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Exploring Factors Influencing Anaemia During Pregnancy in India

With the application of Socioecological Framework: A Literature Review.

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A Thesis submitted in the partial fulfillment of the requirement for the degree of Master of Science, Public Health, By:

Rupali Bhadre.

Declaration:

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Rupali Bhadre
Signature

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List of Abbreviations

ADP	Anemia during Pregnancy
AIP	Anemia in Pregnancy
AMB	Anemia Mukt Bharat
ANC	Ante Natal Care
ANM	Auxiliary Nurses Midwife
ASHA	Accredited Social Heath Activist
AWW	Anganwadi Worker
AYUSH	Ayur Ved Yog Unani Siddha Homeopathy
BMI	Body Mass Index
CD	Community Dialogue
CHW	Community Health Worker
CP	Community Participation
DALY	Disability Adjusted Life Years
GDP	Gross Domestic Product
Hb	Hemoglobin
HBM	Health Belief Model
HMIS	Health Management Information System
HW	Health worker
ICDS	Integrated Child Development Services
IEC	Information Education Communication
IFA	Iron and Folic Acid
I-NIPI	Intensified National Iron Plus Initiative
JSSK	Janani Shishu Suraksha Karyakram
KAP	Knowledge Attitudes Practices
LMIC	Low- and Middle-Income Countries
MMR	Maternal Mortality Rate
MohFW	Ministry of Health and Family Welfare
MoE	Ministry of Education
MoWCD	Ministry of Women and Child Development
NCERT	National Council of Education Research and Training
NGO	Non-Government Organization
NFHS	National Family Health Survey
NHM	National Health Mission
NHSRC	National Health Systems Resource Centre
NIPI	National Iron Plus Initiative
NNACP	National Nutritional Anemia Control Program
PATH	Program for Appropriate Technology in Health.
PAR	Participatory Action Research

PPP	Post Partum Period
PNC	Post Natal Care
RANI	Reduction in Anemia through Normative Innovations
RKSK	Rashtriya Kishor Swasthya Karyakram
SHG	Self Help Group
SEWA	Self-Employed Women's Association
SNEHA	Society for Nutrition, Education & Health Action
SRH	Sexual and Reproductive Health
UNFPA	United Nations Population Fund
UNICEF	United Nations Children’s Fun
VHSNCS	Village Health Sanitation and Nutrition Committee
WASH	Water Sanitation and Hygiene
WIFS	Weekly Iron and Folic Acid Supplementation
WHO	World Health Organization

Glossary of key Terms

1)Anemia- Anemia is a condition in which the number of red blood cells or the hemoglobin (Hb)concentration within them is lower than normal. This leads to a decreased capacity of the blood to carry oxygen to the body tissues, resulting in symptoms like fatigue, weakness, dizziness, and shortness of breath (1).

2)Haemoglobinopathies- Hemoglobinopathies are genetic (inherited) disorders of hemoglobin, the oxygen-carrying protein of the red blood cells (2).

3)Hemolytic anemia- Hemolytic anemia is a disorder in which red blood cells are destroyed prematurely. The cells break down at a faster rate than the bone marrow can produce new cells. Hemoglobin, the component of red blood cells that carries oxygen, is released when these cells are destroyed (3).

4)Anemia during pregnancy-The World Health Organization (WHO) defines anemia of pregnancy as hemoglobin (Hb)< (less than) 11 g/dL, during pregnancy. Most common cause for anemia of pregnancy is iron deficiency, arising from maternal-fetal transfer of iron, frequently aggravated by decreased maternal iron reserves (4).

5)Caste-Caste is a social and cultural institution that has been prevalent in India for more than 2,000 years. The caste is based on the idea that people are born into a particular caste and cannot change it during their lifetime, indicating its rigid and hierarchical structure (5).

6)Caste Systems-Caste system crucially shapes access to social and economic resources (6). It affects health through genetics, early environment, and opportunities due to social mobility. In most health indicators, the backward castes/tribes lag significantly behind the General castes due to inadequate access to healthcare, low literacy rates, and poor economic conditions (7) (8).

7)Tribe-A tribe is a collection of families bearing a common name, speaking a common dialect, and occupying or professing to occupy a common territory. The tribal population constitutes about 8.9% of the total population in India (9).

8)Postpartum period - The postpartum period, also known as the puerperium and the "fourth trimester," refers to the time after giving birth when maternal physiologic changes related to pregnancy return to the nonpregnant state (10).

9)Anemia Mukt Bharat-Anemia free India.

10)Janani Shishu Suraksha Karyakram-Mother and Child Protection Program.

11)Kendra- Centers.

Abstract

Background-Anemia during pregnancy is a critical public health concern in India, with over 50 % of pregnant women being affected and contributing significantly to maternal morbidity and mortality. Despite 50 decades of targeted national programs, it continues to pose major challenges. The causes are multifactorial extending beyond nutritional deficiency to include sociocultural, structural barriers, and gender and socioeconomic disparities. Existing strategies follow centralized one size fit all approaches, hence failing to address deeply rooted socioecological factors.

Objective-To explore socioecological factors contributing to anemia during pregnancy in India, and to recommend interventions to strengthen existing programs with a focus on decreasing maternal mortality and minimizing neonatal complications.

Methodology-The study conducted comprehensive literature review utilizing various search engines and databases including PubMed, BMC, Google Scholar, and grey literature. The review encompassed studies between 2010 to 2025 including qualitative, quantitative, and mixed method studies. The study employed a socioecological framework to analyze factors at individual, interpersonal, cultural, community, organizational, and program levels.

Findings-The study identified significant knowledge gaps among pregnant women, particularly those from rural and marginalized communities leading to poor adherence to IFA supplementation. Cultural barriers including food taboos, caste, and religion specific diets, restrict intake of iron rich nutrients and perceptions around IFA such as fear of side effects like nausea, abdominal discomfort, large baby, further hinder the IFA intake. Gender power relations at household level shaped by patriarchal norms, limit pregnant women's autonomy in nutrition and health care decisions. Mother-in-law often emerges as gate keeper, restricting access to nutrition and care. At community level disparities in health care infrastructure and systemic neglect of health workers hinder the outreach of services. Many frontline health care workers including ANMs, ASHAs exhibit gaps in technical knowledge and practical counselling regarding IFA dosage, side effects management and timely referral reducing the effectiveness of service delivery. At national level, implementation gaps in anemia control programs, combined with sociocultural barriers significantly limit the reach, equity, and impact of control strategies.

Keywords-Anemia during pregnancy in India, maternal health care utilization, socioeconomic status, cultural food taboos, IFA supplementation, National Programs, Implementation gaps, NGO, Community participation.

Word count-11800

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Last but never least my deepest thanks to my children for their patience, love and resilience through my moments of absence, anxiety during my master's journey.

Introduction

I was born and raised in middle class family of Maharashtra, India, where I witnessed the expressions of the gender biases around the society. Culture norms and caste dynamics shaped household routine, access to opportunities, resources, and health care decisions, especially for women.

In the year 2010, after passing public service examinations, I joined the public health department of government of India and started working in primary health center in rural Maharashtra. My responsibilities included outpatient services, family planning, ANC, and routine immunization. Working in the rural part of India exposed me to the ground reality of Indian health system.

Increasingly it became evident that centrally designed programs fall short and struggle creating impact on the peripheral end of the system. I observed, rural parts especially women suffer due to inequalities in services, nutrition and sociocultural barriers and entrenched gender norms. Despite the broad scope of programs, maternal health indicators such as anemia during pregnancy remained persistently poor in peripheral settings.

The mismatch between the program designs and outcome from the peripheral reality is my driving factor in selecting Anemia During Pregnancy as my thesis topic. With the help of this study, I aim to explore how different local social, cultural and system factors intersect and influence the burden of anemia during pregnancy in India. My objective is to examine these factors with the application of a socioecological framework and to propose context specific recommendations to reform national programs to achieve equitable and sustainable maternal health.

Chapter 1-Background Information of India:

India, the seventh-largest country in the world, occupies a sizable portion of the Indian subcontinent (11). As the world's most populous country with over 1.4 billion people, India is marked by vast geographic, cultural, and socio-economic diversity. This complexity has profound implications for public health, particularly maternal health outcomes. Based on Worldometer's elaboration of the latest United Nations data the current population of India is 1,461,974,504 with population density 492 per Km² (1,275 people per mi²) (12).

Figure 1 illustrates geographic distribution of administrative units of India.

Figure 1 Administrative map of India

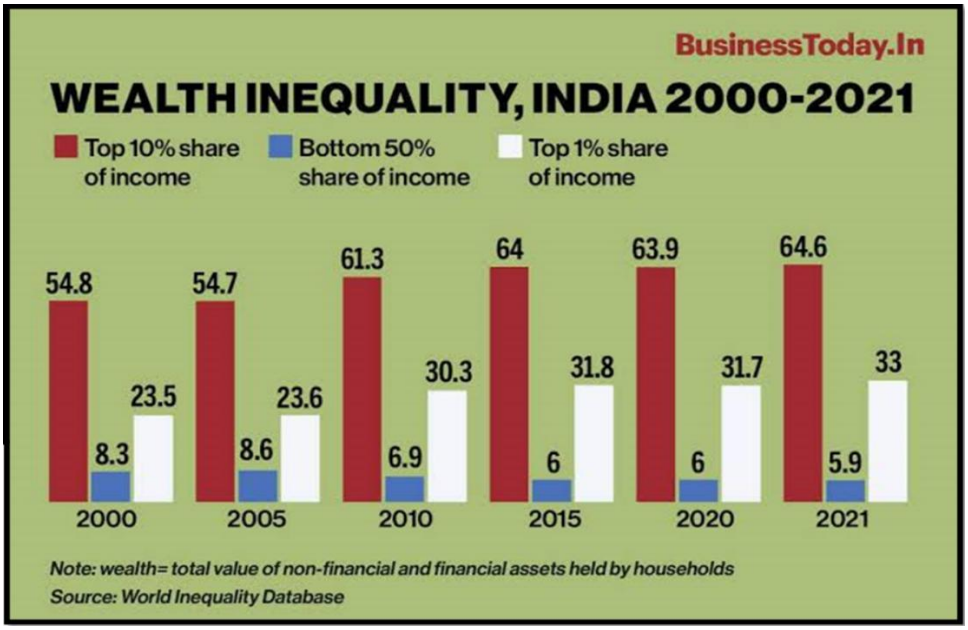
Detailed political and administrative map of India. vidiani.com (13).

Classified by the World Bank as a lower-middle-income economy, India presents the complex socio-economic landscape marked by immense economic potential and persistent challenges (14).
Although India is among the world's largest economies by nominal gross domestic product (GDP), its massive population results in modest per capita income (15). In 2022-2023, the per capita net national income in India was estimated at INR 172,000 with the wealth per adult around $16,500, which is significantly below the global average of $84,718 (16).

Despite substantial reduction in poverty, persistent economic disparities exist across states, and within population groups. The Oxfam international study (2019) indicated while richest 1% in India hold 73% of the wealth, 670 million individuals witnessed only a marginal 1% increase. These inequalities are further reflected in unequal access to essential services such as infrastructure, education, and healthcare (17).

Figure 2 illustrates an overview of socio-economic disparities in India.

Figure 2 An overview of Socioeconomic Disparities, India



Wealth Inequality-Universal Institutions 2024 (18).

Within this broader socioeconomic context, the family in India remains the basic cohesive unit of larger social system with strong coping mechanisms. Family forms vary with class, ethnicity, individuals and are a major factor in survival, health, education, and development (19).

The status of women within Indian families reflects broader social, economic, and cultural norms that put them in subordinate roles. Despite contributing through caregiving and domestic labor, women often lack recognition, autonomy, and control over resources (20).

Women's participation in the formal workforce remains low at 27% despite rising education levels, while cultural norms dictate that women eat last and least affecting nutrition of 50% of women of reproductive age (20).

