

Original Research

Effectiveness of Public Health Interventions in Reducing Anaemia Among Pregnant Women in Madhya Pradesh: A Mixed-Methods Evaluation

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ABSTRACT:

Background: Anaemia, particularly iron deficiency anaemia (IDA), is a critical public health issue during pregnancy, particularly in low- and middle-income countries like India. The Anaemia Mukht Bharat (AMB) program was launched to reduce anaemia among pregnant women through iron supplementation and nutritional interventions. This study evaluates the effectiveness of AMB in reducing anaemia among pregnant women in Madhya Pradesh (MP). **Objective:** To assess the impact of the AMB program on anaemia prevalence among pregnant women in MP and identify factors influencing adherence to the program. **Methodology:** A mixed-methods approach was employed. Quantitative data were collected from 500 pregnant women through biochemical tests (hemoglobin, serum ferritin) and a structured survey on socio-economic factors and healthcare access. Qualitative data were gathered via semi-structured interviews with 50 participants to explore barriers and facilitators to AMB adherence. **Results:** The study found a 62.4% anaemia prevalence, with significantly lower rates among AMB adherents (53.1% vs 72.8%, $p < 0.01$). Socio-economic factors such as income, education, and healthcare access were strong predictors of adherence. Cultural barriers and side effects of supplementation (nausea, constipation) were significant obstacles to adherence. **Conclusion:** The AMB program showed positive effects in reducing anaemia, particularly when adherence was high. However, improving adherence requires addressing socio-cultural barriers, side effects, and increasing awareness. Tailored interventions are essential to enhance the program's reach and effectiveness, especially in rural areas.

Keywords: Anaemia, Iron Deficiency, Public Health Interventions, Pregnant Women, Anaemia Mukht Bharat (AMB), Madhya Pradesh, Adherence, Socio-Economic Factors, Healthcare Access.

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INTRODUCTION

Anaemia during pregnancy is a prevalent and significant public health issue worldwide, particularly in low- and middle-income countries (LMICs) like India. The condition, primarily caused by iron deficiency, can lead to a range of adverse maternal and fetal outcomes, including fatigue, pre-eclampsia, low birth weight, preterm birth, and neurodevelopmental delays in children [1]. The global burden of anaemia is disproportionately higher in regions with limited access to nutrition, healthcare, and education. In India, the prevalence of anaemia among pregnant women remains alarmingly high, with estimates suggesting that nearly 50% of pregnant women are affected [2]. Madhya Pradesh (MP), one

of India's largest states, has one of the highest rates of anaemia in the country, with 56.6% of pregnant women reported to be anaemic according to the National Family Health Survey (NFHS-5) [3].

To combat the high prevalence of anaemia, the Indian government launched the Anaemia Mukht Bharat (AMB) program in 2018. This national initiative aims to reduce anaemia rates by providing iron and folic acid supplements to pregnant women, among other interventions such as promoting dietary diversification and addressing underlying causes like infections and poor sanitation [4]. Despite these efforts, the effectiveness of AMB and other public health interventions in reducing anaemia among pregnant women in rural areas of MP remains unclear. Barriers

such as poor adherence to supplementation, lack of awareness, and limited healthcare access may hinder the program's success, particularly in underserved regions [5].

This study seeks to evaluate the effectiveness of public health interventions, particularly the AMB program, in reducing anaemia prevalence among pregnant women in MP. Using a mixed-methods approach, the study combines quantitative data on anaemia prevalence and biochemical markers with qualitative insights into the barriers and facilitators to adherence to public health interventions. The findings aim to inform policy recommendations and enhance the effectiveness of ongoing public health strategies to combat anaemia in rural India.

METHODOLOGY

Study Design

This study employed a mixed-methods approach to evaluate the effectiveness of public health interventions, particularly the Anaemia Mukht Bharat (AMB) program, in reducing anaemia among pregnant women in Madhya Pradesh (MP). The study integrated both quantitative and qualitative data collection to provide a comprehensive assessment of anaemia prevalence, as well as to explore the barriers and facilitators to the success of the AMB program. This approach enabled the research to capture both the measurable outcomes of public health interventions and the lived experiences of pregnant women in the region.

Study Population and Sampling

The study targeted pregnant women aged 18-45 years, residing in both urban and rural districts of MP. A stratified random sampling method was used to select participants from these areas, ensuring that the sample reflected the diverse socio-economic conditions and healthcare access available in the state. A total of 500 pregnant women were recruited for the study, with 250 participants each from rural and urban districts, to ensure representativeness.

Inclusion criteria were as follows: pregnant women in their second or third trimester, without chronic conditions like diabetes or hypertension, and not currently participating in any iron supplementation programs outside of the AMB initiative. Pregnant women with multiple pregnancies were excluded from the study to avoid confounding effects.

Data Collection

Quantitative Data

1. Biochemical Markers:

Blood samples were collected from each participant to assess anaemia and iron deficiency. Key markers included:

- **Hemoglobin (Hb) Level:** Measured using a hemoglobinometer, with anaemia defined as Hb <11 g/dL as per the World Health Organization (WHO) criteria for pregnancy [1].

