

# **Anaemia in India: Exploring Socio Economic Factors and Intervention Effectiveness**

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I hereby declare that the data presented in this Dissertation report entitled, “Anaemia in India: Exploring Socio Economic Factors and Intervention Effectiveness” is based on the results of investigations carried out by me in the Economics at the Department of Economics, Goa University/Goa Business School under the Supervision of Prof. Avina Kavthankar and Asst. Supervisor Prof. Sumita Datta and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities /Goa Business School will be not be responsible for the correctness of observations / experimental or other findings given the dissertation.

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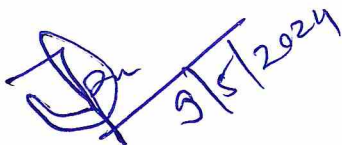
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This is to certify that the dissertation report “**Anaemia in India: Exploring Socio Economic Factors and Intervention Effectiveness**” is a bonafide work carried out by Miss. Juel D’Souza, under my supervision in partial fulfilment of the requirements for the award of the degree of **Masters in Arts** in the Discipline of Economics at the Department of Economics, Goa University/ Goa Business School.

  
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## **Anaemia in India: Exploring Socio Economic Factors and Intervention**

### **Effectiveness.**

#### **ABSTRACT**

Anemia remains a significant public health concern globally, particularly in low- and middle-income countries. In India, the burden of anemia is substantial, affecting various demographic groups differently. This dissertation investigates the socio-demographic factors associated with Anaemia prevalence and tries to know the trend between the 10-19 year school going girls and boys under the targeted beneficiaries of the AMB initiative.

Using the NFHS-5 data, socio-demographic variables such as age, caste, religion, education, wealth index, BMI, children ever born, residence, marital status smoking/ tobacco use, alcohol consumption and occupation are examined in relation to Anaemia prevalence. ANOVA analysis is employed to explore the differences in means of the 10-19 year school girls and boys comparing with the 3 year from 2021-2024 reveals that there is a significant disparity between the counts of targeted beneficiaries of girls and boys at the regional level in Goa, not much difference was observed at the national level in India. This suggests the need for further investigation into the program's implementation and outreach strategies to ensure equitable coverage across demographic groups.

## 1 INTRODUCTION

According to the World Health Organization (WHO), anaemia is defined as a haemoglobin (Hb) level of 12.0g/dL for women and 13.0g/dL for men. However, normal Hb distribution varies not only depending on sex, but also depending on ethnicity and physiological status. Anaemia is a condition in which the number of red cells and the concentration of haemoglobin is within the mere lower than normal. Haemoglobin is necessary to transport oxygen, and if there are too few red cells or abnormal red cells, or there is insufficient haemoglobin, the blood is less likely to transport oxygen to the body's tissues. Anaemia is a common disease affecting about 40% of children and 30% of women of reproductive age, keeping in mind its significant health effects.

Worldwide, it is estimated that 40% of children aged 6 to 59 months, 37% of pregnant women and 30% of women aged 15 to 49 are affected by anaemia. Anaemia caused 50 million years of healthy life, lost due to disability in 2019. Low and middle-income countries suffer the greatest burden of anaemia, especially affecting people living in rural areas, poor households and without formal education. The most vulnerable populations are children under five years of age, particularly infants and children under two years of age, girls and menstruating adolescents, and pregnant and postpartum women. It is estimated that anaemia affects half a billion women aged 15 to 49 and 269 million children aged 6 to 59 in the world. In 2019, 30% (539 million) of non-pregnant women and 37% (32 million) of pregnant women aged 15 to 49 suffered from anaemia.

Maternal and infant anaemia has profound and well-known consequences, including an increase in the risk of postpartum haemorrhage, infection and maternal mortality among women, and low birth weight and low neuron cognitive and motor development in children.

Anaemia is linked to the Sustainable Development Goals (SDGs) for Health and Well-Being (SDGs3). SDG 3 aims to ensure a healthy life and promote well-being for all ages. Anaemia is a health problem that affects the well-being and quality of life of individuals, especially women and children. By addressing anaemia, we can work towards the achievement of SDG 3 by improving the health and well-being of the affected persons. This includes access to adequate nutrition, medical services and education on prevention and treatment of anaemia. Furthermore, the treatment of anaemia can contribute to reducing health outcomes inequalities, as anaemia disproportionately affects certain populations.

Adolescent girls are more likely to become anaemic due to menstrual blood loss, accompanied by rapid growth and increased tissue iron requirements that usually continue throughout adult life. WHO has a global target of reducing anaemia in women of reproductive age by 50% by the year 2025. India has the highest prevalence of anaemia among pregnant women in the world. Previous studies have shown that low intake of iron and folate is one of the main factors contributing to the high proportion of anaemia among women in India. According to the National Family Health Survey (NFHS), 43% of Indian women aged 15 to 49 are anaemic. Although iron deficiency is the main cause of anaemia, especially in women, other causes of anaemia are deficiencies in folate, vitamin B12 or vitamin A. Anaemia in men cannot be due to iron deficiency, as men do not lose iron every month due to menstruation. It may not be prudent to provide iron supplementation for men to treat anaemia without knowing the cause. Today, the focus should be more on supplying vitamins, appropriate food intake to people, rather than on focusing only on iron supplements. (“Anaemia in Indian Women May Be Overestimated,” 2023) Scientists at ICMR-National Institute of Nutrition, Hyderabad, estimated the response curve of Hb to body iron stores (or Hb-plasma ferritin — PF) in 470 anaemic and non-anaemic women of reproductive age on a 90-day therapeutic iron-folic acid (IFA) supplement. Based on this, they developed a Hb

diagnostic cut-off of 11 grams per decilitre, lower than the current WHO adult values of 12 grams per decilitre. The roots of this crisis lie in a complex web of interconnected factors. Poverty, limited access to nutritious foods, and deep-seated gender inequalities all contribute to the disproportionate burden of anaemia borne by Indian women. Many face significant obstacles in obtaining the essential nutrients, such as iron, folate, and vitamin B12, that are crucial for the formation of healthy red blood cells. Compounding this challenge, parasitic infections and menstrual blood loss further exacerbate the problem, leaving women vulnerable to the debilitating effects of anaemia.

