Social Science Spectrum ISSN 2454-2806
Vol. 9, No. 1, March 2023, pp. 23-35

Burden of Anemia and its potential predictors among Scheduled Tribe Pregnant Women in India

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Abstract

The most recent round of the National Family and Health Survey (NFHS-5) and earlier rounds indicate that anemia has significantly increased in India. This alarming finding may even be worse for scheduled tribe women. The present study examines the prevalence and predictors of anemia among pregnant tribal women. Bivariate and multivariate techniques have been used. While assessing access to health care and supplementation services, an additional analysis has been carried out considering women who have delivered their last child in the past four years. Findings suggest that anaemia is higher among pregnant tribal women than their counterparts for severe (2.3% vs 1.3%) and moderate anemia (32% vs 25%) respectively. The adjusted odds ratios confirm that tribal pregnant women are significantly at higher risk for severe [OR=1.17; p<0.001] and moderate anemia [OR=1.23; p<0.001]. Pregnancy at younger age group, higher birth order, lower wealth quintile and rural women are at higher risk for developing anemia. Additionally, women having low dietary diversity and non-improved toilet facility are more likely to be at risk of developing anemia. The study concludes that along with the health care and supplementary services during pregnancy, the continuum of care approach should place a greater emphasis on dietary diversity and household environment.

*Keywords**:** Anemia, scheduled tribes, pregnancy, dietary diversity.*

I. Introduction

Pregnancy and lactating periods are the most nutritionally demanding times of women's life. Anemia during pregnancy may have adverse consequences on maternal and child health such as maternal and perinatal mortality and low birth weight respectively (Kozuki et al., 2012; Stoltzfus et al., 2004). Literature shows that hemoglobin level matching to moderate-to-severe anemia is associated to hazardous side effects on the health of women (Kozuki et al., 2012; Zhang et al., 2009).

Globally, anemia continues to be a major public health issue as the prevalence of anemia is found to be about 30 per cent in the women of reproductive age which is equivalent to over half a billion women aged 15-49 years. WHO has also revealed that since 2000, the global prevalence of anemia in women of reproductive age has been stagnant (WHO, 2021). The trend analysis on the prevalence of anemia at global, regional and national level during 1995-2011 suggests that the level of anemia varied across regions and countries. For instance, the second highest prevalence of anemia among pregnant women was found in South Asia (52%) in the world after Central and West Africa (56%) in 2011 (Stevens et al., 2013; WHO, 2015).

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Acknowledgements: The authors thank the editor and anonymous reviewers whose constructive suggestions helped to improve this paper.

India is home to more than half of the world's tribal population which constitutes 8.6 per cent of the population. Scheduled tribes (STs) are identified with several characteristics by a standing committee on labour and welfare (2002) such as primitive traits, distinct culture, geographical isolation, hesitant to contact with the communities at large and backwardness. STs are socially and economically isolated and disadvantaged groups, characterized by their distinct culture, food and dietary patterns. They are generally excluded from formal education, living with sociocultural taboos and dependent on primitive agricultural practices for livelihoods (Laxmaiah et al., 2007; Maiti et al., 2005). In 2011, while 41 per cent of the tribal population was below the poverty line, the proportion among the non-tribal was 20.5 per cent (Office of Registrar?, 2011). Considering health, the key indicators among this population remain poor. For instance, based on the National Family Health Survey (NFHS-4) (2015-2016), the under-5 mortality rate among the tribal population was 57.2 per 1000 live births compared with 38.5 among others, and the infant mortality rate was 44.4 per 1000 live births compared with 32.1 among others (Indian Institute for Population Sciences, 2017). The poor health status among tribal women is due to insufficient consumption of nutrient rich food which leads to undernutrition and anemia (Kamath et al., 2013).

The most recent round of NFHS-5 and preceding rounds show a significant rise in anemia among women in India, especially moderate and severe anemia. For instance, the prevalence of severe and moderate anemia was reported to be 2.7 per cent and 29 per cent respectively at the national level. In NFHS-4 (2015-16) it was 1 per cent and 12 per cent) for severe and moderate anemia respectively. Among scheduled tribe women the prevalence of severe and moderate anemia was 3 per cent and 35 per cent respectively in NFHS-5 (2019-21), as opposed to 1.3 per cent and 15 per cent in NFHS-4 (2015-16). An alarming rise in the prevalence of anemia, especially among women from scheduled tribes, is a matter of concern for the policy-makers.

In this context, it is imperative to investigate the prevalence of anemia in the sub-groups of population for more effective policy-making. The present study aims to estimate the prevalence of anemia among scheduled tribe pregnant women. While doing so, a comparison between tribal and non-tribal pregnant women has been shown. An attempt has been made to identify the states with a higher prevalence of anemia, particularly states with a higher tribal population. Similarly, potential risk factors of anemia among tribal pregnant women have been identified. Additionally, while assessing access to health care and supplementation services, a separate analysis has been carried out considering women who have delivered their last child in the past four years.

II. Data and methods

Data

This study has analysed the fifth and most recent round of National Family Health Survey (2019–21). The NFHS-5 uses a two-stage sampling design in both urban and rural areas. It involved interviews with a total of 636,699 households and 724,115 women aged 15–49 years across the 707 districts of India with a response rate of 97 per cent for women.

