goa, Sikkim, Manipur, and Nagaland and in 7 of the 8 districts in Mizoram and in 16 of the 20 districts in Arunachal Pradesh. In Tripura, there is no district where the composite index of anaemia in children and women is found to be very low. In Puducherry, the composite index of anaemia in children and women is found to be very low in 2 of the four districts and in 4 of the 11 districts in Meghalaya.

Table 7 also reveals that in states/Union Territories where the composite index of anaemia in children and women is either high or very high, there are districts where the composite index of anaemia in children and women is either low or very low. Similarly, in states/Union Territories where the composite index of anaemia in children and women is either low or very low, there are districts where the composite index of anaemia in children and women is either high or very high. These districts are anomalous districts in the state. There are 14 such states having at least one anomalous district. (Table 8). For example, Gujarat has a very high composite index of anaemia in children and women but there are five districts in the state - Devbhumi, Bhavnagar, Gir-Somnath,

Porbandar and Amreli – where the composite index of anaemia in children and women is very low. Similarly, the composite index of anaemia in children and women is very high in Bihar but districts Gopalganj and Paschim Champaran of the state have very low composite index of anaemia in children and women. (Table 8). On the other hand, the composite index of anaemia in children and women is very low in Arunachal Pradesh but there are 3 districts – Tawang, Dibang Valley and Changlang – where the composite index of anaemia in children and women is either high or very high.

Table 8: Anomalous districts in some states with respect to the composite index of anaemia in children and women.

Composite index of anaemia	States/UTs	Anomalous districts
Very High	Gujarat	Porbandar (L), Amreli (L), Bhavnagar (L), Devbhumi (L), Gir-Somnath (L)
	Bihar	Gopalganj (L), Paschim Champaran (L)
High	Assam	Cachar (L), Karimnagar (L), Hojai (L)
	Odisha	Khandmal (L), Baudh (L)
	Haryana	Ambala
	Telangana	Rajana Sircilla (L), Yaddari Bhuvanagiri (L)
Medium	Uttar Pradesh	UP: Kannauj (VH)
	Madhya Pradesh	Vidisha (VL), Chindwara (VL), Ashoknagar (VL), Jabalpur (VL)
	Rajasthan	Sikar (VL), Jodhpur (VL), Jaisalmer (VL)
	Chhattisgarh	Kabirdham (VL)
	Maharashtra	Ratnagiri (VL), Sindhdurga (VL) , Sangli (VL)
Low	Uttarakhand	Uttarkashi (H)
	Himachal Pradesh	Lahaul Spiti (VH)
Very Low	Arunachal Pradesh	Tawanag (VH), Changlong (H), Diband (H)

Source: Authors

Determinants of Anaemia in Children and Women

Inter-district variation in the composite index of anaemia in children and women is found to be statistically significantly associated with the inter-district variation in the proportion of women aged 15-49 years with at least high school level schooling; proportion of women aged 20-24 years who got married before reaching 18 years of age; proportion of women aged 15-49 years who received 4 antenatal checkups during their last pregnancy; proportion of women aged 15-49 years whose last delivery was institutional; and proportion of women aged 15-49 years who reported that they were consuming tobacco (Table 9). By contrast, inter-district variation in the proportion of women literate; proportion of women and 15-49 years who consumed at least 100 IFA tablets during their last pregnancy; proportion of children aged 12-23 months who were fully immunised; proportion of children below 6 months of age who were exclusively breastfed during the first 6 months of their life; and proportion of women aged 15-49 years who reported that they were

consuming alcohol is not found to be statistically significantly associated with the inter-district variation in the composite index of anaemia in children and women.

Table 9: Multivariate linear regression analysis of the composite index of anaemia in children and women with selected explanatory indicators.

Explanatory variables	B	Standard error	Beta	't'	P
(Constant)	-0.557	0.460		-1.210	0.227
X_1	-0.009	0.005	-0.112	-1.907	0.057
X_2	-0.029	0.004	-0.419	-6.828	0.000
X_3	0.012	0.003	0.146	3.467	0.001
X_4	-0.010	0.003	-0.211	-3.882	0.000
X_5	-0.003	0.002	-0.060	-1.187	0.236
X_6	-0.014	0.004	-0.173	-4.031	0.000
X_7	0.004	0.003	0.052	1.350	0.177
X_8	0.004	0.003	0.044	1.296	0.196
X_9	0.016	0.003	0.190	4.760	0.000
X_{10}	0.006	0.006	0.037	1.086	0.278
$N=706$; $R^2=0.580$					

Source: Authors

Conclusions and Policy Implications

We have developed in this paper a composite index of anaemia in children and women which is based on the prevalence of anaemia in children aged 6-59 months, pregnant women aged 15-49 years, non-pregnant women aged 15-49 years, all women aged 15-29 years and adolescent women aged 15-19 years to explore how the challenge of anaemia in children and women varies across the states/Union Territories and districts of India. The analysis reveals that the challenge of anaemia in children and women varies widely across states/Union Territories and districts of the country and in many states/Union Territories, the prevalence of anaemia in children and women has increased in recent years which is a cause of concern. There are districts where the challenge of anaemia in children and women is quite alarming whereas there are districts where anaemia in children and women does not appear to be a concern as the prevalence of anaemia in children and women appears to be quite low in these districts. The analysis presented in this paper has identified regions where anaemia in children and women is a major development challenge and calls for focused attention by adopting region-specific strategic anaemia-control policies and interventions to bring around optimal results at the national level. The analysis highlights strengthening of behaviour change communication component in the National Programmes for strict implementation of minimum age at marriage, promotion of higher education among adolescent girls, counselling of women on the health damaging effects of tobacco consumption, higher utilization of antenatal and natal services by women of reproductive age. There is a need to strengthen strategic nutrition supplementation and health-services programmes like ICDS, *POSHAN-Abhiyaan*, AMB, launched by the Government of India.