Reproductive healthcare, family planning choices are controlled by husbands and in-laws rather than the women themselves. The burden of subordinate status with pressure of sacrificing motherhood ideologies contribute to depression, anxiety, and stress among women (20).
Moreover, the rise of cultural nationalism in India under the current governments' emphasis on Hindutva and national identity, has had a complex impact on gender issues. The welfare schemes like Beti Bachao Beti Padhao aim to educate and empower the girl child (21). However, they are often framed within a broader nationalist narrative, which portray women symbolic "mothers of nation." While such narrative promotes traditional gender roles and limits autonomy, it also diverts attention from pressing issues of reproductive and sexual rights, maternal health services especially for women in rural areas, urban slums, adolescent mothers, women from minorities (22).

Urbanization further shapes maternal health realities. India's urban population is projected to reach 590 million by 2030, due to migration from rural to urban areas. Migrants in informal settlements lack official recognition resulting in exclusion from essential services (23). Overcrowding, precarious living and working conditions and limited access to formal health

care contribute to poor maternal health outcomes and higher maternal mortality rate (MMR) (24).

Health seeking behavior in India is multifactorial and determined by socio-cultural, economic, gender, role of family, caste, religion, availability, acceptability of health systems. Rather than being an isolated event, it is a dynamic process evolving through self-assessment, self-treatment, seeking advice from family, social networks, and eventually healthcare professionals (25). Indian Health system is marked as medical pluralism with coexistence of ethnic medical traditions, quack practices, local healer, herbalist, spiritual healers, self-care practices, modern medicine. Thus, in the Indian context, health-seeking behavior reflects both individual health needs and deep entrenched social structures in which they are embedded (25).

India has a mixed health-care system, inclusive of public and private health-care providers. While private healthcare providers concentrate in urban areas, providing secondary and tertiary care health-care services, the public health-care infrastructure in rural areas has been developed as a three-tier system based on population norms (26).

A sub-center (SC) is established in a plain area with a population of five thousand people and in hilly areas with a population of three thousand. It is the most peripheral and first contact point between the health-care system and the community and is assigned to maternal and child health, family welfare, nutrition, immunization, and control of communicable diseases (26).

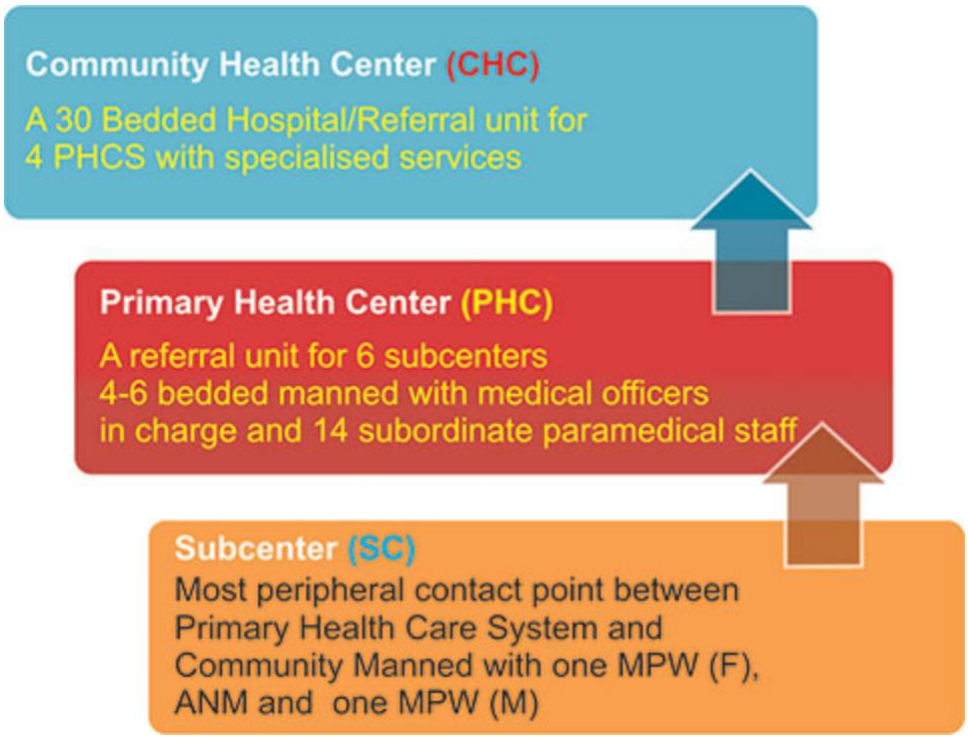
A primary health center (PHC) is established in a plain area with a population of 30 000 people and in hilly areas with a population of 20 000 and is the first contact point between the community and the medical officer. PHC is assigned to provide integrated curative and preventive health care (26).

Community health centers (CHCs) are established and maintained by the State Government in an area with a population of 120 000 people and in hilly areas with a population of 80 000 to serve as a referral center for PHCs, providing obstetric and specialist care (26).

The first referral unit (FRU) is a facility to provide round-the-clock services for emergency obstetric and newborn care (26).

Figure 3 illustrates the tiered structure of rural health system in India

Figure 3-Tier Structure of Rural Health System of India



Source: JaypeeDigital

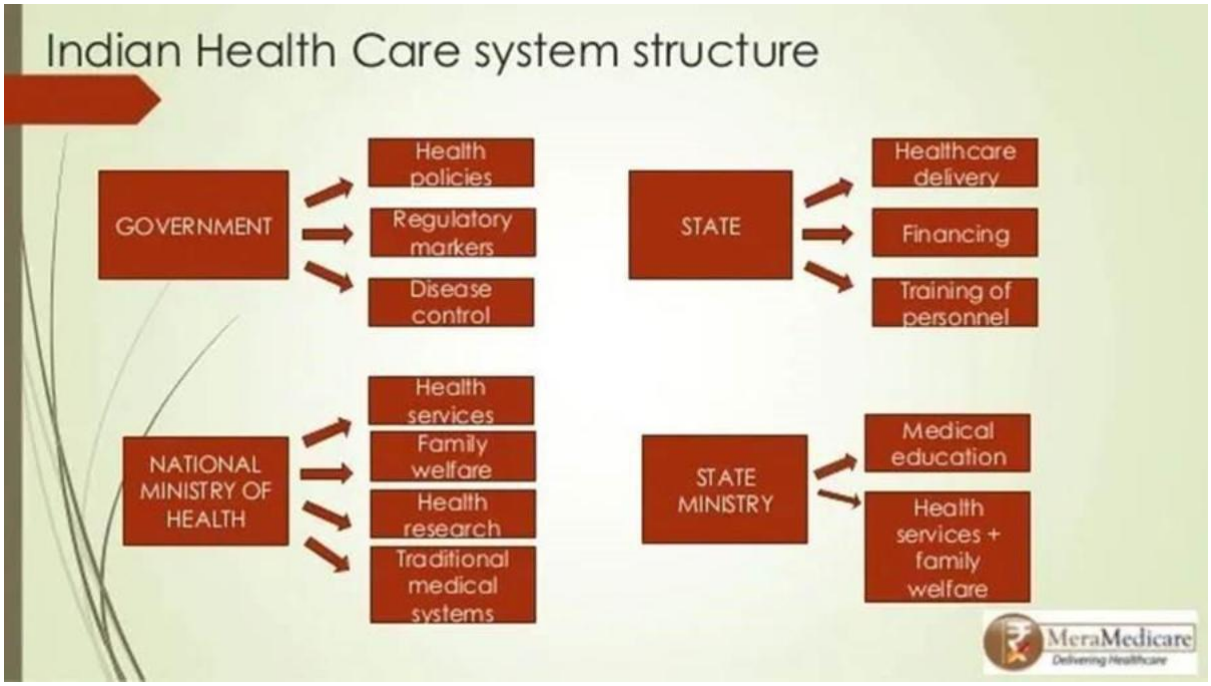
Maternal health services are integrated across all these tiers.

According to India's Constitution, Health is a Concurrent List subject of both the Central and State governments. While public health is the exclusive responsibility of the states, the center exercises great power through fiscal control (27).

The Ministry of Health and Family Welfare (MoHFW) has three independent departments-
1) The Department of Health is responsible for public health, medical education, food and drug standards, professional councils, and international aid and health research.
2)The Department of Family Welfare is primarily responsible for family planning and maternal and child health.
3)The Department of Indian Systems of Medicine and Homeopathy (DISMH) governs alternative systems of medicine (Ayurveda, Siddha, Unani, Homeopathy, Naturopathy, and Yoga) (27).
These departments are supported by a network of autonomous research and training institutions under the central government (27).

Figure 4 illustrates the organizational structure of Ministry of Health and Family Welfare

Figure 4 Healthcare structure- Ministry of Health India.



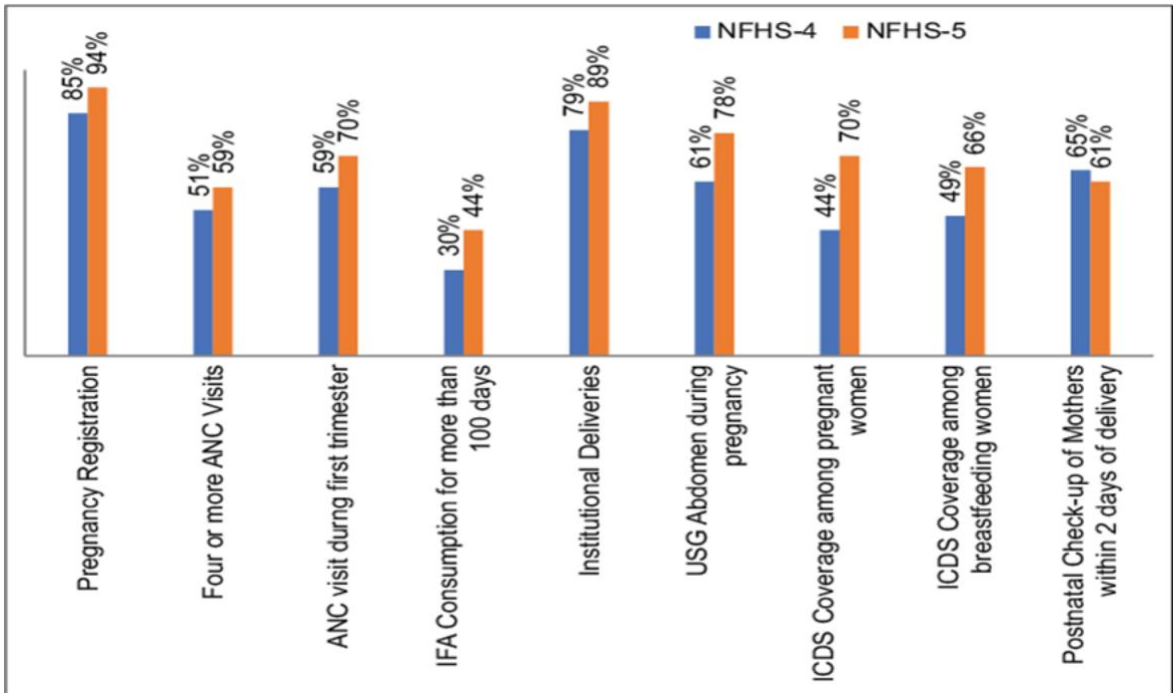
Mezie C. An analysis of the healthcare system in India [Internet]. Mezie's blog 2023 Nov 20 (28).

Although there is no exclusive maternal health department at national level, Government of India adopted the Reproductive, Maternal, New-born, Child, and Adolescent Health (RMNCH+A) framework in 2013, to address maternal and child mortality and morbidity (29).

National Health Mission (NHM), launched in 2013, is a flagship program of MoHFW, aims to provide affordable, accessible, and quality care for maternal and child health (30).

Figure 5 illustrates the progress and challenges in maternal care under NHM -reflected in NFHS 4 and 5

Figure 5- Progress and challenges in Maternal Healthcare: NFHS 4 and 5



Tripathy N, Pathak PK Key-findings-from-NFHS-5-India-report India Report Observing the changes and understanding the challenges. Jpopul soc stud 2022:30:216-25 (31).