From a total sample of women, blood specimens for anemia testing were collected from 690166 women from across the India and the specimens for anemia could not be collected from rest of the women because of their refusal or other reasons. Further, there were 3718 women who were unaware of their caste/tribe and hence excluded from the analysis. Out of 686448 women, 131043 women belonged to scheduled tribes and 555403 women to non-scheduled tribes. Among scheduled tribes 5889 women and 21265 women from non-schedule tribe women were pregnant during the survey and hence the rest were excluded. Body mass index for 54 women showed zero in the dataset and hence were excluded from the analysis. Finally, analysis has been carried out considering a total of 27100 pregnant women which includes 5880 tribal pregnant women.

Measures

Our primary independent variable of interest was status of tribal women. NFHS does collect information on caste/tribe which was assessed via the following question: "What is your caste or tribe?" Secondly, to be precise on the status of caste/tribe, the subsequent question was: "Do you belong to a scheduled caste, schedule tribe, other backward class or none of these?" For the present analysis we have computed dichotomous variable, i.e., scheduled tribe women and non-scheduled tribe women.

Our primary outcome variable of interest is anemia. Blood specimens for anemia testing were collected by health investigators from eligible women aged 15-49 years. Consent for the test was taken from eligible women. Blood samples were collected by a finger prick and collected in a microcuvette. Haemoglobin analysis was conducted on-site with a battery-operated portable HemoCue Hb 201+ analyser. Respondents were found to have severe anemia if the haemoglobin level was below seven grams/decilitre (g/dl) and if the haemoglobin level was below nine g/dl, such women were referred to a nearby health facility for further diagnosis and treatment. For pregnant women, mild anemia was considered between 10.0-10.9 g/dl and for moderate 7.0-9.9 g/dl, for severe <7.0 g/dl and any anemia <11.0 g/dl. Haemoglobin levels are considered in grams per decilitre (g/dl).

Covariates included in the models were measured at the individual level (demographics), household level (socio-economic status) and community level (rural/urban residence). The individual-level demographics included woman's age, education, children ever born and body mass index. The NFHS collected anthropometric data on the height and weight of women aged 15-49 and used to calculate measures of nutritional status such as body mass index (BMI). Household level characteristics such as wealth index, household size and relation to the household head are included. Our community-level variable was rural and urban. It would have been important to incorporate access to healthcare and supplementation services provided to pregnant women through various schemes run by Government institutions, but NFHS data does not capture this information for pregnant women mainly because currently pregnant women are at different trimester of gestational period. Hence, women who have delivered their last child in the past four years from the date of survey have been considered for the analysis and their experiences of health and supplementation services has been analysed separately. Variables such as source of drinking water, improved sanitation facility, components of full ANC, whether received supplementary nutrition, consuming intestine parasitic drug during pregnancy, birth interval (only for those women having next to last-birth), used mosquito net during last pregnancy and dietary diversity have been considered. Swindale and Bilinsky (2006) proposed measure has been used to construct dietary diversity (Swindale and Bilinsky, 2006) which includes (i) milk and dairy products (ii) pulses and beans; (iii) dark green and legumes; (iv) fruits; (v) eggs; (vi) meat and fish; and (vii) fried food. The dietary diversity score is calculated by asking respondents how often they consume various foods in the last week. Responses to the frequency of consumption of any food group was assigned 3 for daily, 2 for weekly, 1 for occasionally and 0 for never consumed. The composite scores were then divided into low, moderate and high.