The Madhya Pradesh government has taken the initiative to eliminate the disease which is witnessed mostly among the tribal community. To do so, it has taken up this issue in the budget of 2023, which aims to address the health challenges of sickle cells diseases. This mission will be implemented in 278 districts across 17 high focus states including Gujarat, Maharashtra, Rajasthan, Madhya Pradesh, Jharkhand, Chhattisgarh, West Bengal, Odisha, Tamil Nadu, Telangana, Andhra Pradesh, Karnataka, Assam, Uttar Pradesh, Kerala, Bihar, Uttarakhand.

(Natekar et al., 2022) The article highlights the persistent high levels of anaemia among Indian women, with about 53% affected, and emphasizes the importance of addressing iron deficiency through public health interventions like the Weekly Iron and Folic Acid Supplementation (WIFS) program. Despite national and international attention, anaemia rates have remained high since 1990, indicating a significant health burden that requires continuous monitoring and assessment for effective management.

Anaemia is often ignored and accepted as a normal part of being a girl or a woman, as it occurs through invisible symptoms such as fatigue, weakness, dizziness, headaches, breathing disorders and stress. In addition, anaemia is often considered to be a disease confined to individuals belonging to poor households. The latest NFHS-5 report noted a decline in the prevalence of anaemia from the poorest to the richest income groups, but anaemia still affects more than 50% of the richest population groups. A lack of understanding and awareness of the signs and symptoms of anaemia contributes to low screening rates. India has reconsidered its anaemia policy and changed the anaemia prevalence estimate from the National Family Health Survey (NFHS) to the Diet and Biomarkers Survey (DABS-I).

The decision comes after concerns have been expressed about the accuracy of the haemoglobin levels estimate in the NFHS, taking into account the growing burden of anaemia in the country. Several programmes have been implemented 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). In children, anaemia can hinder their growth and cognitive development. It can also weaken their immune system, making them more susceptible to infections. This can have long-term effects on their overall health and educational outcomes.

Addressing this crisis requires a multifaceted approach that tackles the root causes of anaemia. Improving access to nutritious foods, fortifying staple foods with essential micronutrients, and providing targeted supplementation programs are crucial steps. Moreover, empowering women through education, healthcare access, and economic

opportunities can help break the cycle of poverty and gender inequality that perpetuates the anaemia epidemic.

The global community must unite in its commitment to prioritizing the health and well-being of women. By addressing the underlying drivers of anemia and investing in sustainable solutions. We can transform the lives of millions of women, unleashing their full potential and paving the way for a more equitable and prosperous future. The time to act is now, as we strive to build a world where anaemia is no longer a debilitating burden, but a challenge that has been decisively overcome.

In addition to these individual health impacts, anaemia also has broader societal and economic effects. It can reduce workforce productivity and hinder economic development, especially in countries with high prevalence rates. To combat the global burden of anaemia, various strategies are being implemented, including nutritional interventions, iron supplementation programs, and public health awareness campaigns.

## **1.1 OBJECTIVES OF THE STUDY**

1. To analyse the association between socio economic factors and the prevalence of anaemia among diverse demographic groups in India.
2. To compare the targeted beneficiaries between 10-19 year girls and boys and total number of adolescent girls of anemia mukt bharat between 2021-2024

## **1.2 RESEARCH PROBLEM**

The economic impact of anaemia in India is a significant concern, influenced by social and economic factors like wealth, education, dietary habits and more. The increasing rates of

anaemia result in higher healthcare cost and reduced productivity. This not only strains healthcare spending but also impedes the growth of human capital, particularly in maternal and child health.

This study seeks to explore the socio-economic burden of anaemia in India by examining the determinants, while looking at the comparison between the target beneficiaries.

### **1.3 RESEARCH QUESTIONS**

1. What are the primary socio-economic factors contributing to the prevalence of anaemia in India?
2. Has the number of targeted beneficiaries of Anemia amukt bharat for the year 2021-2024 changed among the 10-19 year girls and 10-19 boys and adolescent girls.

### **1.4 HYPOTHESIS**

1. There is no significant relationship between the socio-economic factors and the rise in anaemia cases.
2. The implementation of anaemia Mukht Bharat programme has led to a And National Iron Plus Initiative has led to a significant decline in anaemia

### **1.5 METHODOLOGY**

1. *The dependent variable:* If the respondent were anaemic or not. NFHS identified the three levels of anaemia namely mild, moderate and severe with Hb level less than 7.0 g/dl
2. *The independent variable:* Age education, religion, marital status, wealth quintile, place of residence, work status, BMI, smoking/tobacco, alcohol consumption.



## CHAPTER 2

### LITERATURE REVIEW

*((PDF) Anaemia ‘a Silent Killer’ among Women in India: Present Scenario, n.d.)* aims to explore recent advancements in understanding the prevalence, causes, and consequences of anemia among specific sub-groups of women. The findings highlight that globally, anemia affects a significant portion of the population, with the highest prevalence observed in preschool-age children and pregnant women. The factors contributing to anemia include nutritional deficiencies (iron, folic acid, vitamin B12), infections (malaria, hookworm), and socio-cultural factors such as gender discrimination and poor dietary intake. The methodology employed in this review article involves compiling and analyzing data from various national surveys and studies conducted in India, including the National Family Health Survey (NFHS), National Nutrition Monitoring Bureau (NNMB), Indian Council of Medical Research (ICMR), and District Level Household Survey (DLHS). To conclude, the author emphasizes that anemia is not solely a physical health issue but a complex problem rooted in socio-economic and political factors.

**(Balarajan et al., 2013)** analyze changes in social inequalities related to anaemia during this period. The study found that the prevalence of anaemia among women of reproductive age in India rose significantly from 51.3% to 56.1% over the seven-year period, despite adjusting for socioeconomic factors. Regional disparities were evident, with anaemia prevalence increasing notably in 14 of the 25 states examined. Socioeconomic disparities persisted, with higher prevalence observed among poorer,

less educated, and lower caste groups; however, both relative and absolute inequalities in anaemia had diminished over the study period. Increase in anaemia prevalence occurred without much improvements in other indicators of women's health and nutrition status during the same time period. In conclusion, the study revealed a troubling escalation in anaemia prevalence among Indian women over the recent seven-year period, accompanied by a narrowing of socioeconomic disparities in anaemia status.