In this response, Ayurveda Yoga Unani Siddha Homeopathy (AYUSH) has been formally integrated in public health since 2014. Located in 13222 government facilities, AYUSH contributes to maternal and neonatal health complementing modern care (32).

Summary Table of key maternal health programs-Please find annexure-8.1.

Chapter 2-Problem statement, Justification, Objectives:

2.1) Problem Statement

Anemia is a complex global health condition that is most defined and assessed using Hemoglobin (Hb) concentration. During pregnancy, due to hemodilution, Hb concentration naturally declines during the first and second trimesters (33). However, anemia results from a range of underlying causes- Iron deficiency (34), infectious diseases, hereditary hemoglobinopathies (e.g., thalassemia) (35), and socioeconomic barriers disproportionately affecting pregnant women and children (35). In 2021, anemia affected 1·92 billion people globally (24·3%) causing 5·7% of all Disability adjusted life years (DALYs) globally, making it the third leading cause of disability. The highest prevalence was reported in western Sub-Saharan Africa 47·4%, and south Asia 43·0% in 2021 (36).

This significant burden of anemia intensifies during pregnancy, making anemia during pregnancy (ADP) a major global public health concern. According to WHO anemia accounts for a significant global burden of 16,800 to 28,000 deaths annually among women of reproductive age (37). Over 40% of expectant mothers were affected due to anemia in 2016 and 41.98% in 2018. Iron deficiency anemia (IDA) alone complicates 30 to 60% of pregnancies globally, with up to 75% of women affected by the third trimester (37). The 65th World Health Assembly target of 50% reduction in anemia among women of reproductive age by 2025 remains off track (38).

In Asia, anemia is the second leading cause of maternal mortality, with an overall prevalence of 52.5% (39). Within South Asia, India reports the highest prevalence of ADP at 52.2%, significantly exceeding the global average of 35.5% (WHO-2021) (40) and contributes to about 80% of maternal deaths due to anemia in the region (41).
The National Family Health Survey (NFHS)-3 reported over 50% prevalence, primarily concentrated in eastern and central India. The NFHS-4 showed a slight decline; however, the most recent data from NFHS-5 reveals a concerning resurgence (42); reflecting persistent regional disparities and limited program impact.
According to the NFHS-5 report (2019-2020), ADP affects 45.7% women in urban areas and 54.3% in rural areas. Among the states, Jharkhand reported the highest prevalence of 81.22% followed by West Bengal 76.14%, Ladakh71.4% and Meghalaya 70.32%. Kerala reported the lowest anemia prevalence at 32.30% (42).

The causes of anemia in pregnancy are multifactorial and shaped by geographic, ethnic, and socioeconomic determinants. Beyond nutrient deficiency, individuals in lower- income regions are severely affected due to infections, malnutrition, chronic inflammation, and hemoglobinopathies (43).
The etiology of anemia is complex in India with overlapping issues of gender discrimination, poverty, poor hygiene, inadequate access to health services, vegetarian diet, and environmental factors (44).
The persistent burden of anemia among Indian women reflects their poor health and socio-economic condition both within society and the household contributing to both maternal and child morbidity and mortality (42).
The NFHS data consistently show that the burden of anemia is not uniform, rather skewed towards socially disadvantaged groups of women. Different sociodemographic factors are responsible for predicting anemia levels, ranging from poor economic and educational status, rural residence to the limited exposure of mass media (42).

Anemia in pregnancy leads to severe consequences including maternal mortality and morbidity, low birth weight leading to increased infant mortality (45).

Anemia during pregnancy is a significant risk factor for maternal shock, ICU admission, increased risk of hypertension, compromised immunity and increased blood loss during childbirth and the postpartum period (38). Postpartum hemorrhage (PPH) is a leading cause of maternal mortality. The weakened uterine muscles due to anemia reduce uterine contractions during labor, leading to prolonged labor and impaired ability to control bleeding post-delivery (46).

Fetal and neonatal risks of ADP include prematurity, low birth weight, poor Apgar score, neonatal distress requiring prolonged resuscitation and neonatal anemia. Affected infants have a higher rate of failure to thrive, poorer intellectual developmental milestones, and higher rates of morbidities and neonatal mortality. Moreover, children born to mothers with anemia suffer higher rates of cardiovascular morbidities and mortality in their adult lives (47).

Beyond health, Anemia poses substantial economic burden. Globally anemia costs US$161 billion per year for children, and US$113 billion per year for adolescent girls and women (48). Iron-deficiency anemia (IDA) reduces the work capacity of populations, bringing serious economic obstacles to national development and costing developing countries up to a 4.05% loss in gross domestic product (GDP) per year (49). In India economic loss is estimated to 1.2% of GDP amounting approximately $4.2 billion (about $13 per person in the US) (about $13 per person in the US) annually (50).

Recognizing anemia during pregnancy as a significant public health concern the Ministry of Health and Family Welfare (MoHFW) has launched several health programs such as the National Nutritional Anemia Prophylaxis Program (NNAPP), Intensified National Iron Plus Initiative(I-NIPI),and Janani-Shishu Suraksha Karyakram (JSSK) to strengthen the service delivery to antenatal women with anemia in India (51). NNAPP focused on providing iron and folic acid (IFA) tablets (52). I-NIPI adopts a more comprehensive approach including the identification of anemic mothers and provision of iron supplementation. The JSSK initiative was introduced to provide high-quality antenatal and postnatal healthcare services free of cost (51).

Still, anemia prevalence continues to be high, with adherence and coverage remaining significant challenges in national programs. Poor compliance with supplementation, inadequate follow-up during pregnancy, and healthcare system inefficiencies further impede their effectiveness (53).

While numerous studies have documented clinical and epidemiological aspects of anemia during pregnancy in India; the government interventions have primarily focused on antenatal care and iron supplementation. Despite these extensive programmatic efforts, there is limited understanding of how individual, family, culture, gender, caste/religion, community, and system level factors interact to influence anemia. Existing evidence rarely integrates this multi-level factors influence, resulting in a knowledge gap that hinders the development of context sensitive interventions.
This study addresses the gap, aiming to inform responsive interventions for complex realities faced by pregnant women in India.

2.2) Justification:

Anaemia during pregnancy (ADP) poses serious public health threat in India, accounting directly for 20 percent of maternal deaths and indirectly for another 20 per cent (54). Evidence indicates that a substantial proportion of maternal deaths occur due to antepartum and post-partum haemorrhages, pregnancy induced hypertension, and sepsis associated with ADP (38).

The impact of ADP extends beyond maternal outcomes significantly affecting neonatal health. Apart from low birth weight and intrauterine growth retardations, infants born to mothers with anemia face a higher risk of developing anemia themselves, perpetuating an intergenerational cycle of iron deficiency and related health challenges (55). Furthermore, these infants show increased susceptibility to chronic diseases including obesity, insulin resistance, and cardiovascular diseases later in life (56) contributing to overall poor population health outcomes (57).

These profound health impacts also translate into a considerable socio-economic burden. Maternal anemia affects educational outcomes, increases healthcare costs, and reinforces a cycle of poverty and malnutrition across generations (58). Therefore, addressing maternal anemia is not just medical imperative, but crucial to improving maternal health, enhance productivity and economic outcomes for families and communities; thereby breaking the intergenerational cycle and improving the well-being of future generations.

Neglecting broader socioecological factors will inevitably lead to the continued persistence of anemia in pregnancy which has far-reaching consequences on maternal and child survival, and overall public health. Consequently, efforts to tackle ADP require a multipronged approach that includes nutrition interventions, strengthened healthcare services, and targeted community-based education.

By applying a socioecological lens, this study will create a deeper understanding of complexity of socioecological factors. This approach aims to generate actionable insights for holistic, equitable, and effective policy responses to reduce burden of anemia during pregnancy in India.

2.3) Objectives:

2.3.1) Overall Objective:

To explore socioecological factors contributing to anemia during pregnancy in India, generating evidence-based recommendations to strengthen existing maternal health programs with a focus on decreasing maternal mortality and minimizing neonatal complications.

2.3.2) Specific Objectives:

1)To examine the individual-level factors influencing anemia prevalence among pregnant women in India.

2)To analyze interpersonal influences, such as family dynamics, cultural practices, and gender roles, which affect health behaviors and care seeking during pregnancy.

3)To investigate community-level factors, including access to healthcare services, disparities between rural and urban areas, and the role of community health workers in anemia prevention.

4)To review current programs and recommend multi-level strategies to strengthen their effectiveness at reducing anemia during pregnancy.

Chapter 3-Methods:

3.1) Literature review strategy and database search

The literature review of this study was conducted through various reputable databases and search engines including Google Scholar, PubMed, Lancet, BMC, and VU for their extensive collection of biomedical research, and broader public health perspectives.

Alongside the peer reviewed literature, grey literature research was conducted through the national journals and reports for broader understanding. Key national government websites such as Ministry of Health and Family Welfare (MoHFW), National Family Health Survey (NFHS) and international institute websites World Health Organization (WHO), UNICEF were utilized to access most relevant information and data.

Artificial intelligence (AI) tools such as Perplexity and ChatGPT were used, within the permitted academic integrity limits as exploration aids for brainstorming and summarizing lengthy policy documents.
Additionally, online dictionaries like Thesaurus.com, Google Translator, online grammar/spelling tools including Microsoft word editor were used for language refinement and clarity.
Moreover, professional background as involved in maternal health care in rural India provided contextual depth and practical understanding of the infrastructure limitations, unclear role understanding of health workers and gender and caste-based discrimination.

3.2) Literature review steps

A literature review was executed in the following structured stages.

1)Studies reporting the incidence and prevalence of anemia during pregnancy both globally and nationally were reviewed. This helped to establish the magnitude of the problem and set ground to explore multilevel factors influencing the problem.

2)Studies were reviewed to identify influencing factors at diverse levels, and barriers to prevention measures across the socioecological framework.

3)Major national programs including NNAPP, WIFS, Anemia Mukt Bharat (AMB) were reviewed, paying attention to their objectives, coverage, and implementation challenges. The review focused on the literature that evaluated evidence-based strategies to address socioeconomic factors of maternal health. Emphasis was given to successful initiatives led by Non-Government Organizations (NGOs) such as RANI, SNEHA, SAHAJ which created impact through community engaged models. This step provides insights into community-based approaches-behavior change strategies, participatory learning, and the need of intersectoral cooperation.
The literature gaps and implementation challenges of various public programs such as- lack of culturally sensitive design, underexplored organizations, caste and social biases, gender norms were identified. These gaps helped to develop context specific multifactorial recommendations.

3.3) Search Terms and Keywords

A combination of Mesh terms and Boolean operators was employed to refine the search strategy. The review was guided through key terms anemia OR anemia AND pregnancy OR pregnant women AND India AND (prevalence OR incidence OR risk factors OR iron supplementation OR barriers OR health programs OR antenatal care OR Anemia Mukt Bharat.). Various socioeconomic, demographic, and cultural aspects were taken into consideration applying Education AND ANC AND India, Maternal age AND ANC AND India, socioeconomic status AND ANC AND India, food taboos AND ANC AND India, health system Factors AND ANC AND India, Health seeking behavior, ANC, AND India, Place of residence, ANC, AND India. Snowball technique was applied to include relevant articles using the reference list of the key article.

A complete search terms keywords table can be found in Annex 8.4.

3.4) Inclusion and Exclusion Criteria

The search was limited to include the studies between 2010 to 2025, to capture recent advancements in the field. However, a small number of earlier studies were included due to their relevance to specific key influencing factors.

The review encompassed qualitative, quantitative, mixed method studies, systematic reviews, peer reviewed journals articles, national surveys, government documents, and policy papers.