Data analysis

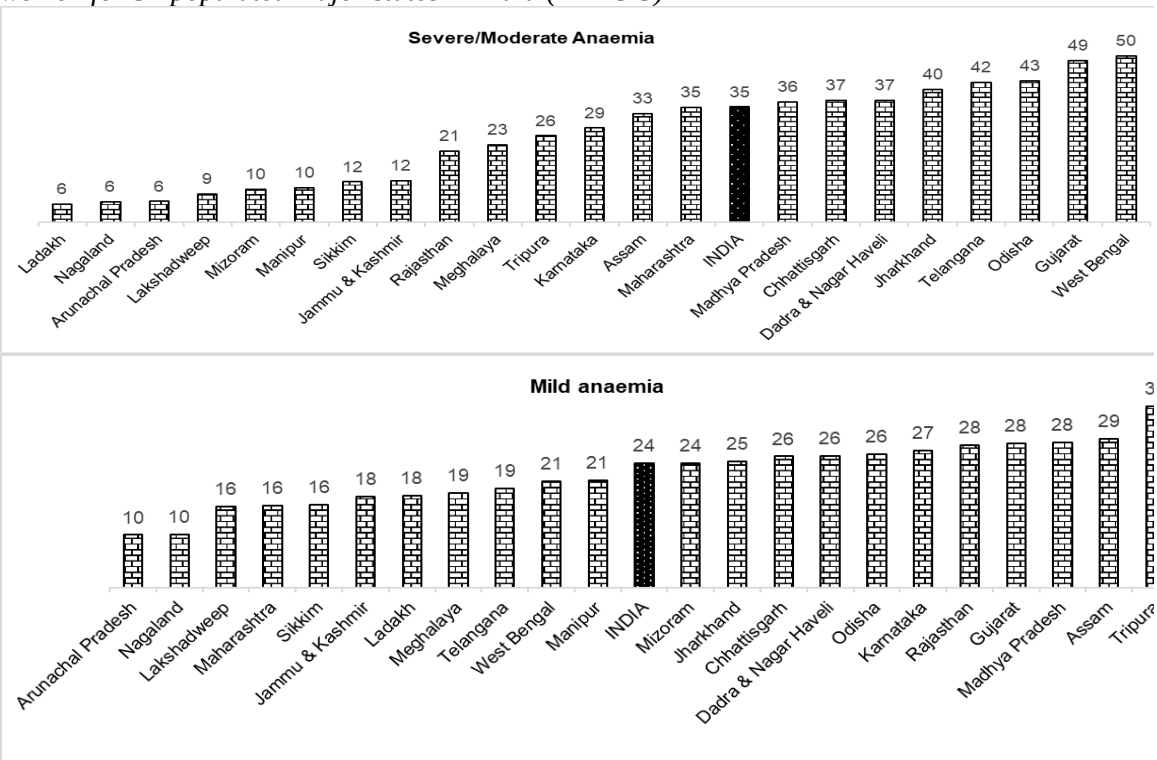
Prevalent data were calculated for all variables including prevalence of any anemia and for severe/moderate anemia. Subsequently, we conducted a series of logistic regression models to understand the association between scheduled tribe status of pregnant women and anemia. The initial model was a simple regression with no covariates (Model 1). Similarly, multivariable analysis has been conducted in the subsequent models to adjust the covariates at each of our levels of interest. Model 2 included individual level characteristics (age, education, children ever born and body mass index). Model 3 included individual and household level characteristics (religion, wealth, household size and relation to household head). Model 4 included individual, household and substance use characteristics (tobacco consumption and alcohol). Model 5 included individual, household, substance use and community level characteristics (rural/urban). A goodness of fit test, (the likelihood-ratio test) was used to compare the models and to understand if the explanatory variables in each successive model fits significantly better than the previous model. We applied appropriate

sampling weights to all analyses. The detailed strategy for calculation of weights is given in the NFHS-5 report. All data analyses were conducted using STATA 15.1, and were adjusted for survey design.

III. Results

The prevalence of anemia varies amongst states in India. Figure 1 shows that it is higher particularly in the states of West Bengal, Gujarat, Odisha, Telangana, Jharkhand and Chhattisgarh.

Figure 1: Percent of severe/moderate and mild anemia among scheduled tribe (ST) pregnant women for ST populated major states in India (NFHS-5)



Further, Table 1 shows the level of anemia among STs by socio-demographic traits. Findings suggest that tribal pregnant women with characteristics such as being between the ages 15-19 years (39%), having no or little education (38%), having two or more children (38%), being thin or obese (37-39%), belonging to the lower wealth quintile (38%), living in rural areas (36%) and using alcohol almost daily or once a week (48%) had higher rates of severe/moderate anemia.

Table 2 attempts to investigate the association between tribal affiliation and anemia risk after adjusting for socio-economic and demographic factors. Unadjusted odds ratios show a substantially increased risk of anemia in pregnant women from scheduled tribe communities compared with pregnant women from non-scheduled tribe communities [OR=1.37; $p<0.001$]. When factors including age, women's education and number of children ever born are taken into account, an increased risk of anemia remains [AOR=1.29; $p<0.001$]. Further, a higher risk of anemia persists when the model is additionally adjusted for household, substance use and place of residence [AOR=1.17; $p<0.001$].

Additionally, an attempt has been made to explore the relationship of having tribal status and risk of developing severe/moderate anemia when adjusted for socio-economic and demographic characteristics. Results of unadjusted odds ratios depict that scheduled tribe pregnant women are significantly more likely at risk of severe/moderate anemia than non-scheduled tribe women

[AOR=1.44; p<0.001]. A significantly higher risk of any anemia persists when adjusted for individual level characteristics such as age, education of women and children ever born [AOR=1.34; p<0.001]. Further, a higher risk of anemia persists when the model is additionally adjusted for household, substance use and place of residence that is urban or rural [OR=1.23; p<0.001].

Similarly, Table 3 assist to identify the potential predictors of anemia and severe/moderate anemia in pregnant tribal women. Results from logistic regression analysis suggest that pregnant tribal women between the ages of 15-19 and 20-24 had significantly higher chance of anemia [OR=1.86; p<0.01, OR=1.67; p<0.01] when compared with those aged 30 years or older. Considering children ever born, results indicate that women with two or more children were more likely to be anemic than women without children [OR=1.90; p<0.001]. According to wealth index, anemia is more common among women from low wealth quintile than those from high wealth quintile groups [OR=1.99; p<0.001].

While assessing access to healthcare and supplementation services by women who have delivered last child in the past four years, results suggest that the dietary diversity, improved source of drinking water and toilet facility are significantly lower among tribal women than non-tribal women. Similarly, access to ANC services such as pregnancy registration, full antenatal care services and routine health check-up services during pregnancy does not vary significantly between tribal and non-tribal women. Usage of mosquito net, consumption of intestinal parasites during pregnancy and access to supplementation services was significantly higher among women from scheduled tribes (Table 4).