**(Alvarez-Uria et al., 2014)** likely utilized a literature review approach to investigate the prevalence of anaemia in pregnancy, its repercussions for both the mother and fetus, available detection and treatment technologies, and the efficacy of interventions. The findings suggest that anaemia during pregnancy poses significant adverse effects on maternal and fetal health, potentially impacting neonatal and infant well-being, increasing the risk of non-communicable diseases in adulthood, and contributing to low birth weight in subsequent generations. However, the article highlights that technology for detecting and treating anaemia is accessible, affordable, and can be effectively implemented in primary healthcare settings. The primary objectives of the article likely aimed to raise awareness regarding the high prevalence of anaemia in pregnancy in India, underscore the adverse consequences of maternal anaemia on maternal and infant health, stress the importance of effective detection and treatment of anaemia, and advocate for the implementation of strategies to address anaemia during pregnancy.

**(Kishore et al., 2020)** presents findings from a cross-sectional study conducted in Uttarakhand by AIIMS Rishikesh. The methodology involved the inclusion of 5,776

beneficiaries, with data collected on age, gender, and haemoglobin levels using HemoCue Haemoglobinometer. Statistical analysis was conducted using Epi Info software version 7, and ethical clearance was obtained from the institute's ethical committee. The findings revealed that 53.2% of participants were anaemic, with females exhibiting a higher prevalence (54.6%) compared to males (45.1%). Among pregnant females, 33.5% were anaemic, indicating a substantial public health concern. The primary objective of the study was to assess the prevalence of anaemia among beneficiaries of the Anaemia Mukht Bharat Campaign in Uttarakhand and to explore its association with age and gender.

The research paper focuses on anemia prevalence and iron and folic acid intake among women benefiting from Janani Suraksha Yojana (JSY) and Janani Shishu Suraksha Karyakram (JSSK) in Punjab. Researchers picked Community Health Centers (CHCs) and Block Primary Health Centers (PHCs) in each district using a multistage and stratified sampling method. The study found a high anemia prevalence among beneficiaries, with many women having mild, moderate, or severe anemia during pregnancy. Despite iron and folic acid availability, intake was low due to factors like lack of awareness and women's casual attitude towards health.

**(Bentley & Griffiths, 2003)** this paper shows a significant impact on the burden women have to bear while suffering from anemia. The study aimed to investigate the prevalence and determinants of anemia among women in Andhra Pradesh, India. Conducted by ME Bentley and PL Griffiths, the study sought to assess the association between anemia and factors such as social class, urban versus rural location, and body mass index (BMI) among women in the region. Findings from the study revealed a high prevalence of anemia among women in Andhra Pradesh, with 32.4% experiencing mild anemia. Notably, rural women exhibited a

higher prevalence of anemia compared to their urban counterparts. Furthermore, the study underscored a significant association between low BMI and the risk of anemia among women in the region.

(Wirth et al., 2019) this study aimed to assess nutrition trends in Guinea over a fifteen-year period focusing on children, adolescent girls, and women. The methodology involved a secondary analysis of cross-sectional data on these demographic groups in Guinea. By analyzing existing data, the study aimed to provide a comprehensive overview of nutritional trends over the specified time frame.

***((PDF) Iron Deficiency Anemia among Women of Reproductive Age, an Important Public Health Problem: Situation Analysis, n.d.)*** aimed to review and synthesize literature concerning the burden, causes, outcomes, and interventions related to iron deficiency anemia (IDA) in developing countries. The methodology involved an extensive literature review utilizing databases such as PubMed, Google Scholar, Science Direct, World Bank, and WHO databases. Relevant articles were retrieved using specific keywords/phrases related to anemia, iron deficiency, risk factors, outcomes, and interventions in developing countries. The types of studies included in the review were descriptive, observational, correlational, and comparative studies published in English over the last 15 years, reporting data on IDA, its determinants, outcomes, and interventions.

Key findings from the literature review highlighted IDA as a significant public health issue, particularly prevalent among women of reproductive age in developing countries. Various factors including age, parity, socioeconomic status, and diet were identified as determinants of iron stores in women.

**((PDF) REVIEW OF PROGRESS TOWARDS ANEMIA MUKT BHARAT Reasons for Staggered Reduction in Anemia -A Review, n.d.)** aims to track the progress of reducing anemia across the lifecycle in India, particularly focusing on the Anemia Mukh Bharat initiative. Key findings from the review highlight that despite substantial programmatic efforts over the last fifty years, progress in reducing anemia has been slow across all age groups in India. High prevalence rates of anemia (>50%) persist among various demographic groups such as children, adolescent girls, and pregnant women. The paper discusses the evolution of anemia control programs in India, culminating in the Intensified National Iron Plus Initiative (I-NIPI) or Anemia Mukh Bharat strategy launched in 2018. Despite the implementation of the I-NIPI's 6x6x6 strategy targeting beneficiary groups, interventions, and institutional mechanisms, the decline in anemia prevalence has remained insignificant over the past five decades.

**(Sharif et al., 2023)** The study focuses on analyzing the prevalence of anemia among reproductive women in various social groups in India. The research methodology involved using data from the National Family Health Survey (NFHS) to identify factors associated with anemia, such as demographic, economic, and behavioral variables. Statistical analyses, including univariate, bivariate, and logistic regression, were conducted to assess the levels of anemia and determine the relative risk of different factors on anemia occurrence among women in different social categories. The study also utilized GIS techniques to create state-

level maps showing the spatial variation of anemia prevalence among women aged 15-49 years in different social groups.