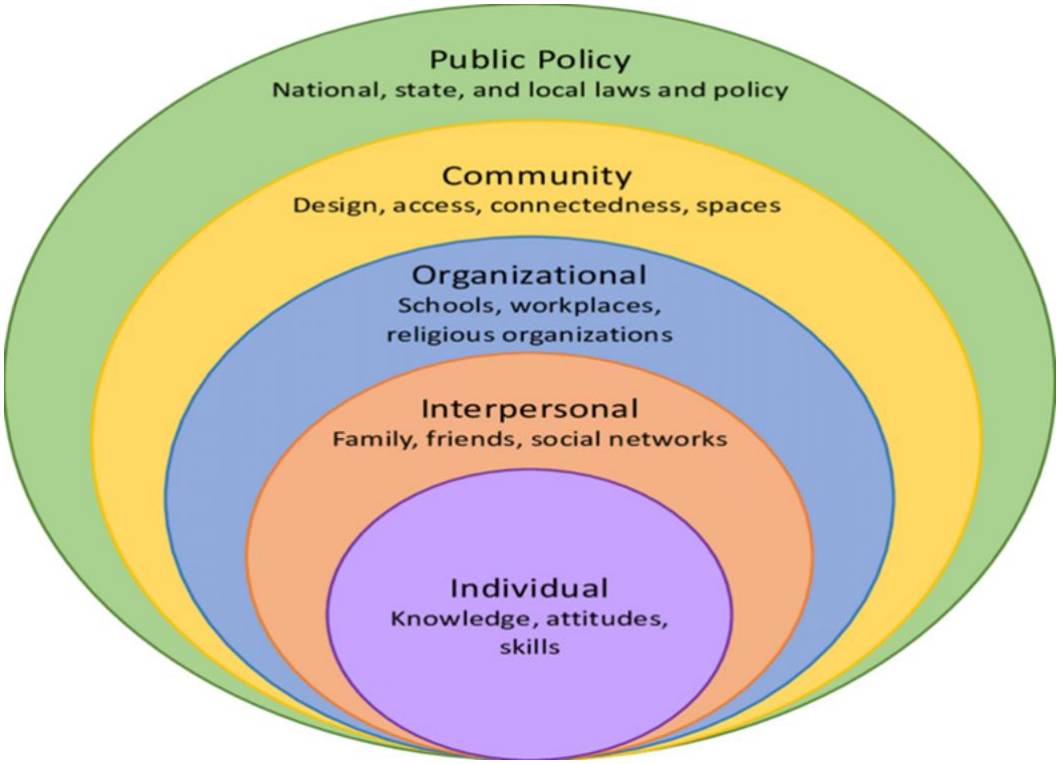
The search was limited to English-language articles. English is the primary language in academic publications, ensuring access to a wide range of peer reviewed studies. Studies from South Asian countries were referred and included due to socioeconomic relevance's in country contexts.

The review excludes the studies published in non-English languages, studies with no full text access and population other than pregnant women.

3.5) Analytical Framework

Socioecological Framework

Figure 6-Conceptual Framework of Factors influencing Anemia during Pregnancy in India



Socioecological Model. Adapted from Fry et al based on the US Department of Health and Human services (59).

Beyond biological and nutritional aspects, anemia during pregnancy (ADP) in India is driven by broader social determinants such as poverty, gender inequality, healthcare access, and cultural practices. The socio-ecological framework provides a comprehensive approach that considers individual, interpersonal, community, institutional, and societal factors contributing to the burden of ADP.

At the individual level, inadequate diet, genetic predispositions, and poor health literacy are key contributors. Interpersonal level is strongly associated with family dynamics and patriarchal norms affecting women's autonomy. Prevailing cultural practices such as food taboos, caste/religion norms and traditional beliefs significantly restrict access to diverse, nutrients rich diets. Community influences involve the availability of healthcare services, healthcare infrastructure quality and the role of community health workers. Lack of coordination at organizational levels such as local governances and school undermines early prevention strategies. At the national level, anemia control programs directly impact prevention and management. Societal factors like socio-economic disparities and entrenched gender norms shape the broader environment in which anemia occurs (60).

The diverse sociocultural landscape of India and complexity of maternal health demand nuanced analytical approach. Hence, traditional socioecological framework has been adapted to better explore a broad range of influencing factors.

1)Cultural food taboos, caste/religion specific diet practices and traditional beliefs of tribal communities directly influence nutrition and IFA uptake, contributing to anemia prevalence.

Given the significant impact of culture on ADP, it is essential to integrate cultural aspects into socioecological framework to ensure a comprehensive understanding of the issue.

2)While adapting the framework for this study, the component of organizational level- religious organizations has been excluded, due to its limited direct relevance to the topic.

3)The outer layer of the original framework at societal policy level has been reframed to "Multilevel interventions for improving maternal health with a focus on Anemia During Pregnancy in India." This alteration allows the study focusing on strategies and implementation of government programs which directly influence ADP in India. Moreover, it enables to extract lessons from successful drives in maternal health for adaptation in Indian context.

Ethical clearance was not required, as the study constituted a literature review. Attention has been given to acknowledge the underrepresentation of tribal, urban slums, and low caste populations. These marginalized groups have been brought to the discussion, and recommendations have been proposed to address these issues.

Chapter 4- Socioecological influencing factors

Having outlined the methodological approach in preceding chapter, this section presents the study's findings. Guided by socioecological framework, the analysis examines factors influencing anemia during pregnancy (ADP) across various levels.

4.1) Individual Level Factors:

Anemia during pregnancy is strongly associated with the factors at individual level, including nutritional deficiencies and low nutritional intake, preexisting conditions, and knowledge attitude practices of women towards health and nutrition.

4.1.1) Nutritional Deficiency

Micronutrients encompass vitamins and minerals which are essential for normal human development and functioning and are needed in minute quantities (61).

Although human adults require only about 1 mg of absorbable iron per day, the problem of iron deficiency anemia is widespread, especially among women of reproductive age (62).

A cross-sectional survey from south India found that along with Iron and vit B 12, Folic acid deficiency in pregnancy contributes to maternal anemia and addition of folic acid supplements to iron not only reduces anemia but is also associated with increase in birth weight by 200 g on average in pregnant Indian women (62).

Low consumption of green leafy vegetables, pulses and legumes, and dietary insufficiencies serve as major contributor to anemia in India, especially in rural and deserted areas. The National Nutrition Monitoring Bureau (NNMB) and NFHS reveal high dependence on cereals and millets, while the consumption of green vegetables, eggs, meat, milk, and milk products dropped by 6 to 16% between 2006 to 2016 (63).

A proportional odds model study, India found that women with low body mass index (BMI) are prone to anemia during pregnancy indicating dietary low iron consumption and absorption. It also suggests a sustained pattern of undernutrition in early childhood and implying both inadequate caloric intake and overall inadequate diet (60).

4.1.2) Preexisting conditions

Besides nutrition deficiencies, genetic predispositions exacerbate anemia risk. A hospital-based study in Eastern India investigated that Thalassemia trait mothers are at risk of development of anemia during pregnancy. The findings in the study revealed a significant higher prevalence of anemia among women carrying thalassemia trait as compared to non-carriers suggesting ineffective erythropoiesis, hemolysis, resulting in anemia. The study concludes that- In addition to nutritional anemia, thalassemia poses a major health challenge for pregnant women. The problem is compounded by the lack of any national screening program and lack of awareness in carrier women (64).

4.1.3) Knowledge Attitude Practices (KAP)

Adequate knowledge regarding nutrition and dietary intake during pregnancy is essential to improve maternal and child health outcomes. Evidence suggests that nutrition education provided during pregnancy notably influences the understanding and dietary behaviors of expectant mothers (65). However, significant Knowledge, Attitude, Practices (KAP) gaps persist across various regions of India.

A cross-sectional study regarding KAP in India revealed, while women recognize anemia as health concern, knowledge regarding causes, symptoms and prevention strategies remains limited; especially the knowledge concerning iron enhancers (e.g., citrus fruits) and inhibitors (e.g., tea, coffee) (66).

The NFHS 3 survey indicated that despite adequate IFA coverage, only 23% reported having consumed IFA for at least 90 days during their pregnancy. This poor compliance is majorly attributed to inadequate knowledge regarding anemia, iron rich food, and the role of iron supplements (67).

Further supporting this, a study from Gujarat reported overall KAP score regarding anemia and its prevention at only 49.1%, influenced by age, level of education and socioeconomic status (68). Although higher age (31-40 years) and higher levels of education (graduates) improve awareness, perceptions about anemia's causes, symptoms, and consequences persist, affecting behavior. (Perceptions such as anemia and symptoms like weakness, paleness is normal during pregnancy) (69).

Negative attitudes such as reluctance towards antenatal visits, underestimating healthy diet and IFA intake profoundly impact compliance (67).

Thus, knowledge gaps and negative attitudes along with financial constraints to buy iron rich nutritious food collectively contribute to inadequate practices. Furthermore, communities' concerns discourage IFA tablet consumption. Concerns as IFA consumption causes big baby leading to difficult labor and cesarean (53) or results in baby’s dark skin (70).

While some women express the preference for eating iron rich food, adherence to iron tablets is alarmingly low, because of reluctance coming from smell and taste, abdominal pain, nausea, vomiting (66).

4.2) Interpersonal Level Family and Household Factors:

Individual level factors provide critical insights into personal health status and behavior. In Indian context early marriage, family dynamics and gender norms are equally important in understanding risks and outcomes of ADP.

4.2.1) Early marriage and early childbearing

A narrative study from African continent highlights that early/forced marriage significantly contributes to anemia during pregnancy. During adolescence, spurt growth and onset of menstruation results in elevated demand for iron. As pregnancy occurs at this stage of life, the demand is exaggerated, making it difficult to meet iron demands resulting in anemia. In African context early marriages are associated with gender inequality, unexpected pregnancy, broken homes, poverty, ignorance, and customs/traditions (71).

India has a long history of early marriage, rooted in a complicated web of cultural practices, social norms, economic considerations, and deeply ingrained prejudices (72). The persistence of this issue varies across different states in terms of population, geography, economy, religion, and culture. Although the prevalence of child marriage has declined for the nation (26.8% of NFHS 4 (2015–2016), localized norms contribute to the continuation of the practice in certain communities and states like Bihar, Andhra Pradesh (72).

The ramifications of early marriage and early childbearing are severe, where adolescents from impoverished households face pregnancy with preexisting anemia, undernourishment, and poor access to health care. These vulnerabilities are further compounded by family structures (73).

4.2.2) Intrahousehold dynamics and Family Support

In Indias patriarchal society women are socialized to prioritize male family members, serving food to their husbands and male children first, leaving themselves nutrition deficient (74). This reflects gendered power imbalance where females face significant social discrimination resulting in limited control over intra-household decisions, nutrition, and health (74).

In a considerable number of South Indian households, husband and mother-in-law take decisions of food purchase and consumption, suggesting that they are important stakeholders in shaping pregnancy-related nutrition (74).

A qualitative study in India revealed while husbands show more support, mother-in-law discourages supplement use as they do not perceive it as a priority and fear big baby (53).

Another study from Uttar Pradesh further highlights that family members lack awareness of the importance of early and frequent ANC visits, and health visits are delayed until serious health issues. High household work burden and lack of familial support impede access to ANC checkups.

Despite the availability of IFA supplementations in govt program, adherence and consistency are interrupted due to conflicting information and a lack of shared responsibility from family members (75).

Family decision patterns further reflect and reinforce broader gender norms, shaping women's agency and health.

4.2.3) Gender Dynamics

Across multiple regions of India, gender inequalities negatively affect women through male-dominated decision making, economic and educational disparities, violent relationships, and the socialization of women to prioritize others at the expense of their own health. While fulfilling others' expectations and serving families, they ignore signs of anemia like fatigue (76). The double burden of generating income, and unpaid responsibilities within the household restrict their ability to visit the ANC and obtain iron supplements.

A qualitative study from villages in Odisha examining how gender norms affect anemia revealed, while men spend their incomes on non-essential things like alcohol, women lack ability to purchase diverse and iron rich food (76).

Cultural restrictions on mobility limit women's ability to seek care in need (77). A qualitative study from Mohali, Punjab showed sociocultural beliefs and norms along with digital restriction compromise women's access to accurate health information. This cultural limitation reduces support through mhealth platform, hindering ANC services and IFA supplementation (77).