Acknowledgements

Our gratitude to Prof. S.K. Singh, IIPS, for making available NFHS-5, Key-indicators Fact Sheets in Excel Format facilitating quick finalisation of data files.

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Appendix Table: Indicators of the prevalence of anaemia in children and women in India, states, and Union Territories.

India/State/UT	Prevalence of anaemia (Per cent) in									
	Children 6-59 months		Non-pregnant women aged 15-49 years		Pregnant women aged 15-49 years		All women aged 15-49 years		Women aged 15-19 years	
	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021
India	58.6	67.1	53.2	57.2	50.4	52.2	53.1	57.0	54.1	59.1
EAG States										
Bihar	63.5	69.4	60.4	63.6	58.3	63.1	60.3	63.5	61.0	65.7
Uttar Pradesh	63.2	66.4	52.5	50.6	51.0	45.9	52.4	50.4	53.7	52.9
Madhya Pradesh	68.9	72.7	52.4	54.7	54.6	52.9	52.5	54.7	53.2	58.1
Rajasthan	60.3	71.5	46.8	54.7	46.6	46.3	46.8	54.4	49.1	59.4
Jharkhand	69.9	67.5	65.3	65.7	62.6	56.8	65.2	65.3	65.0	65.8
Uttarakhand	59.8	58.8	45.1	42.4	46.5	46.4	45.2	42.6	46.4	40.9
Chhattisgarh	41.6	67.2	47.3	61.2	41.5	51.8	47.0	60.8	45.5	61.4
Odisha	44.6	64.2	51.2	64.4	47.6	61.8	51.0	64.3	51.0	65.5
Other Large States										
Assam	35.7	68.4	46.1	66.4	44.8	54.2	46.0	65.9	42.7	67.0
West Bengal	54.2	69.0	62.8	71.7	53.6	62.3	62.5	71.4	62.2	70.8
Punjab	56.6	71.1	54.0	58.8	42.0	51.7	53.5	58.7	58.0	60.3
Haryana	71.7	70.4	63.1	60.6	55.0	56.5	62.7	60.4	62.7	62.3
Jammu & Kashmir	53.8	72.7	49.0	67.3	46.9	44.1	48.9	65.9	49.9	76.2
Himachal Pradesh	55.4	55.0	53.4	53.4	42.2	43.9	53.0	53.3	53.2	52.3
Gujarat	62.6	79.7	55.1	65.1	51.3	62.6	54.9	65	56.5	69.0
Maharashtra	53.8	68.9	47.9	54.5	49.3	45.7	48.0	54.2	49.7	57.2
Karnataka	60.9	65.5	44.8	47.8	45.4	45.7	44.8	47.8	45.3	49.4
Andhra Pradesh	58.6	63.2	60.2	59.0	52.9	53.7	60.0	58.8	61.1	60.1
Telangana	60.7	70.0	56.9	57.8	48.2	53.2	56.6	57.6	59.7	64.7
Tamil Nadu	50.7	57.4	55.4	53.6	44.4	48.3	55.0	53.4	54.2	52.9
Kerala	35.7	39.4	34.7	36.5	22.6	22.6	34.3	36.3	37.8	32.5
Small States/Union Territories										
National Capital Territory of Delhi	59.7	69.2	54.7	50.2	46.1	42.2	54.3	49.9	55.1	51.6

India/State/UT	Prevalence of anaemia (Per cent) in									
	Children 6-59 months		Non-pregnant women aged 15-49 years		Pregnant women aged 15-49 years		All women aged 15-49 years		Women aged 15-19 years	
	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021
Chandigarh	73.1	54.6	75.9	60.1	75.9	75.9	75.9	60.3	74.7	57.7
Goa	48.3	53.2	31.4	38.9	26.7	41.0	31.3	39.0	30.5	44.5
Lakshadweep	43.1	36.1	26.0	24.1	20.9	19.2	25.8	23.7	31.4	31.9
Puducherry	44.9	64.0	53.4	55.5	26.0	42.5	52.4	55.1	55.0	58.4
Andaman & Nicobar Islands	49.0	40.0	65.8	57.6	61.4	53.7	65.7	57.5	68.1	44.9
Dadra & Nagar Haveli	82.0	75.8	73.4	62.6	62.3	60.7	72.9	62.5	75.9	63.9
Sikkim	55.1	56.4	35.2	42.1	23.6	40.7	34.9	42.1	48.7	46.7
Tripura	48.3	64.3	54.5	67.4	54.4	61.5	54.5	67.2	52.2	67.9
Mizoram	19.3	46.4	24.7	34.8	27.0	34.0	24.8	34.8	21.3	34.9
Manipur	23.9	42.8	26.4	29.3	26.0	32.4	26.4	29.4	21.1	27.9
Meghalaya	48.0	45.1	56.4	54.4	53.3	45.0	56.2	53.8	52.1	52.5
Arunachal Pradesh	54.2	56.6	43.5	40.8	37.8	27.9	43.2	40.3	48.2	48.5
Nagaland	26.4	42.7	27.7	29.3	32.7	22.2	27.9	28.9	26.3	33.9
Ladakh	91.4	92.5	78.4	93.7	79.3	78.1	78.4	92.8	81.6	96.9

Source: Government of India (2017; 2022).