**(Singh et al., 2022)** aimed to address the lack of attention given to anaemia among men in rural India. The study utilized data from the National Family Health Survey (NFHS-5) conducted between, 2019-2021, which included a sample of 61,481 men aged 15-54 living in rural areas. Through a comprehensive analysis, the study revealed that three out of ten rural men in India were affected by anaemia. Factors such as older age (49-54 years), lack of formal education, belonging to Scheduled Tribes, being in the poorest wealth quintile, and being underweight were identified as high-risk factors for anaemia among men. The findings underscored the importance of recognizing anaemia among men as a significant public health issue and emphasized the need for tailored interventions to address the varying socioeconomic, geographic, health-related, and behavioral factors contributing to anaemia prevalence.

***(Availability of National Policies, Programmes, and Survey-based Coverage Data to Track Nutrition Interventions in South Asia - PMC, n.d.)*** utilized data from India's Comprehensive National Nutrition Survey (CNNS) conducted between 2016-2018. The study aimed to determine the prevalence and burden of anaemia among Indian adolescents aged 10-19 years and identify associated factors. The CNNS employed a multistage, stratified sampling methodology, collecting data on household characteristics, health status, dietary intake, and anthropometry from 35,916 adolescents, with a subsample of 14,669 having valid haemoglobin measures

**(Maji et al., 2023).** aims to assess the changing trend in anaemia prevalence among Indian women of reproductive age using NFHS data. The methodology involves analyzing NFHS 3, 4, and 5 factsheets to gather information on anaemia prevalence among pregnant women and those aged 15-49, including IFA consumption data. Findings reveal an increase in anaemia prevalence among all women, particularly pregnant women, between NFHS 4 and 5, with significant variations among states and UTs.

**((PDF) India Steps Ahead to Curb Anemia: Anemia Mukht Bharat, n.d.)** employs a review article format to critically assess and synthesize existing literature and programs related to anemia in India. The primary objective is to highlight the prevalence of anemia in India and efforts to combat it, emphasizing its impact on health and socio-economic development. Findings reveal high anemia prevalence across various age groups despite national programs, necessitating a comprehensive approach.. The article concludes by supporting for community awareness, uninterrupted IFA supply, and effective monitoring within the NIPI framework to effectively combat anemia in India. Overall, it highlighted the urgency for concerted efforts to address this persistent public health challenge comprehensively.

**(Anemia Status, Hemoglobin Concentration and Outcome after Acute Stroke: A Cohort Study / BMC Neurology, n.d.)**The study conducted a prospective cohort analysis on 859 patients hospitalized for acute stroke to investigate the impact of anemia status and hemoglobin concentration on long-term outcomes. Anemia was defined based on WHO criteria, and hemoglobin levels were categorized into gender-specific quartiles. Patients were evaluated for risk factors, stroke severity, and stroke type. Follow-up assessments were conducted at 1 month and 1 year post-stroke to determine outcomes. The findings revealed

that WHO-defined anemia was present in 19% of both male and female patients with acute stroke. Patients with anemia had a higher risk of all-cause death and disability at both 1-month and 1-year follow-ups. The relationship between hemoglobin levels and outcomes showed a non-linear association, with increased risk observed at both low and high concentrations stroke. In conclusion, the study highlights the importance of evaluating anemia status and hemoglobin concentrations in patients with acute stroke to improve long-term outcomes.

**(Kulkarni, Bhawalkar, and Jadhav (2022))** conducted a study to assess the effectiveness of Vitamin C supplementation with Iron and Folic Acid (IFA) under the National Iron Plus Initiative (NIPI) in improving hemoglobin levels among adolescent girls in India. The research aimed to address the high prevalence of anemia in the country, particularly among vulnerable groups like adolescent girls. The study utilized an interventional follow-up approach in three secondary schools in Western Maharashtra, where adolescent girls in 7th-9th standard were recruited after obtaining ethical approvals and consent. The findings of the study indicated that various intervention groups showed improvements in haemoglobin levels after the 12-week intervention period.

**(Md. Akhtarul Islam, n.d.)** the study employs chi-squared and gamma tests, as well as multinomial and ordinal logistic regression analyses, to identify factors influencing childhood anemia. The study utilizes data from the Indian Demographic and Health Survey 2015–16 and applies chi-squared and gamma tests, along with multinomial and ordinal logistic regression models, to determine the influencing factors of childhood anemia in India. The findings reveal significant associations between childhood anemia and various factors, including maternal education level, stunting, underweight, wasting, child age, size,



and source of drinking water. Children with highly educated mothers are found to be less likely to be anemic, while stunting, underweight, and wasting increase the risk of anemia among children .

**(Understanding Socio-economic and Demographic Determinants of Childhood Anemia in India,by Sankar Goswami and Kishore K. Das)** aims to assess the socio-economic and demographic factors influencing anemia among Indian children aged 6-59 months. Utilizing data from the 2005-2006 National Family Health Survey in India, the study analyzes a weighted sample of 40,885 children, employing multinomial logistic regression analysis to evaluate the significance of various risk factors in different degrees of child anemia, diagnosed using World Health Organization (WHO) haemoglobin level cut-off points. The key findings of the study reveal a high prevalence of anemia among Indian children, affecting 69.5% of the sample, with varying degrees of severity. Factors such as rural residence, high birth order, maternal anemia, lack of iron supplementation during pregnancy, and maternal vegetarianism are associated with increased risks of childhood anemia.

***(Prevalence and Factors Associated with Anaemia among Pregnant Women Attending Reproductive and Child Health Clinics in Mbeya Region, Tanzania / PLOS Global Public Health, n.d.)*** aimed to investigate the prevalence of anaemia and identify factors associated with anaemia among pregnant women attending antenatal clinics in the Mbeya Region of Tanzania. The study employed a cross-sectional survey method, which included 420 pregnant women aged between 15 and 49 years from seven districts in the Mbeya region. The findings of the study revealed that a significant proportion of pregnant women in the Mbeya region were affected by anaemia. Factors such as maternal age, educational level, marital status,

parity, household wealth, ANC visits, and dietary quality were found to be associated with the prevalence of anaemia. The data analysis, conducted using SPSS version 22, included univariate and multivariable logistic regression analyses to explore the relationships between the outcome variable (anaemia status) and various independent variables.