4.3) Cultural Practices:

Moving from interpersonal sphere, cultural norms significantly shape dietary habits, healthcare-seeking behaviors, and acceptance of medical interventions (78). Practices like food taboos, caste and religion based dietary habits, traditional tribal beliefs critically influence anemia in pregnant women.

4.3.1) Cultural food taboos

In several Indian communities and cultural traditions, foods are labelled as Hot and cold foods, based on traditional perceptions, rather than temperature and nutritional values. Meat, eggs, jaggery, dates, papaya are categorized as hot foods and restricted during pregnancy because traditionally they are believed to cause miscarriages (79).

One of the cultural practices is deliberately reducing food consumption or “eating down” during pregnancy due to fear of excessive weight gain and difficult labor (77). Thus, dietary restrictions contribute to protein and iron deficiency.

A Qualitative Study of rural pregnant women of Bangladesh revealed that food taboos were driven by fear of harming the baby, preference for vaginal delivery, and blind adherence to elders' advice. Various food items from animal sources, fruits, vegetables were being avoided due to traditional belief of convulsions, fetal malformation, and miscarriage (80).

During routine antenatal care, a notable instance of dietary restriction was observed. Upon enquiry it became evident that mother-in-law was restricting a pregnant woman from consuming sufficient food, because she believed starving or empty stomach in the first trimester would result in the birth of a baby boy. This experience illustrates how intergenerational beliefs intersect family dynamics and gender discrimination to negatively impact maternal nutrition.

4.3.2) Religion, Caste, and Dietary patterns

Vegetarianism (exclusive consumption of plant-based diets) is a common dietary pattern in India, influenced by ethical teachings of Ahimsa (nonviolence) inherent in Hinduism, and Jainism. Vegetarianism has important implications for maternal iron-deficiency in India, in terms of the availability and chemical form of iron in plant-based foods (81).
A cross-sectional analytical study in India found that, Indian women consuming veg diet had significant iron deficiency; despite an adequate intake of iron (82).

This dietary pattern along with cultural food taboos contribute to higher prevalence among Hindu women compared to Muslim and Christians (83). Muslims and Christians consume more diverse diets including meat, which provide better iron intake reducing anemia risk (60).

A cross-sectional analysis in India found that caste plays a significant role in dietary patterns, particularly fruit and vegetable consumption. Fifty grams/person/day consumption gap exists

between upper and lower castes, reflecting disparities in socio-economic conditions, education levels, and place of residence (84).

4.3.3) Tribal communities

Beyond geographical and infrastructural limitations, tribal communities face challenges of language and cultural beliefs. Traditional healing practices are deeply rooted in the culture of Indigenous communities and failing to acknowledge and integrate them leads to distrust and reluctance among tribal populations seeking healthcare from modern facilities (85).

Adherence to traditional healthcare practices creates obstacles in obtaining optimum maternal and child healthcare services. This is reflected in research that found that only 10% of tribal women fully utilized necessary ANC services (86).

Traditional practices encouraging early marriage and pregnancy in adolescence place girls at risk for adverse pregnancy outcomes. Cultural dietary restrictions during pregnancy further limit their intake, barring certain vegetables, fruits, and meat (87).

A review of published literature from Maharashtra indicated that tribal communities fear inappropriate advice from health workers. Traditional belief that IFA tablets contain heat and causes abortions, discourages IFA use (88).

As healthcare workers do not belong to tribal communities, disconnect of ethnicity, language and social status contributes to disrespectful, rude, and unwelcoming behavior with tribal women. Poor communication, cultural insensitivity, and perceived discrimination demotivate tribal women from seeking public health services (87).

4.4) Organizational Level:

While cultural level provides context in which health behavior occurs, organizational level plays a critical role in enabling or restricting access to preventive care. Evidence shows critical gaps in implementation of village health sanitation and nutrition committee (VHSNCs) and school based adolescent education, limiting access to nutrition and IFA awareness, thereby affecting reproductive health in long term.

4.4.1) Village Health Sanitation and Nutrition committee (VHSNCs)

On VHSNC day representatives from different departments including Health and Family Welfare, Women and Child Development, Social Welfare, Panchayati Raj Department, Rural Development, Water and Sanitation Missions, and community-level stakeholders are supposed to coordinate (89). However, evaluation of VHSNCs across various regions of India revealed these critical implementation gaps- irregular meetings, lack of training of the VHNSC members, their limited understanding of roles and responsibilities, restrictions on planning and fund utilization, and weak linkages with the broader health system (90).

Additionally, health system functionaries perceive no need to involve the community in health planning, and stakeholders lack motivation and ownership (91). There is inadequate representation by members of education, self-help groups (SHG) and NGOs (92).
Committee composition leans disproportionately towards upper caste, failing to reflect majority population's needs (93).
These barriers hamper VHSNCs ability to promote ANC service, IFA, and nutrition uptake.

Despite the multi sectoral design, and strong policy vision, VHSNCs fail to address anemia and thereby improve maternal health outcomes, along with the intersection of caste hierarchies and socioeconomic disparities.

4.4.2) Schools

Despite progress in reducing gender discrimination in education, sociocultural factors such as early marriage, household responsibilities, economic constraints, and infrastructure challenges in schools continue to hinder meaningful gender equity in education (94).

During the transition, adolescents, particularly girls, remain vulnerable to a range of health issues, such as early and unwanted pregnancy, unprotected sex leading to sexually transmitted infections, malnutrition with anemia (95). Limited awareness of menstruation and schools lacking proper toilet facilities lead to poor hygiene practices and school dropouts (96).

Even with a design specifically for adolescents, Rashtriya Kishor Swasthya Karyakram (RKSK) program (97), fails to reach its beneficiaries due to non-availability and lack of awareness. Existing cultural and traditional norms in society hinder sexual and reproductive health (SRH) education in school, with significant resistance from parents, teachers, politicians, and it is banned in several states of India (96).

Multiple NGOs including Hindustan Latex Family Planning Promotion Trust (HLFPPT) working in the field suffer from lack of co-ordination, quality implementation, and effective linkages with the state governments (98).

As a result, a substantial proportion of adolescents rely more on the Internet, pornographic materials, and peer conversations for SRH information leading to harmful practices (95).

Thus, organizational gaps endanger adolescent well-being and have far reaching consequences for reproductive and maternal health outcomes.

4.5) Community Level Access to Healthcare Services:

Beyond individual, family, and cultural factors, ADP is directly influenced by broader community level factors. Structural disparities, infrastructure and workforce limitations, availability and accessibility of supplements affect the continuity of maternal care at community level.

4.5.1) Rural Urban Disparity

A Pooled Study of the Demographic and Health Surveys of 37 Middle-Income Countries revealed the disparities between rural and urban areas in maternal health service (MHS) utilization, with only 26.7 % of rural women utilizing MHS compared to 50.7 % of urban women (99). Similarly, in 27 Sub-Saharan African countries, antenatal care utilization is greater in urban areas with 34.7 % against 22.4 % in rural areas with household wealth index, media exposure education and childbirth order being key contributing factors (100).

In India maternal health service utilization unveils a notable rural urban disparity with rural utilization rate of only 43.5 %, compared to 53.9 % of urban areas. The full utilization of continuum of maternal health care remains considerably low in rural areas, marked by pronounced geographical disparities at both state and district levels (101).

Rural mothers face unique challenges, including limited accessibility, affordability issues, inadequate healthcare infrastructure, and rising poverty, all of which hinder them from fully utilizing essential services such as ANC routine checkup and IFA supplementation (101).

While rural urban disparities in service utilization have been well documented, evidence also suggests the inequalities within urban areas, particularly urban slums. Over 80 % women in urban slums from developing countries including India lack durable and secure housing, essential services of clean water and sanitation. Urban poverty, characterized by informal settlements, unequal rights, mobility, and connectivity reduces their ability to access sexual and reproductive healthcare (102).

Forced eviction and relocation from land and home disproportionately affect women. For instance, a case study of resettlement colonies in Delhi, India showed that relocation intensifies women's vulnerabilities and insecurities affecting their access to livelihood, social support, and healthcare (103).

A Cross-sectional study conducted in slums of an industrialized city in western India revealed only 51 % of women completed recommended 4 ANC visits. 40 % women lack access to IFA and nutrition supplements due to contributing factors like illiteracy, unemployment, lack of access to transport and health centers, inadequate follow up by community health workers (104).

4.5.2) Health System and infrastructure challenges

Despite progress in reducing maternal mortality globally, significant challenges of maternal health equity persist, especially in low- and middle-income countries (105). The COVID-19 pandemic prompted a substantial reallocation of health funding away from established priorities like maternal and child health, threatening to reverse decades of progress in maternal health. Geopolitical tensions and societal divisions, emerging threats strain already fragile health systems (105).

A qualitative study of health workers perspective in Indonesia revealed obstacles in preventing anemia during pregnancy. These include- inadequate facilities and infrastructure, lack of complete clinical guidelines to manage anemia in pregnancy, high workload, lack of training opportunities, and learning resources for the health care providers (106).

Persistent maternal deaths and maternal health inequities in India show not only the Indian government’s unfulfilled commitment to respect, protect, and fulfill women’s maternal survival rights but also a lack of accountability of the health system (107).

Though the NHM has been successful in increasing institutional deliveries through a cash-based incentive program—the Janani Suraksha Yojana (JSY); A scoping review of qualitative and mixed-methods studies from public health sector in India showed that JSY has not been able to effectively reduce the MMR. The exclusive focus on institutional deliveries hides the need for continuity of care. This review stated that majority women did not receive any antenatal care (ANC), and for those who did, it was limited to providing iron and folic acid tablets, without follow up and comprehensive ANC care (107).

It has been extensively reported that inadequate quality or lack of health care is a result of lack of political commitment. This gap often reflects in limited infrastructure, shortage of equipment and supplies, and inadequate and incompetent human resources (107).

Marginalized women lack any voice in policies due to limited capacities and access to resources, resulting in the skewed distribution of health services. For example, pregnant women below 19 years of age, women with more than two children, migrants, and married women who are not residing in their husband's home are not eligible for JSY benefits, or maternal entitlements (107).

Even with the emphasis to create infrastructure, the Indian public-health system continues to face basic problems. Over half of the SCs and 30% of the PHCs do not have their own buildings. More than half of the CHCs, FRUs, and district hospitals do not have residential quarters for staff, contributing to the shortage of skilled staff (108).

Over 70% of the FRUs and CHCs do not have linkages with a district blood bank.
Though blood is provided free of cost; major barrier for poor women is processing charges (about US$ 10-15 per unit). Most rural banks suffer from minimal infrastructure, inadequate licensing, and irregular blood supply (108). Although not a direct influencing factor for anemia, these inefficiencies hinder timely management, thereby contributing to complications and maternal mortality.

Direct engagement with peripheral health system revealed a number of critical operational difficulties. Notably, a persistent lack of vehicles hindered health workers' ability to reach subcenters and provide ANC services and simultaneously created a barrier for beneficiaries in accessing services. Furthermore, shortages of essential supplies e.g., hemoglobin meters and strips compromised screening capabilities at subcenters.

4.5.3) Supply demand barrier to IFA

Formative research conducted with mixed qualitative and quantitative methods in selected Asian and African countries identified key supply demand barriers in IFA supplementation. These are- the inconsistent prescription practices of health care providers, stockouts at health facilities, inadequate tools, and skills in counselling to support and monitor adherence.
Facility-based ANC was the primary delivery platform for IFA supplementation in all the countries, however hampered by inadequate community-based distribution, low quality services, and limited provider capacity (109).
On demand side delayed initiation, side effects, forgetfulness, and low prioritization were the identified barriers (109).

ANC-based IFA distribution programs in India have low coverage rates, with insufficient IFA tablets as the major supply barrier. The supply-demand side gap in communication affects women's understanding of the significance of Fe-deficiency anemia, and the need to seek ANC visits. Concerns about IFA tablet characteristics (e.g., taste, appearance, or packaging); and about actual or possible side-effects (nausea, constipation, black stools) reduce their willingness to lead to inadequate compliance and adherence (110).