Assessing healthcare and supplementation services and other potential risk factors of anemia for women who had their most recent child during the previous four years has been presented in Table 5. Results show that scheduled tribe women are significantly at higher risk to have any anemia [AOR=1.393; p<0.001] and severe/moderate anemia [AOR=1.256; p<0.001] compared with non-scheduled tribe women. As expected, severe/moderate anemia and any anemia are significantly more common among women with low dietary diversity [AOR=1.239; p<0.001 and AOR=1.167; p<0.001 respectively]. Similarly, women who do not have access to improved toilet facility are are at a higher risk of either severe/moderate anemia [AOR=1.215; p<0.001] and any anemia [AOR=1.198; p<0.001].

IV. Discussion and conclusion

The literature revealed that there is not much empirical evidence suggesting the level of anemia among pregnant tribal women at national level. The present study is the first attempt to understand the prevalence of anemia among scheduled tribe pregnant women and its associated potential risk factors by using latest round of NFHS-5 dataset (2019-21).

The study shows that the prevalence of severe/moderate anemia is higher in West Bengal, Gujarat, Odisha, Telangana, Jharkhand and Chhattisgarh among the states where the tribal population is skewed. A similar trend has been observed in the case of mild anemia. Analysis of risk of anemia, suggests that tribal pregnant women are at a higher risk for both anemia [OR=1.17; p<0.001] and severe/moderate anemia [OR=1.23; p<0.001] when the model is adjusted for individual level characteristics, household, substance use and place of residence.

According to a review of literature, there is less focus on the level of anemia among pregnant tribal women, but anemia among tribal women in reproductive age is well documented. For instance, a study conducted in Palakkad district of Kerala suggests that anemia is as high as 78 per cent among tribal women (PR, 2012). Another study conducted on tribal women from Kasargod district of Kerala suggests that a majority participants had moderate anemia (62%) and 11 per cent had severe anemia (Rohisha et al., 2019). According to a study by Gustavo Correa, an overall 92.4 per cent tribal pregnant women had anemia of whom 7.5 per cent had severe, 72.9 per cent had moderate and 19.6 per cent had mild anemia (Corrêa et al., 2017). In contrast, Ponny et al. observed that the prevalence

of anemia among the tribal pregnant women attending primary healthcare was 53 per cent. They further found mild, moderate and severe anemia was as 27 per cent, 25 per cent and 2 per cent respectively (Ponny et al., 2021).

While identifying the potential predictors of any anemia and severe/moderate anemia, the findings suggest that in a younger age group and in a higher number of birth order, pregnant tribal women from lower wealth quintile and tribal pregnant women from rural areas are more likely at a higher risk of anemia and severe/moderate anemia. Our findings on determinants of anemia are well aligned with those from other studies that have examined the determinants of anemia at global (Balarajan et al., 2011) and regional levels (Harding et al., 2018; Headey et al., 2016) as well as in India (Ahankari et al., 2017; Balarajan et al., 2013; Bharati et al., 2015; Chakrabarti et al., 2018).

WHO's view of global prevalence of anemia suggests that India was amongst countries with the highest prevalence of anemia among pregnant women (53%) during 2011(WHO, 2015). Similarly, the successive rounds of NFHS show that the anemia prevalence increased from 52 per cent in 1998-99 to 56 per cent in 2005-06 and from there with a negligible decrease during a decade to 53 per cent in 2015-16 and then further to 57 per cent in 2019-21, and this trend is true in the case of pregnant women (International Institute for Population Sciences, 2017). Whereas, a study demonstrated the overall prevalence of anemia to be 84 per cent among pregnant women (Toteja et al., 2006). This could be because iron requirements are higher for pregnant women, i.e., 1.9 mg/1000 Kcal of dietary energy in the second trimester and 2.7 mg/1000 Kcal in the third trimester.

India is one of the countries having a higher prevalence of anemia in the world. India contributes to about 80 per cent of the maternal deaths due to anemia in South Asia (Ezzati et al., 2002). Anemia is the world's second leading cause of disability and is responsible for about one million deaths a year of which three-fourths occur in Africa and South-east Asia (World Bank, 2004). In terms of lost years of healthy life, Iron Deficiency Anemia causes 25 million cases of Disability Adjusted Life Years (DALYs) which accounts for 2.4 per cent of the total DALYs worldwide (WHO, 2011).

After India's independence, the Government of India has made programmatic and policy efforts, particularly in 2013 under the Rashtriya Kishor Swasthya Karyakram (RKSK), to mitigate anemia in the adolescent population with inclusion of counselling as a critical intervention to improve compliance amongst adolescents (National Health Mission, 2017). Since anemia is not just about medical interventions but to a great degree about behaviour change (both in terms of dietary habits and compliance), an attempt has been made to do extensive communication campaign. Adolescents (aged 10–19 years) are at a higher risk of iron deficiency and anemia due to increased requirements for iron, high rate of infection, worm infestation, social norm of early marriage and teenage pregnancy. During this period the requirement of nutrition and micronutrients is relatively high. Therefore, adolescents, particularly girls especially those between the ages of 12–15 years, are vulnerable to iron deficiency.