**(Association between Food Insecurity and Anemia among Women of Reproductive Age**

**[PeerJ], n.d.)** The study utilized data from the Bangladesh Demographic and Health Survey.

Covariates such as age, type of residency, educational attainment, wealth status, employment status, microcredit borrower status, and BMI were categorized for analysis. Pearson's Chi-square tests were conducted to assess the statistical association between anemic and non-anemic groups for food security status and socioeconomic variables.

The study found that about one-third of women were aged below 25 years, with the majority being of rural origin. Women from the richest category comprised a significant portion of the sample population. A quarter of the women had no formal education.

***(Is the Burden of Anaemia among Indian Adolescent Women Increasing? Evidence from Indian Demographic and Health Surveys (2015–21) - PMC, n.d.)***

aims to investigate the changes in the prevalence of anaemia among adolescent women in India between 2015-2016 and 2019-2021. Additionally, the study seeks to identify various biodemographic, socioeconomic, behavioral, geographic, and health-related factors associated with anaemia in this population. The methodology employed in the study involved a multivariable binary logistic regression analysis to examine the independent effects of factors associated with anaemia. By pooling data from NFHS-4 and NFHS-5, the researchers were able to assess the independent effect of the survey year on the likelihood of anaemia. The findings of the study revealed an increasing burden of anaemia among Indian adolescent women, approximately 10% and 8% of sampled women being married before 18 years in NFHS-4 and NFHS-5, respectively.

**(Al-Khaffaf et al., 2020)** aimed to assess the prevalence of anaemia and identify factors associated with this condition among pregnant women in the Mbeya Region. Through their research, the authors provided valuable insights into the prevalence and factors associated with anaemia among pregnant women in Mbeya Region, Tanzania, contributing to the body of knowledge on maternal health and nutrition in the region. The data collection included demographic information, eating habits using a 24-hour dietary recall, and hemoglobin testing using the HemoCue 201+ device. The findings of the study revealed that the overall prevalence of anaemia among pregnant women was 25.5%, with a majority of the anaemic cases classified as mild. Factors associated with anaemia included lower socio-economic status, geographical location, consumption of dark green leafy vegetables, and vegetable liquid cooking oil. Pregnant women from lower socio-economic backgrounds were more likely to develop anaemia, while those living in specific districts and consuming certain dietary components had lower odds of being anaemic.

**(Sharma et al., 2018)** The study aimed to determine the prevalence of anemia among women in India by various background characteristics, analyse socio economic inequality in anemia across Indian states, and investigate the spatial correlation of anemia among women and its covariates across 640 districts of India. The methodology involved using data from the IV round of the National Family Health Survey (2015-2016) conducted by the International Institute for Population Sciences in Mumbai. Bivariate analysis and Binary Logistic Regression were employed to assess the effects of socio-economic characteristics, while Concentration Index and Poor-Rich ratios were calculated to understand socio-economic inequality. The findings of the study revealed significant correlations between anemia among women and various independent variables such as age, residence, religion, caste, quintile.

## CHAPTER 3

### **DATA, VARIABLES AND METHODOLOGY**

The data has been collected from the DHS program website, the data ranges from the year 2019-2021, 5<sup>th</sup> round /phase of NFHS. The variable included in the study are age of the women, education level, caste, religion, BMI, marital status, children ever born, wealth quintile, residence and work status, smoking/tobacco use, alcohol consumption. To compare the target beneficiaries of the Anemia Mukht Bharat from the year 2021-2024 only for the adolescent girls, 10-19 year girls and 10-19 year boys. 2 way Anova was used.

#### **3.1 Variables-**

1. Age: This refers to the person's age. Younger women, especially teenagers, and older women may be more prone to anemia.
2. Education Level: This is the level of education the person has attained, such as primary, secondary, or higher education. Higher education is often linked to lower anemia risk.
3. Caste: This is the social group the person belongs to in the Indian caste system. Individuals from lower caste groups may have a higher risk of anemia.
4. Religion: This is the person's religious affiliation, such as Hindu, Muslim, or Christian. Religious and cultural practices can influence diet and healthcare access, affecting anemia risk.
5. BMI: This is a measure of a person's body weight in relation to their height. Both underweight and overweight/obesity can increase the risk of anemia.

6. Marital Status: Whether the person is married, unmarried, or in another marital status. Marital status can affect a woman's access to resources and decision-making power, which may impact anemia.
7. Children Ever Born: The number of children a woman has given birth to. This can influence a woman's nutritional status, especially during and after pregnancy.
8. Wealth Quintile: This groups households into five equal-sized categories based on their wealth or economic status. Women from poorer households are more likely to be anemic.
9. Residence: Whether the person lives in an urban or rural area. Access to healthcare and nutritious foods can vary between urban and rural areas, affecting anemia.
10. Work Status: The person's employment and occupation. This can determine their income, autonomy, and access to resources, which may influence anemia risk.
11. Smoking/tobacco use: The consumption of these can have effects on women health and can have a relation with anemia.
12. Alcohol consumption: the consumption of liqure can have side effects to a women if she is pregnant.

### **3.2 Data sources**

- 1) The data collected for the first objective is from the IR file of the official DHS website.
- 2) The variables selected are age, caste, education ccupation, wealth index, tobacco/smoking, alcohol consumption, residence, religion, BMI, marital status.
- 3) The data collected for the second objective is from the official website of Anemia Mukd Bharat for the year 2020-21, 2021-22, 2023-24.

### **3.3 Methodology**

The methodology used to get the result is logistic regression. Logistic regression is a statistical model used for binary classification tasks, known to predicts the probability of occurrence of an event by fitting data to a logistic curve. The multinomial logistic regression was used to interpret the data as the model had more than one independent variable. Multinomial logistic regression (mlogit) was used to know the relationship between the predictors and the multinomial outcome variable representing different levels of anemia severity. The dependent variable is the anemia level and the independent variable are age, occupation, wealth index, tobacco/smoking, alcohol consumption, residence, religion, BMI, marital status, caste, education. The variables were selected using the code book from the DHS website, also the codes were renamed to a specific variable name for the dissertation purpose only.