4.5.4) Health Workers

A review-based policy report in low- and middle-income countries (LMICs) revealed these health worker barriers- Limited leadership and capacity of existing human resources to champion anemia prevention and control, poor awareness of the need for anemia prevention and control, technical and operational knowledge gaps to guide more effective implementation (111).

A study in Jharkhand, India revealed auxiliary nurses' midwife (ANM's) gap in knowledge and practices regarding anemia: only half can identify a case of severe anemia, 81% of ANMs lack knowledge of recommended IFA dose which impacts their counselling capacity to encourage women to consume IFA. 41% are unaware of correct and timely referrals. Moreover, they are not fully aware of the balanced diet required to prevent anemia (112).

Another survey indicated that while accredited social health activists (ASHAs) exhibit above-average awareness of anemia, gaps exist in referral management and critical care practices, where only 29% are aware of severely anemic patients to be immediately referred and just 5% are aware of blood transfusion. Healthcare workers (54%) receive in-service training in contrast to going through a pre-service training program exhibiting foundational clinical knowledge gaps (113).

Health system unaccountability affects health worker performance. A scoping review of literature from India reported these issues: failure to perform designated duties, negligence in providing health care, inappropriate and irrational referrals, and inadequate interpersonal communication. Additionally, behaving in a demeaning fashion towards patients, corruption and demanding informal payments deter women seeking maternal care (107).

Public health nurses are overwhelmed due to administrative duties such as managing funds, attending meetings, and maintaining records. Further frequent transfers, postings, and poor working conditions divert them from routine anemia screening prevention and IFA supplementations (114).

Despite policy reforms, ASHAs continue to face deep rooted gender inequalities-remain unpaid unrecognized, without legal protection, affecting their ability to deliver public health services effectively (115).

During the field work, it became evident through direct observation and informal interaction with health workers, that they were overburdened due to multiple public health programs, irregular payment and lack of recognition and support from senior officials; all this contributed to the lack of motivation. Parallelly, discriminatory attitudes of health workers based on caste, religion, socioeconomic status compromise equity of services.

Thus, structural barriers intensify by intersection of gendered roles, social hierarchies and caste discrimination, reducing health workers' ability to provide equitable maternal health services.

4.6) Multilevel interventions for improving maternal health with a focus on Anemia During Pregnancy in India:

Following the preceding analysis of community level barriers, this section examines multilevel interventions designed to improve maternal health outcomes with a specific focus on anemia. Insights are drawn from national program evaluations, community-based strategy models from LMICs, including India, and NGO-Government partnership. This approach addresses key determinants of maternal nutrition and anemia. The synthesized evidence informs context specific anemia control strategies and offers insights for integrated maternal health programs.

4.6.1) Structural gaps in National Anemia Control Programs

Anemia control programs in India exhibit diverse structures, objectives, target groups, and coverage. Despite the variations, common implementation challenges persist, including inadequate supply chain management, inferior quality IFA, insufficient counselling and follow-up, limited training of community health workers, lack of community engagement and misinformation regarding side effects. These issues compounded with a weak monitoring system, lack of intradepartmental coordination and low priority of anemia interventions reduce the effectiveness of programs (116), (117), (118), (119).
These systemic gaps indicate that government led efforts alone often face limitations in delivering comprehensive, context specific and sustained interventions.

Summary Table of Key National Programs addressing Anemia in India-Please find Annexure 8.2

4.6.2) Community Driven and Participatory Strategies for Maternal Health

Evidence from LMICs, including India, demonstrates that community-driven strategies effectively influence awareness, health behaviors, and social norms, thereby contributing to increased service uptake and improved maternal health outcomes. These strategies, based upon Health Belief Model, Community Dialogues, and Community Participation including male engagement address trust issues, structural gaps and create sustainable impact.

1)Health Belief Model (HBM)-

The Health Belief Model (HBM) illustrates how personal beliefs shape health behavior and helps identify reasons for non-compliance with preventive measures (120).
Quantitative research from Indonesia identified HBM components influencing anemia prevention in pregnant women: perceived susceptibility (belief in one's personal risk of developing anemia), perceived severity (belief about seriousness of consequences to maternal and child health), perceived benefits (belief that preventive measures IFA and diet will reduce the risk), perceived barrier (lack of support) and self-efficacy (confidence in one's ability to engage in preventive measures). Among these, perceived susceptibility, severity, benefits, and self-efficacy were positively associated with women's ability to prevent anemia (121).

A quasi-experimental study in Cairo, Egypt evaluated impact of health promotion directive based on HBM on pregnant women diagnosed with iron deficiency anemia (IDA). The intervention consisted of education sessions conducted by experienced researchers, targeting IDA risk and severity, benefits of prevention, strategies to overcome barriers and self-efficacy to perform anemia prevention. After three months all HBM constructs exhibited significant improvements- dietary behavior, cooking practices, compliance with IFA supplementation, mean Hb levels. This demonstrates that theory driven education can effectively improve pregnant women's nutritional behaviors for anemia prevention (120).

An observational study in Bangladesh applied both Andersen’s behavior model and HBM to analyze maternal healthcare utilization. The findings showed that women with greater knowledge and awareness of pregnancy complications (predisposing factor) and free ANC and PNC services (enabling factor) more significantly used the maternal services (122). This highlights the combined importance of personal beliefs and structural access.

While majority interventions primarily focus on improving knowledge, giving less attention to other behavior drivers such as self-efficacy which is a key linking principle between knowledge and transformation into action (123). A controlled intervention study from Iran showed that combining self-efficacy with strengthened social support significantly improved ANC behavior including timely ANC visits, adherence to IFA and recommended dietary practices (124).

Collectively these findings indicate that HBM interventions are most effective when they extend beyond providing knowledge to women and include their confidence building, family support and addressing barriers in services. Operationalizing HBM components integrating knowledge delivery with strengthened self-efficacy and addressing perceived barriers can be an effective approach in Indian context.

While HBM focuses on individual perception and self-efficacy as drivers of behavior, community dialogues (CDs) offer complementary approach by creating safe, participatory space for shared discussions.

2)Community dialogue (CD)-

A qualitative study across three LMICs (Zambia, Mozambique, Uganda) demonstrated that CDs contributed to building trust in community in the work of CHWs, increased awareness, and positively influenced health seeking behavior. These behaviors included-seeking timely care in case of child sickness, care seeking from trusted health providers, reduced reliance on harmful traditional practices, and greater acceptance of preventive measures (125).

A realistic review examining community engagement strategies for maternal and newborn care in LMICs found that CDs were most effective when community members including men, women, local leaders, and health workers were actively involved in design of programs. Success of improved maternal and neonatal health was attributed to trusted communication, culturally acceptable message, and prioritized community needs (126).

This finding is further supported by a study in Democratic Republic of Congo. This research used dialogue model to bring together beneficiaries including men, women, community health workers (CHWs), representatives of the health sector and local authorities in an advisory process to identify barriers and codesign feasible solutions for maternal health, simultaneously addressing accountability gaps-voice, answerability, and enforceability (127).

These findings suggest that CDs are beyond mere informing communities; they actively shape relationships between health care providers and community members, and enable them to tackle misinformation, cultural resistances, and power imbalances. In Indian context CDs offer powerful approach to build trust, mutual respect and shared understanding of barriers and solutions to nutrition and IFA uptake.

While community dialogues enable shared understanding of problems, community participation goes further by involving community members in collective ownership and action.

3)Community Participation (CP)-

Participatory action research (PAR) in Nigeria involving community members, health workers and local leaders demonstrated that community participation facilitated solutions to immunization barriers and built trust. This led to increased community ownership, contributing to significant rise in immunization coverage from 60 % to 90% (128). This highlights the effectiveness of collaboratively developed strategies that can be locally owned and improve service utilization.

A randomized controlled trial from South Asian countries demonstrated that male involvement, particularly by husbands, increased support for ANC attendance. Community meetings and education further enhanced their awareness and participation (129).

Supporting this a systematic review showed that community capacity building through the involvement of pregnant women and their partners in localized health discussions improved maternal health knowledge and service utilization, improving maternal, neonatal, and perinatal health outcomes (130).

These findings highlight that CP has potential to transform communities from passive beneficiaries to active participants in health initiatives. In the Indian context, engaging men within community structures through participatory planning can positively shift entrenched social norms and create more supportive environment for maternal health. However, such initiatives must also promote gender equitable norms and strengthen women's autonomy, rather than just influencing male decision making.

4.6.3) NGO, NGO Government Partnership Initiatives Enhancing Anemia Prevention Efforts

As previously outlined, government-led programs face structural and operational limitations. In such circumstances, partnering with NGOs can play complementary role, mobilizing community network, trust and participatory approach to bridge the implementation gaps and enhance the effectiveness of national programs.

A wide range of non-government organizations (NGOs) independently or in partnership with government have contributed in efforts to reduce the burden of anemia during pregnancy in India. These initiatives have focused on multidepartment coordination and behavior change through participatory community engagement and demonstrated successful coverage and adherence to IFA.

Below is a summary table of selected initiatives:

Name and type	**Approach/Strategy**	**Outcome/Impact**
1)SAHAJ (NGO partner with community organizations, Government health systems) -A qualitative study based on participatory research in Gujarat (131).	a) NGO partnered with community collectives to raise awareness about maternal health entitlements, b) supporting community monitoring of outreach government services, and c) facilitating dialogue with government providers and authorities to communicate	a) In marginalized districts, substantial increases in receipt of entitlements information and utilization of antenatal and delivery care. b) a notable shift from private facilities to the public for the most vulnerable. Supportive implementation factors included a) NGO alignment b)

	findings and demand improvements.	participatory tool design c) repeated capacity building and d) government collaboration.
2)SEWA Shakti Kendras - Community based initiative led by NGO in partnership with Government. Implementation research study in Gujarat (132).	Empowering women to navigate public system by establishing community centers (Kendra), facilitating community access to health insurance. The approach is rooted in (1) local leadership (2) government partnerships and (3) a flexible approach to meet a range of community needs.	Successfully helped women independently seek services and negotiate government systems, thereby addressing gender- based barriers to health insurance utilization. It also demonstrated how community engagement can be implemented through a local, flexible, and community-run model that is a literal 'bridge' between people and public services
3)RANI- NGO government partnership- A cluster randomized trial (133).	The approach linked interpersonal communication with health behavior by promoting IFA consumption among pregnant women. Key components-a) Group participatory learning through module related to IFA use and anemia, involving women and their social networks (e.g., husbands and mothers-in-law) b) Locally made health communication videos followed by group discussion. C) Hemoglobin testing.	The RANI Project significantly enhanced both general health and anemia-specific interpersonal communication in women of reproductive age. IFA consumption improved up to 88%, reducing anemia prevalence.
4)SNEHA – Multisector NGO government partnership. A descriptive case study (134).	Integration with municipal corporation for early registration and screening of pregnant women, providing IFA, ICDS involvement for nutrition supplements, myths and non-adherence addressing through-home based counseling, couple counselling, culture influenced food practices, capacity building of community health workers.	Anemia declination by 50 % in marginalized population among Mumbai slums, achieved substantial success in increasing coverage of interventions in pregnant women in reducing maternal anemia, attending ANC clinics, taking iron-folic acid supplements.
5)PATH- NGO government collaboration. Implementation research based on mixed methods (135).	rapid assessment of 15 states in India to gain insights into the barriers and enablers of the AMB program implementation, the use of	This initiative created actionable evidence through low-cost digital tools, noninvasive hemoglobinometers, and

	living labs with a human-centric research design to co-design solutions from the perspectives of health care workers, key informant interviews, state-level consultation workshops, and a comprehensive review of the different components of the AMB program to develop landscape documents and reports.	awareness flipbooks. It supported AMB through supply chain monitoring and contributed to improved anemia screening, referrals, and service delivery.
6)The Shravasti story (A part of PATH initiative) - A descriptive program case documenting (136).	a) Establishing synergies between stakeholders for last-mile distribution and consumption compliance as part of the strategy, the campaign ensured that all the stakeholders, including government departments, Anganwadi workers, and non-governmental organizations (NGOs), were aligned on their roles and responsibilities. b) Communication and training - communication with adolescents, their families, and the community was undertaken to explain the benefits of IFA consumption and compliance. C) Dedicated WhatsApp war room to monitor various program activities.	Achievement of increasing the coverage of IFA supplementation from 8 percent to 87 percent among children aged 10–19 due to better supply chain management, stronger community mobilization, and higher knowledge among health care practitioners and the general population.