Establishing a continuum of care, the National Iron+ Initiative also defines packages of services for treatment and management of anemia at each level of care. Services at each level have also been mapped out with detailed roles and responsibility of service providers. Additionally, a recently launched Anemia Mukt Bharat- 6x6x6 strategy aims to strengthen the existing mechanisms and foster newer strategies for tackling anemia (NHM-GoI, n.d.). It identifies and focuses on six types of beneficiaries (children 6-59 months, children aged 5-9 years, adolescent girls and boys aged 10-19 years, women of reproductive age of 20-24 years, pregnant women and lactating mothers with 0-6 months old child), six types of interventions (prophylatic iron folic acid supplementation, deworming, intensified year-round behaviour change communication campaign, using digital methods and point of care treatment, mandatory provision of iron folic acid fortified foods in public health programs and addressing non-nutritional causes of anemia in endemic pockets with special focus on malaria, haemoglobinpathies and fluorosis) and six institutional mechanisms (National Anemia Mukt-Bharat, intra-ministerial coordination, strengthening supply chain logistics,

convergence with other ministries, national centre of excellence and advance research on anemia control and Anemia Mukt-Bharat dashboard and digital portal, i.e., one stop shop for anemia).

An additional analysis considering women who have received the healthcare and supplementation services during their last pregnancy in the past four years suggest that access to ANC healthcare and supplementation services by tribal pregnant women is at par with women from non-tribal community. Strikingly, women having low dietary diversity and non-improved toilet facility are more likely to be at risk of developing anemia. The paper concludes that the above discussed strategy to combat the challenges posed by persistent anemia needs to be implemented with well-designed evaluation plan which will render the expected outcome. Along with the healthcare and supplementation services, the Government needs to emphasize dietary diversity through food-based approach across the life cycle which may help in relatively rapid improvements in the level of anemia among tribal women. Additionally, access to improved source of drinking water as well as toilet facility may help to reduce the risk of anemia among tribal women. Further, ASHAs (an incentivized field-based health worker) can play a crucial role in identifying anaemic women and refer to institutions for preliminary screening and diagnosis.

References

Ahankari AS, Myles PR, Fogarty AW, et al. (2017) Prevalence of iron-deficiency anaemia and risk factors in 1010 adolescent girls from rural Maharashtra, India: a cross-sectional survey. *Public health* 142. Netherlands: 159–166. DOI: 10.1016/j.puhe.2016.07.010.

Balarajan Y, Ramakrishnan U, Ozaltin E, et al. (2011) Anaemia in low-income and middle-income countries. *The Lancet* (London, England) 378(9809). England: 2123–2135. DOI: 10.1016/S0140-6736(10)62304-5.

Balarajan YS, Fawzi WW and Subramanian S V (2013) Changing patterns of social inequalities in anaemia among women in India: cross-sectional study using nationally representative data. *BMJ* Open 3(3). British Medical Journal Publishing Group. DOI: 10.1136/bmjopen-2012-002233.

Bharati S, Pal M, Som S, et al. (2015) Temporal trend of anemia among reproductive-aged women in India. *Asia-Pacific Journal of Public Health* 27(2). China: NP1193-207. DOI: 10.1177/1010539512442567.

Chakrabarti S, George N, Majumder M, et al. (2018) Identifying sociodemographic, programmatic and dietary drivers of anemia reduction in pregnant Indian women over 10 years. *Public Health Nutrition* 21(13). England: 2424–2433. DOI: 10.1017/S1368980018000903.

Corrêa G, Das M, Kovelamudi R, et al. (2017) High burden of malaria and anemia among tribal pregnant women in a chronic conflict corridor in India. *Conflict and Health* 11(1). *Conflict and Health* 1–9. DOI: 10.1186/s13031-017-0113-1.

Ezzati M, Lopez AD, Rodgers A, et al. (2002) Selected major risk factors and global and regional burden of disease. Lancet (London, England) 360(9343). *The Lancet*: 1347–1360. DOI: 10.1016/S0140-6736(02)11403-6.

Harding KL, Aguayo VM and Webb P (2018) Hidden hunger in South Asia: a review of recent trends and persistent challenges. *Public Health Nutrition* 21(4): 785–795. DOI: 10.1017/S1368980017003202.

Headey D, Hoddinott J and Park S (2016) Drivers of nutritional change in four South Asian countries: a dynamic observational analysis. *Maternal & Child Nutrition* 12 Suppl 1: 210–218. DOI: 10.1111/mcn.12274.

Indian Institute for Population Sciences (2017). *National Family Health Survey (NFHS-4) 2015-16 India*. International Institute for Population Sciences (IIPS) and ICF. DOI: kwm120 [pii]10.1093/aje/kwm120.

International Institute for Population Sciences (2017). *National Family Health Survey - 4 2015-16*. Ministry of Health and Family Welfare National. Mumbai. Available at: http://rchiips.org/nfhs/NFHS-4Reports/India.pdf.

International Institute for Population Sciences (2021). *National Family Health Survey - 5 2019-21*. Ministry of Health and Family Welfare National. Mumbai. Available at: http://rchiips.org/nfhs/NFHS-5_FCTS/India.pdf.

Kamath R, Majeed JA, Chandrasekaran V, et al. (2013) Prevalence of Anemia among Tribal Women of Reproductive Age in Udupi Taluk, Karnataka. *Journal of Family Medicine and Primary Care* 2(4): 345–348. DOI: 10.4103/2249-4863.123881.