The data on the targeted beneficiaries from the Anemia Mukht Bharat site has been used to compare the dataset for three years(2021-2024) between the adolescent girls, 10-19 year girls and boys. The two way annova test has been used to get the results, and based on the answer the comparison has been made for the three years. The software to run the mlogist regression was stata.

## CHAPTER 4

### **RESULTS AND DISCUSSION**

#### **4.1 Introduction**

Anemia, a widespread health condition characterized by a deficiency of healthy red blood cells or hemoglobin, is a pressing global concern, particularly for women in developing nations. Certain regions, such as Jharkhand, Rajasthan, and Gujarat, face an even graver challenge, with anemia rates exceeding 60-70% in these states. Anemia can have lot of consequences during child birth. These not only effects not only take a toll on the individual but also hinder economic productivity and development at a broader societal level.

Factors such as age, education level, caste, religion, body mass index (BMI), marital status, the number of children born, household wealth, place of residence, and employment status all play a crucial role in shaping the landscape of anemia. Anemia level do not only depend the selected variables but also on the other variables which are not mentioned.

## **4.2 Anemia Mukht Bharat – Target beneficiaries, (2021-2024)**

The Anemia Mukht Bharat (AMB) scheme is a comprehensive program launched by the Government of India in 2018 to tackle the persistent problem of anemia among women and children. The main objectives of the scheme are to reduce the prevalence of anemia by 3 percentage points per year among children, adolescents, and women of reproductive age, with the goal of achieving a 6-12% reduction in anemia by 2022. The scheme targets various vulnerable groups, including children, adolescents, pregnant women, and lactating women. In the data set the main focus has been the 10-19 year girls and boys and adolescent girls. The data taken from the website is used to compare/ check the amount of the targeted beneficiaries the results will be analyzed using annova test on excel.

## **4.3 HYPOTHESIS OF THE STUDY**

**Ho= there is no relationship between the socio economic factors and the anemia level**

**Ha= there exist a positive relationship between the socio economic factors and the anemia level**



**H<sub>0</sub>= there is no significance between the girls and boys of 10-19 years with comparison of the 3 year data**

**H<sub>a</sub>= there is a significance between the girls and boys of 10-19 years with comparison of the 3 year data**

#### **4.4 Variables**

##### **AGE**

H<sub>0</sub>= the age of the women doesn't have any impact on the anemia level

H<sub>a</sub>= the age of a women have an impact on the anemia level.

##### **RESIDENCE**

H<sub>0</sub>= the residence of the women doesn't have any impact on the anemia level

H<sub>a</sub>= the residence of a women have an impact on the anemia level.

##### **EDUCATION**

H<sub>0</sub>= the education of the women doesn't have any impact on the anemia level

H<sub>a</sub>= the education of a women have an impact on the anemia level.

## CASTE

$H_0$ = the caste of the women doesn't have any impact on the anemia level

$H_a$ = the caste of a women have an impact on the anemia level.

## OCCUPATION

$H_0$ = the occupation of the women doesn't have any impact on the anemia level

$H_a$ = the occupation of a women have an impact on the anemia level.

## RELIGION

$H_0$ = the religion of the women doesn't have any impact on the anemia level

$H_a$ = the religion of a women have an impact on the anemia level.

## MARITAL STATUS

$H_0$ = the marital status of the women doesn't have any impact on the anemia level

$H_a$ = the marital status of a women have an impact on the anemia level.

## WEALTH INDEX

$H_0$ = the wealth index of the women doesn't have any impact on the anemia level

$H_a$ = the wealth index of a women have an impact on the anemia level.

## SMOKING AND TOBACCO USE

$H_0$ = smoking and tobacco consumption by women doesn't have any impact on the anemia level

$H_a$ = smoking and tobacco consumption by women have any impact on the anemia level

## BODY MASS INDEX

$H_0$ = the body mass index of a women do not have any impact on the anemia level

$H_a$ = the body mass index of a women have any impact on the anemia level

## **4.5 Multinomial logistic regression models**

**Model a)**

Anemia\_level~age+marital\_status+workstatus+

residence+caste+Bmi+wealthindex+education+children everborn.+smoking\_tobacco+alcohol

**Table 4.1.Classification Of Anemia Level In 3 Different Categories.**

Severe	> 7 g/dL
Mild	10-12 g/dL
moderate	< 12.0 g/dL

**Table 4.2. Odds ratio for the given variable with the reference to the anemia level.**

VARIABLES	SEVERE	P VALUE	MODERATE	P VALUE	MILD	P VALUE
Age						
25-34	0.911(-.0925287)	0.692	0.940(-.0617534 )	0.468 **	0.946(-.0552482	0.537 **
35-44	0.9299 (-.0726076)	0.788	0.817(-.200936 )	0.052	0.885(  -.1220756)	0.259 **
45-49	0.832 (-.1835296)	0.559 *	0.720 (-.3280068 )	0.008 *	0.810(-.2104507	0.105 *
Education level						
middle-school	0.9588 (-.0420173 )	0.856	0.758 (-.276597 )	0.010 .***	0.753(-.2829911	0.015 ***
secondary	0.591 (-.5248182 )	0.006 *	.0.660(.4142954)	0.000 ***	0.728(-.0974561 )	0.000 ***
higher secondary	0.296 (-1.214905	0.000 ***	0.564(5718178	0.000 ***	0.746(-.8080109 )	0.006 ***
Residence						
Rural	1.103 (.0985619 )	0.563 **	7.890(.094605	0.146	2.031(.7086477 )	0.285
Caste						
schedule tribe	1.352(3020808 )	0.107 *	0.980( -.0192175)	0.811	0.961(-.0391037	0.646
other backward class	0.815(-.0203776 )	0.890	0.876(-.1320505 )	0.022 *	0.878(-.1300257	0.033*
undefined category	1.075 (.0731872 )	0.922	0.714(3364959)	0.258 ***	1.761(.5663231 )	0.057 *

Table 4.3. Odds ratio for the given variable with the reference to the anemia level.