Chapter 5) Discussion, Strengths, and Limitations

5.1) Discussion

This study explored socioecological factors influencing anemia during pregnancy in India and identified systemic gaps reducing the effectiveness of national programs.

Individual nutritional deficiencies of Iron, folic acid, vit B12 remain a primary concern for women in reproductive age. Low body mass index (BMI) reflects both current undernutrition and chronic childhood nutrition deprivation. Persistent gaps in routine screening of inherited disorders continue to contribute to burden of ADP. These findings align with evidence from LMICs that biological risks are intensified by low socioeconomic conditions and limited access to nutrients and services. However, critical finding at the individual level is the knowledge gaps, particularly among young and rural women regarding anemia, iron rich diet and role of IFA supplements in anemia prevention. Despite the availability of IFA supplements, adherence remains low due to fear of perceived side effects reflecting populations' low health literacy and failure of effective counselling from health systems.

Individual vulnerabilities are aggravated by interpersonal dynamics where elderly family members control pregnant women's access to health and nutrition. Early marriage and early childbearing heighten adolescents' risk of anemia, reflecting broader gender inequality. Further patriarchal hierarchies restrict pregnant women's nutrition intake, while mother-in-law acts as gatekeeper of IFA intake influenced by traditional beliefs, misinformation and perceptions regarding safety and effects of IFA. Although these findings imitate to global family dynamics, in Indian context they are compounded with intergenerational norms and restrictions. Addressing these requires engaging husband and mother-in-law through active two-way communication to generate support for improved nutrition and service use during pregnancy. In addition to engagement, transformative strategies are required to shift gender norms, roles and power relations that limit women’s autonomy.

Cultural practices often intertwine with gender and caste/religious identities and thereby undermine protein and iron intake. Distrust in formal health system rooted in language barrier and perceived disrespect by providers discourage tribal women from utilizing ANC services and IFA uptake. Studies have interpreted cultural phenomenon such as restrictive gender norms and traditional food taboos as a barrier in health care systems (137). Yet, existing programs have failed to create an inclusive environment to acknowledge cultural norms and traditional knowledge. Health systems should respectfully integrate traditional practices to complement modern care. Recognizing the impact of culture on societies is imperative for behavior change.

VHSNCs and school-based organizations remain underutilized due to the implementation gap and lack of coordination. These organizational failures reflect the missed opportunity to institutionalize preventive care.

Further, broader community level disparities emerge as critical aspect in shaping experiences of pregnant women in maternal health care. Women in both rural areas and urban slums face poor infrastructure, inadequate information regarding anemia and its prevention, limited outreach by frontline community workers. CHWs (ANM, ASHA, and Anganwadi workers) are key links between the health system and community; they remain overburdened due to

inadequate human resources, lack of training, unclear roles. Systemic neglect of frontline workers undermines service delivery and community trust.

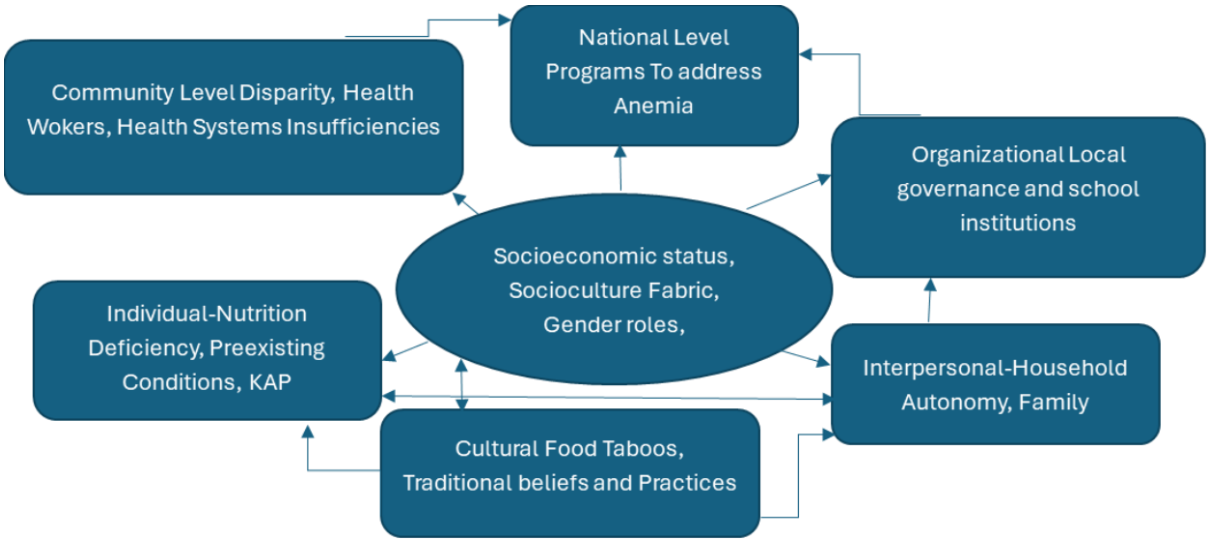
Programs addressing anemia have evolved from the narrow prophylactic approach with NNAPP in 1970 to the broader life cycle approach under Anemia Mukt Bharat in 2018. However, this study identifies persistent overlapping implementation challenges, with a critical gap of overlooking of sociocultural influence, which severely limits their effectiveness.

Evidence from LMICs including India have demonstrated the efficacy of community-based approaches on transforming behavior and increasing service uptake. Strategies informed by health belief model successfully improved community awareness of maternal health and anemia care. Findings further emphasize behavior change requires knowledge pairing with self-efficacy and social support. Moreover, community dialogues build trust enabling critical reflection on norms, while participatory strategies ensure local relevance promoting sustained behavior change.

Finally, collaborative efforts with NGOs display complementary strengths, emphasizing effectiveness rooted in community-based organizations. In the Indian context NGOs and NGO -government partnerships like SAHAJ, SEWA, PATH, RANI, SNEHA have demonstrated that integration with government systems, community alignment, continuous capacity building, robust monitoring and accountability can markedly achieve increased service uptake and adherence. These community driven models contrast the rigid one size fits all approach of government programs, highlighting culturally sensitive design, respectful communication and active community participation are cornerstones of equity and effectiveness. Adopting these participatory approaches is vital for Indian health system to bridge structural and sociocultural gaps in anemia prevention.

The study's findings and discussion are structured using the socioecological framework. The key findings include persistent personal knowledge gaps, restrictive family beliefs, limitations in health worker capacity and absence of socioecological consideration in program design. Critically these factors intersect with socioeconomic status, cultural practices and gender roles to influence anemia during pregnancy in India. The analysis underscores the need for interventions that must extend beyond biological and nutritional aspects of anemia to address gender hierarchies, culture norms, social structures, and systematic barriers. Tackling these multilevel challenges is essential for designing effective, inclusive, and locally adaptive strategies while strengthening existing programs.

Figure 7 Observation of complexity of influencing factors



5.2) Strengths and Limitations

A Key strength of this study is the application of socioecological framework to understand complex interconnected determinants of maternal health behaviour in Indian context.

Another key strength is the review of national programs, which provides critical insights into persistent implementation gaps and shortcomings of strategies that limit their effectiveness. Alternatively, examination of successful NGO led initiatives provided valuable lessons of behavior change strategies, community participation, community dialogue, and accountability. This comparison informed identification of improvements for effective implementation.

Finally, Authors experience in primary health care settings in rural India allowed to connect to the multitude of systemic challenges explored in the study.

Due to overrepresentation of rural focused research in existing literature, this study disproportionately reflects rural settings, leaving critical gaps in understanding the problems faced by pregnant women in urban settings, slums and other deprived environments.
In addition, by focusing on commonalities of issues across states, the study did not fully capture the diversity of experiences and context specific variations within India. A mixed method of study approach in the future would holistically address this asymmetry.

This study's scope was restricted to literature review due to time and resource constraints. Future research involving participatory field approach would provide deeper enriched understandings particularly around interpersonal, cultural, and social dimensions.

The review of evidence of effective strategies was selective and limited in depth. A comprehensive synthesis of all interventions would require a separate thesis and may reveal knowledge gaps beyond the scope of this work.

Finally, this study did not encompass broader systemic dimensions such as economic shifts, geopolitical situation, climate change and post-covid implications. These external factors potentially impact public health infrastructure, access to nutrition, and maternal care. Although not the primary focus of this study, future work should consider integrating these factors and develop more adaptive framework for better understanding of anemia and maternal health in India and other LMICs.

Chapter 6) Conclusion and Recommendations

6.1) Conclusion

ADP is a complex public health challenge, deeply rooted in broader social, cultural, and structural contexts, demanding urgent reformation of current anemia control strategies.

At community level interventions must prioritize culturally sensitive, inclusive engagement. This includes encouraging involvement of women, families, community leaders with strategies tailored to local community needs. Interventions must adopt evidence-based strategies including community participation, structured dialogues, and context responsive integration of traditional practices. This is crucial for addressing intergenerational beliefs, entrenched social norms, community concerns, and thereby ensuring trust building and sustainability of initiative.

Moving to district and state level, program management requires robust monitoring, uninterrupted supply chain and effective intradepartmental coordination. Strengthening the role of community health workers through comprehensive training, adequate resources and supportive supervision is essential for service outreach, follow-up, and counselling.

Finally, at the national policy level, prioritizing quality care over quantitative coverage is essential. This requires an equity-oriented, decentralized approach that integrates state/district specific planning, accountability mechanisms and socioecological consideration in program designing. Besides, multisectoral coordination with sociopolitical commitment is essential to achieve meaningful and sustainable improvements in maternal health outcomes.

To translate these conclusions into action, following recommendations are proposed targeted at strengthening anemia prevention programs.

6.2) Recommendations

During my tenure as medical officer at a primary health center, I served as a link between community health workers (CHWs), and the district health department. Due to my constrained autonomy, I could not address these ground issues- lack of transportation for ANC camps, vacant posts of ANMs at subcenters, irregular and inadequate supply of IFA and Hb meters. These were overlooked by the district health department and lack of connection with local governance further delayed action. Female health workers, particularly ANMs were expected to work across all programs, without institutional recognition and support-reflecting the gendered bias. Unclear expectations and roles, and overburden created significant knowledge gaps, eroding trust between community and health centers.

Based on these experiences and findings of the study, following recommendations are proposed.

Recommendations are categorized as short term and long term based upon urgency of action. Short term measures are proposed to address pressing issues such as community involvement for service uptake, strengthening of health care system for supplies and monitoring for service delivery.

Long term measures focus on sustained change such as health workers capacity building, transforming social norms, which require gradual systemic integration.

1)Community level

Short Term

1.1) Community Participation and Community Dialogues for Nutrition and IFA uptake -State health departments, partnering with NGOs and ASHA network need to organize structured community dialogues integrated with community participation platforms like women self-help group (SHG) and village health committee. This practice needs to involve pregnant women, husbands, mother-in-law, religious leaders to reflect on norms, values, intergenerational beliefs, food taboos around pregnancy and concerns around IFA use. CDs should be facilitated by trained CHWs and nutrition specialists focusing on practical/locally available iron-rich diet and IFA adherence, utilizing culturally appropriate material and respectful two-way communication to ensure acceptance.