Kozuki N, Lee AC and Katz J (2012) Moderate to severe, but not mild, maternal anemia is associated with increased risk of small-for-gestational-age outcomes. *The Journal of Nutrition* 142(2). 358–362. DOI: 10.3945/JN.111.149237.

Laxmaiah A, Rao KM, Kumar RH, et al. (2007) Diet and Nutritional Status of Tribal Population in ITDA Project Areas of Khammam District, Andhra Pradesh. *Journal of Human Ecology* 21(2). Routledge: 79–86. DOI: 10.1080/09709274.2007.11905954.

Maiti S, Unisa S and Agrawal PK (2005) Health Care and Health Among Tribal Women in Jharkhand: A Situational Analysis. *Studies of Tribes and Tribals* 3(1). Routledge: 37–46. DOI: 10.1080/0972639X.2005.11886518.

National Health Mission (2017) Rashtriya Kishor Swasthya Karyakram. Available at: http://nhm.gov.in/images/pdf/programmes/RKSK/RKSK_Operational_Framework.pdf.

NHM-GoI (n.d.) Poshan Abhiyan-Anaemia Mukt Bharat. Available at: https://anemiamuktbharat.info/home/6x6x6-strategy/.

Office of Registrar (2011). *Census of India.*

Ponny MS, Nandini VR, Nirmala C, et al. (2021) A study of prevalence of anemia and associated risk factors in pregnant women of tribal community attending antenatal clinic at Trivandrum district, Kerala, India. *International Journal of Community Medicine and Public Health* 8(6). Medip Academy: 2969–2976. DOI: 10.18203/2394-6040.ijcmph20212002.

PR S (2012) Anaemia and body mass index of non-pregnant tribal women of reproductive age group in Palakkad district of Kerala, India. *Indian J Prev Soc Med* 43: 35–41.

Rohisha I, Jose T and Chakrabarty J (2019) Prevalence of anemia among tribal women. *Journal of Family Medicine and Primary Care* 8(1). Wolters Kluwer -- Medknow Publications: 145–147. DOI: 10.4103/jfmpc.jfmpc_249_16.

Stevens GA, Finucane MM, De-Regil LM, et al. (2013) Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: A systematic analysis of population-representative data. *The Lancet Global Health* 1(1). Elsevier: e16–e25. DOI: 10.1016/S2214-109X(13)70001-9/ATTACHMENT/E073F9DA-1330-4A1D-A1A0-67CAF08C11BF/MMC1.PDF.

Stoltzfus RJ, Mullany L and Black RE (2004) Iron deficiency anaemia. In: Ezzati M, Lopez AD, Rodgers A, et al. (eds). *Comparative Quantification of Health Risks: Global and Regional Burden of Disease Attributab*le *to Selected Major Risk Factors.* Volume 1. Geneva, Switzerland: World Health Organization, Geneva, Switzerland, pp. 1–2258. Available at: https://apps.who.int/iris/handle/10665/42770.

Swindale A and Bilinsky P (2006) Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide Version 2. Available at: https://www.fantaproject.org/sites/default/files/resources/HDDS_v2_Sep06_0.pdf.

Toteja GS, Singh P, Dhillon BS, et al. (2006) Prevalence of anemia among pregnant women and adolescent girls in 16 districts of India. *Food and Nutrition Bulletin* 27(4). Food Nutr Bull: 311–315. DOI: 10.1177/156482650602700405.

WHO (2011) Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Geneva, Switzerland. Available at: https://apps.who.int/iris/bitstream/handle/10665/85839/WHO_NMH_NHD_MNM_11.1_eng.pdf.

WHO (2015) The global prevalence of anaemia in 2011. WHO Library Cataloguing-in-Publication Data. Geneva, Switzerland. Available at: www.who.int (accessed 28 April 2022).

WHO (2021) Global anaemia estimates in women of reproductive age, by pregnancy status, and in children aged 6-59 months. Available at: https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children (accessed 2 July 2022).

World Bank (2004). *Public health at a glance.*

Zhang Q, Ananth C V., Rhoads GG, et al. (2009) The Impact of Maternal Anemia on Perinatal Mortality: A Population-based, Prospective Cohort Study in China. *Annals of Epidemiology* 19(11). Elsevier: 793–799. DOI: 10.1016/J.ANNEPIDEM.2009.06.002.

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Table 1. Prevalence of anemia among scheduled tribe pregnant women in India (NFHS-5) (N=5880)