VARIABLE	SEVERE	P VALUE	MODERATE	P VALUE	MILD	P VALUE
<b>Religion</b>	294,107.315	0.984		0.050		0.285 **
<b>Non-Christian</b>	{12.5917		1.099(.094605 )		1.035(.0344768 )	
<b>Marital status</b>						
<b>Married</b>	0.524(-.6447094	0.078 *	0.731(-.312471)	0.013 ***	0.913(-.224514)	0.085
<b>Widowed</b>	0.304(-1.189875)	0.060 *	0.925(0771806)	0.706	0.797(-.2267639)	0.312 **
<b>divorced</b>	1.569(45059 )	0.479 **	0.749(-.2885901	0.409 **	0.683(-.3798479	0.322**
<b>Wealth index</b>						
<b>Middle income</b>	0.751 (-.2861351)	0.144 *	0.854(-.1572382)	0.053	0.961(-.039446	0.644
<b>Rich</b>	0.979(.0278775 )	0.869	1.111(.1055168)	0.141	1.088(.0846105 )	0.270 **
<b>Occupation</b>						
<b>Non-Agricultural</b>	1.0766	0.639	0.953	0.467 *	.016	0.810
<b>Agricultural</b>	0.7011	0.265 **	1.294	0.011 ***	0.907	0.404 **
<b>Don't know</b>	0.000006614	0.987	2.304	0.200 *	0.445	0.471 **

variables	severe	P value	moderate	P value	mild	P value
<u>Smoking tobacco</u>	5.727(-17.35)	.996	0.082	.999	1.685(-9.168)	.996
Alcohol consumption						
About once a week	Base count		2321.108(17.86282)	0.000	2765.0113	0
Less than a week			232562(18.9739)		83963(18.9739)	0
BMI						
Healthy range			0.00012(-8.967)	.053**	0.00010(-9.168)	0.053 0
Over weight	BASE COUNT		0.791(-.0609229)	0	0.0064(-5.036198)	0
Obesity			0.0075(-9.637471)	0	6.526(-5.082924)	0

**Table 4.4. Odds ratio for the given variable with the reference to the anemia level.**

### Interpretation:

Table 4.2. shows that moderate anaemia level having the odds of 94% for the age group of 25-34 are more likely to be more anemic along with mild anaemia from the same age group compared to the reference category, while the Women who have completed middle schooling a lightly to have severe anaemia of 95% compared to the reference category. While there is no difference within the educational level of women having mild anaemia

The odd ratio of anemia level occurring among the rural population increases by 1.103 factor compared to the reference category. It suggest the individuals residing in the rural areas has slightly higher odds of the outcome compared to the urban area

For the cast category the individuals belonging to the schedule tribe have 1.352 times the odd of the outcome compared to the reference category while the backward class have 0.815 times the odds of the outcome. Individuals belonging to the schedule tribe have a higher odd of the outcome compared to the reference category while the backward class have the lower odds

Table 4.3 Gives the odds ratio of the religion we can find that the outcome of the nom Christian are much higher compared to the odds of the reference category. The odd ratio of the anemia level shows that individual have a higher education have outcome of 0.524 lower than the reference category.

Wealth index shows that 96% of the individual from the middle income are having mild anaemia while 97% of the richer population have severe anaemia compared to the moderate and mild. The odds of moderate anemia for a women working in non-agricultural occupation is 95% more compared to the reference category.

In the table 4.4 the odds ratio of a women having mild anemia occurring among the women who consume alcohol increases by 2765.0113 units. Also the women who smoke, the chances of these women having severe anemia increases 5.727 units. The women who are obese have high chances of having mild anemia by 6.526 units

#### **4.6 TARGETED BENEFICIARIES COMPARISON ON GOA BETWEEN 10-19 YEAR SCHOOL BOYS AND GIRLS WITH RESPECT TO THE (WIFS)**

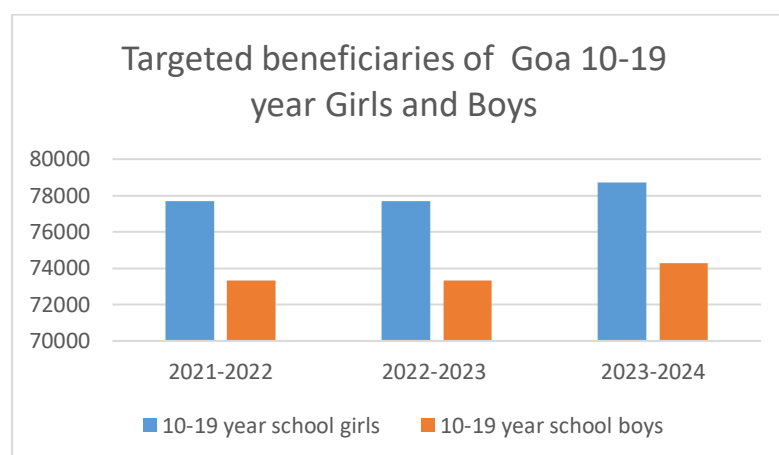
**TABLE 4.5: 3 year comparison between 10-19 year girls and boys in Goa.**

YEAR	10-19 YEAR SCHOOL GIRLS	10-19 YEAR SCHOOL BOYS
2021-2022	77691	73308
2022-2023	77691	73308
2023-2024	78728	74286

(Source secondary data)

The above table shows Goa's three year data from 2023-2024, and with the 10-19 year girls and boys with each year horizontally showing the coverage of the targeted beneficiaries.

**FIGURE 4.1: Targeted beneficiaries of Goa, 10-19 year girls and boys**



(source: authors computation, Anemia Mukht Bharat)



In the above graph displays the targeted beneficiaries between boys and girls of 10-19 years, for the year 2021-2024. Each bar represents the targeted beneficiaries of school going girls and boys. We can see than there has been an increase in the number of the targeted beneficiaries for the year 2023-2024, compared to the previous years. The year 2021-22, 2022-2023 shows that there has been no increase in the number of the targeted beneficiaries from the year 2021-2023 the number of boys and girls remains constant (77691, 73308). There has been increase in the coverage of school girls compared to the boys in the year 2023-24, which indicates that more girls are being benefited by the programme. The proportion of boys has also increased compared to the previous year but it is comparatively less compared to the coverage of girls.