1.2) Integration of Traditional Practices- MoHFW in coordination with AYUSH department and local NGOs should pilot models to integrate traditional practices into formal maternal care. Training community nominated interpreters will help overcome language barriers and build trust. IEC material should be developed and distributed in culturally sensitive local language, respectfully promoting anemia, nutrition, and IFA awareness among communities. Panchayat raj, women SHG and local leaders need to regulate and promote these initiatives complementing health workers effort. Additionally, to ensure continuity and institutional support of this initiative, it is essential to create a joint advocacy mechanism involving health workers and community leaders, in coordination with district level.

Long Term

1.3) Transforming Social Values- Addressing harmful social norms and gender disparities requires sustained community participation and constructive dialogues platforms engaging community leaders, parents, boys, and men. The Ministry of Women and Child Development (MoWCD) should coordinate with Ministry of Education (MoE), district authorities and Panchayat Raj with NGOs support, to create safe spaces for reflection on social values, gender roles, girls' rights, education, and nutrition. These awareness and transformation efforts need to be embedded in SHG, school committees, with ongoing community advocacy for gender responsive maternal health care.

1.4) Early Marriage Prevention- State administration should coordinate with district authorities to establish community led accountability mechanism under leadership of Panchayat Raj to address early marriage. Through community participation platforms like village committee, awareness and advocacy should be conducted through community leaders for parents and elderly, while ensuring compliance with Prohibition of Child Marriage act.

2) State/District Level

Short Term

2.1) Empowering Local Authorities- Empowering district health departments and primary health centers by allowing them to customize programs and adjustments of strategies for local needs will increase efficiency of national programs. MoHFW with state departments and NGOs need to strengthen monitoring and evaluation through regular audits, community feedback mechanisms, and health worker supervision.
State Health Department needs to seek technical support from MoHFW to activate existing digital anemia platforms, and link to community level to track service delivery and follow up, thereby enabling data driven advocacy.

2.2) Maternal health care strengthening- For rural maternal health, MoHFW and state health departments must strengthen existing health centers ensuring reliable transport and availability of essentials through NHM financing. National Health Systems Resource Center (NHSRC), in coordination with state logistic units and local bodies, must enhance procurement, distribution and storage of IFA and diagnostic tools.
In urban slums, the Ministry of Housing and Urban development needs to coordinate with NGO specializing in WASH to improve housing and sanitation. NHM with municipal institutes need to operate mobile health clinics for anemia screening, counselling, and supplements.

Long Term

2.3) Health Workers Capacity Building- MoHFW with state and district training institutes and NGO support, should integrate comprehensive anemia modules into preservice and in service training for all front-line workers. Training should encompass of iron rich diet, IFA supplementation, and cadre specific regime guidelines in local languages, along with value clarification, disrespectful attitude awareness activities.

The state health department with local NGO should maintain regular training, monitoring, and stress management for worker well-being, alongside the provision of incentive schemes like recognition awards and rural service benefits. Public health agencies and NGOs can provide technical guidance and pilot models in underperforming regions to sustain motivation.

3)National Level

Short Term

3.1) National Anemia Subcommittee- MoHFW needs to establish a dedicated subcommittee to improve inter-ministerial coordination and monitoring of multisectoral actions on anemia. This body should include representatives from MoHFW, MoE, MoWCD and technical partners WHO and UNICEF, with regular monitoring input from NGOs. Responsibilities include developing region-specific strategies, strengthening accountability mechanisms through regular review, advocacy for sociopolitical leadership to prioritize maternal anemia in policy agenda, ensuring adequate budget allocation and intersectoral coordination. Activities would be financed via NHM integrated into existing Health Management Information System (HMIS).

3.2) Oversight through Watchdog Committee- Existing watchdog committees for RMNCHA must expand to include specific focus on anemia. These committees supported by International public health organizations such as WHO, UNFPA in association with contextual NGOs can provide financial and technical support, simultaneously demanding transparency

and improvement, monitoring progress, advocacy for corrective actions, ensuring health systems are working equitably and effectively.

Long Term

3.3) Strengthening Adolescent Anemia prevention- To promote early awareness and shape long-term anemia prevention behavior, national level stakeholders of RKSK and WIFS should assess and redesign context-sensitive modules to cover nutrition, reproductive and sexual health, maternal health, and anemia. This needs an alignment with National Council of Educational Research and Training (NCERT) curriculum and adaptation to state/district contexts.
As evidence suggests that schools face implementation challenges, at state/district level complementary approaches should be explored through community-based sessions, peer education initiatives, and adolescent-friendly media, such as local language television, radio, and social media platforms. The Ministries of Education and Information & Broadcasting should coordinate this initiative, with financing channeled through NHM and MoHFW supervision.

On returning to Pune, I intend to engage with the medical officer's association and advocate for collaborating with NGOs working for maternal health. My goal is to present the study to State and District health officials. The aim is to demonstrate that despite the existence of broad scale programs, structural disconnects at various levels critically diminish their impact. I will advocate for participatory learning approaches including state, district officials, health workers and community leaders. This will include respectful constructive dialogue in program designing and implementation, to effectively address anemia during pregnancy contributing to equitable improved maternal health.

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8)Annexure

8.1) Table of Key National Health Policies and Schemes in India for Maternal health (From 1951-2022) (138).

Year	Program Name	Key Features
1951	Family Planning Program	Programmed to control population growth, India was first country in the world to launch program.
1955	Maternal and Child Health integrated with General Health Services	Formal integration of MCH services
1977	Family Welfare Program-Reproductive and child health integration	Program aimed to ensure safe pregnancy and childbirth, with survival and well-being of women.
2005	Second phase of Reproductive and child health program (RCH 2)	Enhanced service delivery under NRHM, targeted MDG goals.
2005	Janani Suraksha Yojana	JSY is a safe motherhood initiative within the National Rural Health Mission (NRHM) that encourages institutional delivery among pregnant mothers from low-income families in an effort to reduce maternal and newborn mortality.
2011	Janani Shishu Suraksha Karyakram	The goal of removing all out-of-pocket costs for unwell newborn and pregnant women.
2011	MAMATA Scheme	This scheme aims to provide financial assistance to pregnant and lactating women to ensure better nutrition and healthcare during pregnancy and after childbirth. It focuses on improving maternal and child health outcomes by promoting institutional deliveries and ensuring access to essential healthcare services for women in need, particularly those from marginalized communities.
2013	RMNCAH+N	Essentially aimed to address the major causes of mortality

		and morbidity among women and children.
2013	Mamta Vahan	MAMTA Vahan aims to improve maternal and child health outcomes by ensuring that essential healthcare reaches underserved communities where access to regular health facilities may be limited.
2014	Mission Indradhanush	Immunization drives kids and provides free medical treatment to expectant mothers and their babies.
2015	Dakshata Initiative launched under the National Health Mission (NHM)	This initiative was launched with the aim of improving the quality of intrapartum and immediate postpartum care provided by healthcare providers.
2016	Pradhan Mantri Surakshit Matritva Abhiyan PMSMA	To provide comprehensive and quality antenatal care to pregnant women. The primary objectives of PMSMA are to reduce maternal and infant mortality rates and to ensure safe pregnancies and deliveries.
2016	Kilkari- Initiative under NHM	Improving maternal and child health outcomes through innovative mobile health (mHealth) solutions.
2017	Maternity Benefit Amendment Act	Extension of maternity leave and benefits for women workers to promote maternal health and well-being by providing adequate time for recovery, childcare, and breastfeeding support.
2017	The Pradhan Mantri Matru Vandana Yojana (PMMVY)	The program aims to provide partial wage compensation to pregnant and lactating women to help them with rest and recuperation during their pregnancy and after delivery, thereby promoting better maternal and child health.
2017	Maternal Death Surveillance and Response (MDSR)	The MDSR system was introduced to systematically review and investigate maternal deaths to understand the causes

		and preventability of each death
2017	LaQshya– Labour Room Quality Improvement Initiative: An Initiative under NHM	To improve the quality of care in labor rooms and maternity operation theatres in public health facilities.
2019	Surakshit Matritva Aashwasan (SUMAN)	The scheme focuses on reducing preventable maternal and neonatal mortality and morbidity by providing assured, dignified, and respectful care at no cost.
2022	Mission Saksham Anganwadi	This initiative focuses on transforming Anganwadi Centers into places of excellence that provide quality early childhood care and education, along with maternal and adolescent health services. The mission aims to enhance the overall development and well-being of children, pregnant women, and lactating mothers by improving infrastructure, facilities, and the skill sets of Anganwadi workers.

8.2) Summary Table of National Programs to address Anemia in India

Year	**Program**	**Target Group**	**Intervention**	**Highlight**
1970	National Nutritional Anemia Prophylaxis Program (NNAPP) (139).	Pregnant and Lactating women Children 1-5years	60mg iron and 0.5mg folic acid daily for 100 days. Children 1-5years 20mg iron and 0.1 mg folic acid daily for 100 days	In 1990, poor coverage of 19 % among pregnant women and 1% in children. Poor monitoring, compliance, and lack of screening.
1990	National Nutritional Anemia Control Program (139).	Pregnant, Lactating women and Children 1-5 years	Dosage changed to 100 mg of iron during pregnancy. Anemic person receives 2 tablets	Emphasis on screening for anemia and improving coverage.
2012	Weekly Iron Folic Acid	Adolescent girls and boys enrolled in government/government	100mg elemental iron and 500µg folic acid	Fixed day approach for weekly IFA

	Supplementation Program (140).	aided/municipal schools from 6th to 12th classes, and Adolescent Girls who are not in school.	for 52 weeks in a year	distribution, Branding of IFA as blue WIFS
2013	National Iron Plus Initiative (NIPI) (141).	Life cycle approach	Targeted approach for anemic persons and mass program for non-anemic persons	Tie-up with NRHM. The color of the IFA tablet for adolescent girls was changed to blue. Auto dispenser for feeding biweekly iron syrup to children.
2018	Poshan Abhiyaan (142).	Prime Ministers Overarching Scheme for Holistic Nutrition is India's flagship program to improve nutritional outcome		Leveraging technology, a targeted approach and convergence (food fortification, supplementation, anemia)
2019	Intensified National iron plus initiative (I -NIPI) -AMB (143).	6X6X6 strategy	The iron dosage was reduced from 100 mg to 60 mg for adults	Test, Treat and Talk

8.3) Table of 6*6*6 Strategy of AMB

6 Beneficiaries	**6 Interventions**	**6 Institutional Mechanisms**
Children (6–59 months)	Prophylactic Iron Folic Acid Supplementation	Intra-ministerial coordination
Adolescent girls (15–19 years)	Deworming	Strengthening supply chain and logistics
Adolescent boys (15–19 years)	Intensified year-round Behavior Change Communication Campaign	National Centre of Excellence and Advanced Research on Anemia Control
Women of reproductive age	Testing of anemia using digital methods and point of care treatment	National Anemia Mukt Bharat Unit
Pregnant women	Mandatory provision of iron folic acid fortified food in public health programs	Convergence with other ministries
Lactating Women	Addressing non-nutritional causes of anemia in endemic pockets, with special focus on	Anemia Mukt Bharat dashboard and digital Portal - one-stop shop for anemia

	malaria, haemoglobinopathies and fluorosis	

8.4) Search terms and Key words

Problem Term (OR)	**AND**	**Related Factor Term (OR)**	**AND**	**Geographical area Term (OR)**
Anemia		Maternal age		South Asia
Anemia during pregnancy		Educational level		India
Maternal Anemia		Socioeconomic status		Pakistan
Antenatal Care		Caste/Religion/Ethnicity		Bangladesh
Maternal health care		Culture norms/Food taboos/Diet Practices		Nepal
Maternal care utilization		Gender Roles		Rural areas
Maternal nutrition		Early marriage,		Urban areas
ANC		Family support		Urban slums
Iron deficiency		Autonomy		LMICs
Iron deficiency Anemia		Health Center		Sub Saharan Africa
Micronutrient Deficiency		Health systems		
Low hemoglobin levels		Infrastructure		
Supplementations		Transport		
		Health Workers		
		ANMs		
		ASHAs		
		AWW		
		Availability		
		Accessibility		