Characteristics	Anemia			Not Anemic
	Severe/Moderate	Mild	Any	
Age (years)				
15-19	39.3	25.5	64.7	35.3
20-24	36.5	26.0	62.5	37.5
25-29	33.8	22.8	56.7	43.4
>=30	26.1	23.4	49.5	50.5
Education (in years)				
No formal education	38.3	25.6	63.8	36.2
1-5	38.5	25.3	63.8	36.2
6-10	36.5	24.8	61.2	38.8
>10	23.5	22.4	45.9	54.1
Children ever born				
No children	32.1	23.4	55.4	44.6
One	34.0	24.5	58.5	41.5
>=2	37.7	26.1	63.8	36.2
BMI				
Thin	37.7	27.8	65.5	34.5
Normal	35.2	24.0	59.2	40.8
Over weight	23.4	22.7	46.0	54.0
Obese	39.6	27.5	67.1	32.9
Relation to head				
Head	26.4	29.0	55.4	44.6
Wife	33.1	21.9	55.0	45.0
Daughter	34.5	25.0	59.5	40.5
Daughter-in-law	35.8	25.5	61.3	38.7
Others	36.6	33.3	69.8	30.2
Religion				
Hindu	36.5	24.9	61.4	38.6
Muslim	22.9	22.4	45.4	54.7
Other	23.0	22.6	45.6	54.4
Household size				
<=4 members	27.1	25.1	52.2	47.9
5-7 members	36.7	23.3	60.0	40.0
>7 members	35.9	28.7	64.6	35.4
Wealth index				
Low	38.3	26.2	64.5	35.5
Middle	30.7	20.0	50.7	49.3
High	18.8	21.1	39.9	60.2
Tobacco				
No or sometimes	34.0	24.6	58.6	41.5
Almost every day	39.7	24.1	63.8	36.2
Alcohol				
No	34.2	24.5	58.7	41.3
Almost every day/once a week	47.9	22.7	70.6	29.5
Residence				
Urban	19.6	25.0	44.7	55.3
Rural	36.0	24.5	60.5	39.5
Total	*34.3*	*24.5*	*58.8*	*41.2*
N	*1,428*	*1,271*	*2,699*	*3,181*

Table 2. Results of adjusted logistic regression model suggesting risk of any anemia and severe/moderate anemia among pregnant women by social groups [NFHS-5], n=27100

Characteristics	Model 1 OR	Model 2 AOR	Model 3 AOR	Model 4 AOR	Model 5 AOR
Any anemia					
Social group					
Non-Scheduled Tribes®					
Scheduled Tribes	1.372***	1.294***	1.184**	1.177**	1.174**
	[1.224,1.539]	[1.162,1.442]	[1.058,1.325]	[1.050,1.318]	[1.048,1.315]
Pseudo R2	*0.0016*	*0.0182*	*0.0222*	*0.0222*	*0.0223*
Wald chi2	*29.25*	*322.83*	*392.58*	*396.45*	*395.53*
Severe/moderate anemia					
Social group					
Non-Scheduled Tribes®					
Scheduled Tribes	1.437***	1.337***	1.240***	1.229***	1.226***
	[1.290,1.600]	[1.205,1.485]	[1.111,1.384]	[1.101,1.373]	[1.098,1.370]
Pseudo R2	*0.0022*	*0.0185*	*0.0221*	*0.0222*	*0.0223*
Wald chi2	*43.51*	*316.19*	*373.22*	*378.58*	*378.19*

Model 2 is adjusted for individual level characteristic such as age, education, children ever born and BMI.
Model 3 is adjusted for individual and household level characteristics such as religion, household size and wealth index.
Model 4 is adjusted for individual, household and substance used variables such as alcohol and tobacco use.
Model 5 is adjusted for individual, household, substance use and by type of residence i.e. urban and rural.

Note: ® Reference category; * p<0.05, ** p<0.01, *** p<0.001; OR=Odds ratio, AOR=Adjusted odds ratio

Table 3. Odds of any anemia and severe/moderate anemia among tribal pregnant women [NFHS-5] (n=5880)

	Any anemia		Severe/Moderate anemia	
Characteristics	OR	CI	OR	CI
Age				
15-19	1.863**	[1.243,2.790]	1.799**	[1.206,2.683]
20-24	1.668**	[1.191,2.336]	1.587**	[1.175,2.142]
25-29	1.208	[0.883,1.654]	1.327	[0.995,1.770]
>=30®				
Education				
No formal education	1.224	[0.890,1.684]	1.293	[0.931,1.796]
1-5 years	1.286	[0.922,1.796]	1.358	[0.948,1.945]
6-10 years	1.289	[0.996,1.667]	1.353*	[1.018,1.797]
>10 years®				
Children ever born				
No children®				
One	1.364**	[1.078,1.724]	1.221	[0.957,1.556]
>=2	1.898***	[1.413,2.550]	1.416*	[1.049,1.911]
BMI				
Thin®				
Normal	0.875	[0.677,1.132]	1.015	[0.784,1.315]
Over weight	0.691	[0.460,1.038]	0.741	[0.496,1.107]
Obese	1.842	[0.886,3.831]	1.734	[0.727,4.139]
Relation to head				
Head®				
Wife	0.913	[0.551,1.513]	1.181	[0.743,1.878]
Daughter	1.19	[0.657,2.155]	1.173	[0.674,2.041]
Daughter law	1.132	[0.650,1.970]	1.067	[0.649,1.756]
Others	1.756	[0.871,3.544]	1.21	[0.613,2.389]
Religion				

Hindu®				
Muslim	0.593*	[0.372,0.945]	0.566*	[0.323,0.991]
Others	0.559***	[0.451,0.694]	0.539***	[0.426,0.682]
Household size				
<=4 members®				
5-7 members	0.972	[0.735,1.286]	1.376*	[1.033,1.833]
>7 members	1.068	[0.729,1.564]	1.291	[0.879,1.897]
Wealth index				
Lower	1.998***	[1.377,2.898]	1.733**	[1.199,2.504]
Middle	1.263	[0.840,1.899]	1.45	[0.944,2.225]
Higher®				
Tobacco				
No or sometimes®				
Almost every day	1.194	[0.870,1.640]	1.229	[0.868,1.740]
Alcohol				
No®				
Almost every day or once a week	1.586	[0.871,2.886]	1.663	[0.874,3.165]
Residence				
Urban®				
Rural	1.152	[0.770,1.723]	1.531*	[1.001,2.340]

® Reference category; * p<0.05, ** p<0.01, *** p<0.001; OR=Odds ratio.