**Table 4.6 The summary of the targeted beneficiaries by using Annova**

SOURCE OF VARIATON	SS	MS	P.VALUE	F	F.CRITICAL
ROW	1353408	676704.2	0.000857	1166.396	19
COLOUM	29075211	29075211	2E-05	50115.27	18.51282
ERROR	1160.333	580.1667			

(source secondary data)

In the above table shows the results of the Annova done on excel for the year 2021-2024. The row source of variation for the time period for the year 2021-2024, shows that the calculated F-value (1166.40) is significantly greater than the critical F-value (19) at the significance level of 0.05. The p-value (0.0009) is less than 0.05, indicating strong evidence against the null hypothesis. This suggests that there is statistically significant variability between the different time periods (2021-2022, 2022-2023, 2023-2024) in terms of the counts.

For Columns source of variation is between the (Gender Groups) The calculated F-value (50115.27) is significantly greater than the critical F-value (18.51) at the significance level of 0.05. The p-value (0.00002) is less than 0.05, indicating strong evidence against the null hypothesis. This suggests that there is statistically significant difference between the counts of 10-19 year school girls and boys in Goa.

For the row show that the sum of square is greater than the sum squared errors. And the mean squared is greater than the mean squared error than we can say that there is significant variance between the column.

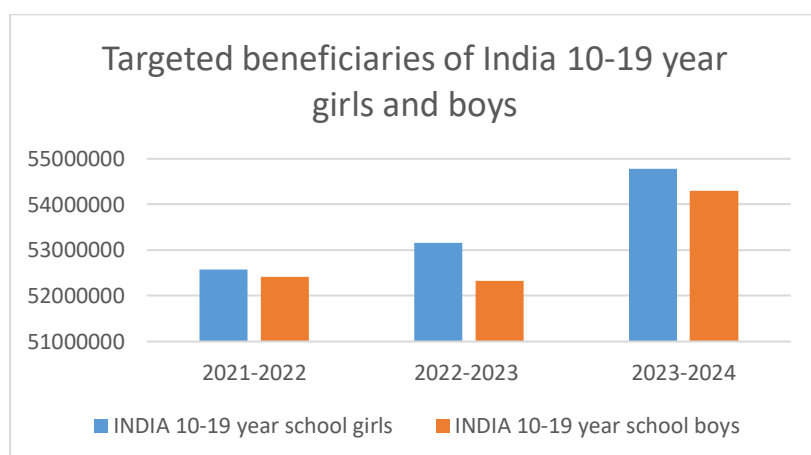
#### **4.7 TARGETED BENEFICIARIES COMPARISON ON INDIA BETWEEN 10-19 YEAR SCHOOL BOYS AND GIRLS WITH RESPECT TO THE (WIFS)**

**TABLE 4.7: The 3 year comparison between 10-19 year girls and boys in India**

YEAR	10-19-YEAR SCHOOL GIRLS	10-19-YEAR SCHOOL BOYS
2021-2022	52580196	52422827
2022-2023	53157753	52321753
2023-2024	54787183	54296941

(source secondary data)

**Figure 4.2: Targeted beneficiaries of India, 10-19 year girls and boys**



(sources: authors computation, Anemia Mukht Bharat)

The above graph shows the targeted beneficiaries of the boys and girls within the age group of 10-19 year. The targeted group of individual for the year 2023-24 has increased comparatively as of last year and before. The above graph shows a great coverage by the anemia mukt bharat programme for the young girls and boys, has been successfully reaching all the states of India.

**Table 4.8: The summary of the targeted beneficiaries by using Anova**

SOURCE OF VARIATION	SS	MS	P.VALUE	F	F.CRITICAL
ROW	4.98E+12	2.4896E+12	0.022603	43.24214	19
COLOUM	3.6685E+11	3.6685E+11	0.127589	6.371758	18.51282
ERROR	1.1515E+11	5.7574E+10			

(source secondary data)

In the above table shows the results of the Anova done on excel for the year 2021-2024. The row source of variation for the time period for the year 2021-2024, shows that the calculated F-value (43.24214) is significantly greater than the critical F-value (19) at the significance level of 0.05. The p-value (0.022603) is greater than 0.05, which shows that there is no strong evidence against the null hypothesis. This suggests that there is no statistically significance variability between the different time periods (2021-2022, 2022-2023, 2023-2024) in terms of the counts.

For Columns source of variation is between the (Gender Groups) the calculated F-value (6.371758) is significantly greater than the critical F-value (18.51282) at the significance level of 0.05. The p-value (0.127589) is more than 0.05, indicating that there is no strong evidence against the null hypothesis. This suggests that there is no statistically significant difference between the counts of 10-19 year school girls and boys in Goa. The mean of square value for the column is greater than the mean of square of error we say that there significance variance to the column where the column has effect on the outcome variable. Similarly to the row mean of square is much less than the row error than we can say that there is no significance between the variable.

## Chapter 5

### **Conclusion**

The study aimed to shed light on the socio-economic determinants of anemia prevalence in India and evaluate the effectiveness of the Anemia Mukht Bharat program in targeting 10-19 year school girls and boys while looking at the coverage of the 3 year(2021-2024). Analysis of various socio-economic factors such as age, education, residence, caste, religion, marital status, wealth index, occupation, and smoking/tobacco revealed significant associations with varying levels of anemia. Notably, middle aged group, lower education levels, rural residence, certain castes, non-Christian religions, unmarried status, lower wealth index, specific occupations, and tobacco use were found to be correlated with higher rates of anemia. Additionally, the study assessed the targeted beneficiaries of the Anemia Mukht Bharat program among 10-19 year-old girls and boys in Goa and India over a three-year period. Results indicated a commendable increase in the number of beneficiaries, particularly among adolescent girls, signifying progress in addressing anemia-related issues. However, while there was a significant disparity between the counts of targeted beneficiaries of girls and boys at the regional level in India and no such difference was observed in Goa. This suggests the need for further investigation into the program's implementation and outreach strategies to ensure equitable coverage across demographic groups. Overall, the study contributes valuable insights into the socio-economic burden of anemia and underscores the importance of targeted interventions to mitigate its impact and promote public health in India.

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