Table 4. Percentage of women who received health and supplementation services and other risk factors to anemia among those who have delivered their last child in the past four years by tribal and non-tribal status, India (N=172,560)

Women characteristics	Non-tribal	Tribal	Chi-square
Dietary diversity			
Low	19.0	21.6	(Chi2=206.57; p=0.000)
Moderate	50.6	54.9	
High	30.4	23.6	
Source of drinking water			
Improved	96.7	87.7	(Chi2=2119.74; p=0.000)
Non-improved	3.3	12.3	
Toilet facility			
Improved	78.8	60.3	(Chi2=1895.86; p=0.000)
Non-improved	21.2	39.7	
Pregnancy registered			
Not registered	6.2	5.7	
0-3 months	80.1	81.0	(Chi2=0.95; p=0.3308)
4th month	8.1	8.4	
>=5 months	5.6	5.0	
Full ANC	28.3	27.7	(Chi2=1.75; p=0.1865)
Used a mosquito net during pregnancy			
Regularly	38.2	44.8	(Chi2=266.87; p=0.0000)
Sometimes	16.5	18.1	
Never	45.3	37.1	
Received healthcare services during pregnancy			
Weighted	91.2	90.9	(Chi2=1.36; p=0.2431)
Blood pressure taken	90.5	89.9	(Chi2=4.01; p=0.0452)
Urine sample taken	88.0	87.7	(Chi2=0.69; p=0.4051)

Blood sample taken	88.6	88.3	(Chi2=0.83; p=0.3609)
Abdomen examined	87.0	86.6	(Chi2=1.50; p=0.2200)
Intestinal parasite drug consumed	31.2	35.7	(Chi2=97.97; p=0.000)
Last 3 months of pregnancy meet ANM	68.5	74.1	(Chi2=128.96; p=0.000)
Receive any supplementary nutrition	68.0	79.6	(Chi2=496.30; p=0.000)
Always get supplementary nutrition	59.2	71.4	(Chi2=575.81; p=0.000)

Table 5. Odds of anemia and severe/moderate anemia among women who have delivered their last child in the past four years according to their experience of access to health and supplementation services and other risk factors to anemia

	Any anemia		Severe/Moderate anemia	
Characteristics	AOR	CI	AOR	CI
Social group				
Non-Scheduled Tribe®				
Scheduled Tribe	1.393***	[1.334,1.455]	1.257***	[1.196,1.323]
Dietary diversity				
Low	1.167***	[1.118,1.218]	1.239***	[1.172,1.309]
Moderate	1.037*	[1.001,1.074]	1.108***	[1.057,1.162]
High®				
Source of drinking water				
Improved®				
Non-improved	1.04	[0.977,1.106]	1.091*	[1.009,1.179]
Toilet facility				
Improved®				
Non-improved	1.198***	[1.158,1.240]	1.215***	[1.165,1.267]
Registered pregnancy				
Not registered®				
0-2 months	0.973	[0.911,1.040]	0.972	[0.894,1.056]
3-4 months	0.981	[0.905,1.062]	0.957	[0.865,1.059]
>=5 months	1.002	[0.917,1.095]	0.994	[0.889,1.111]
Full ANC				
No®				
Yes	0.920***	[0.889,0.952]	0.906***	[0.863,0.951]
Weighted during pregnancy				
No®				
Yes	0.992	[0.905,1.088]	0.927	[0.826,1.041]
Blood pressure taken during pregnancy				
No®				
Yes	1.026	[0.932,1.130]	1.049	[0.931,1.181]
Urine sample taken during pregnancy				
No®				
Yes	0.912*	[0.845,0.984]	0.887*	[0.806,0.977]
Blood sample taken during pregnancy				
No®				
Yes	1.068	[0.985,1.157]	1.089	[0.981,1.210]
Abdomen examined during pregnancy				
No®				
Yes	0.884***	[0.828,0.943]	0.866***	[0.796,0.941]
Intestinal parasite drug consumed during pregnancy				
No®				
Yes	0.948***	[0.919,0.978]	0.948*	[0.909,0.989]

Last 3 months of pregnancy meet ANM				
No®				
Yes	1.034	[0.996,1.072]	1.038	[0.988,1.090]
Received any supplementary nutrition				
No®				
Yes	1.004	[0.952,1.058]	0.985	[0.918,1.056]
Always received supplementary nutrition				
No®				
Yes, always	1.050*	[1.002,1.101]	1.105**	[1.038,1.176]

Note: ® Reference category; * p<0.05, ** p<0.01, *** p<0.001; AOR=Adjusted odds ratio.