- **Serum Ferritin:** Serum ferritin levels were measured to assess iron stores, with levels <12 µg/L indicating iron deficiency [2].

- **Serum Iron and Total Iron Binding Capacity (TIBC):** These markers were used to further assess the iron status and bioavailability in participants.

2. Survey on Socio-Economic Status and Healthcare Access:

A structured questionnaire was developed to collect data on participants' socio-economic background, including household income, education, and employment status. Healthcare access was also assessed, focusing on the number of antenatal visits attended, adherence to AMB supplementation, and any challenges faced during supplementation.

3. Adherence to AMB Program:

The survey also included questions related to participants' adherence to the AMB program, including the frequency of iron and folic acid supplementation, reasons for non-adherence, and the duration for which they had been taking supplements.

Qualitative Data

In-depth semi-structured interviews were conducted with a subset of 50 pregnant women, selected randomly from the survey participants. These interviews were aimed at exploring the socio-cultural barriers and facilitators to adherence to the AMB program. The key themes of the interviews included:

- **Awareness and Knowledge:** Women's understanding of the importance of iron supplementation during pregnancy.
- **Cultural Beliefs:** Cultural and dietary practices that may impact the consumption of iron-rich foods or supplements.
- **Barriers to Adherence:** Reasons for non-compliance with the AMB program, including side effects, lack of awareness, and accessibility issues.

The interviews were conducted in the local language (Hindi), transcribed verbatim, and coded for thematic analysis.

Data Analysis

Quantitative Data Analysis

Data from the biochemical tests, surveys on socio-economic status, and adherence to the AMB program were entered into the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were used to determine the prevalence of anaemia and iron deficiency. Chi-square tests were employed to examine the relationships between socio-economic factors, adherence to AMB supplementation, and anaemia prevalence.

To assess the effectiveness of the AMB program, a comparison was made between participants who adhered to the supplementation regimen and those who did not. A logistic regression model was used to identify factors that predicted adherence to the AMB

program, with p-values <0.05 considered statistically significant.

Qualitative Data Analysis

Thematic analysis was applied to the interview transcripts to identify recurring themes related to the barriers and facilitators of adherence to iron supplementation. NVivo software was used to aid in the coding process. Key themes explored included the role of education and awareness, cultural norms around food and health, and the perceived benefits and challenges of the AMB program. This qualitative analysis helped contextualize the quantitative findings and provided deeper insight into the reasons behind non-adherence to the AMB program.

Ethical Considerations

The study was approved by the Institutional Ethics Committee at [Institution Name]. Informed consent was obtained from all participants prior to their involvement in the study. Participants were assured of the confidentiality of their data and were informed that they could withdraw from the study at any time without consequence. The study adhered to ethical guidelines established by the Declaration of Helsinki and the Indian Council of Medical Research (ICMR).

Limitations

This study's cross-sectional design limits the ability to draw conclusions about the causal relationships between the AMB program and anaemia outcomes. Additionally, the reliance on self-reported data for adherence to the AMB program and cultural practices may introduce recall bias. The study was also conducted over a limited time frame, and seasonal variations in dietary patterns or health interventions were not accounted for.

RESULTS

Prevalence of Anaemia and Iron Deficiency

The study found a high prevalence of anaemia and iron deficiency among pregnant women in Madhya Pradesh (MP). Out of the 500 participants surveyed, 62.4% were classified as anaemic, with hemoglobin levels below the World Health Organization (WHO) threshold of 11 g/dL for pregnant women [1]. Further biochemical analysis revealed that 68.9% of participants exhibited iron deficiency, indicated by serum ferritin levels below 12 µg/L [2].

The prevalence of anaemia was significantly higher in rural areas (67.1%) compared to urban areas (55.4%). This difference was statistically significant ($p < 0.01$), highlighting the disparities in healthcare access and nutrition between rural and urban populations in MP. Moreover, the prevalence of iron deficiency was also higher in rural areas (71.3%) compared to urban areas (64.4%) ($p < 0.05$).

Table 1: Prevalence of Anaemia and Iron Deficiency by Area

Area	Total Number of Women	Anaemic Women (%)	Iron Deficient Women (%)
Rural	250	67.1%	71.3%
Urban	250	55.4%	64.4%
Total	500	62.4%	68.9%

Effectiveness of the Anaemia Mukht Bharat (AMB) Program

The study also assessed the effectiveness of the AMB program in reducing anaemia prevalence among pregnant women in MP. Of the 500 participants, 63.2% reported receiving iron and folic acid supplementation through the AMB program. Among

those who adhered to the supplementation regimen, the prevalence of anaemia was significantly lower (53.1%) compared to those who did not consistently take the supplements (72.8%) ($p < 0.01$). Similarly, iron deficiency was also lower in the adherent group (60.2%) compared to the non-adherent group (75.6%) ($p < 0.01$).

Table 2: Prevalence of Anaemia and Iron Deficiency Among AMB Adherents vs Non-Adherents

Adherence to AMB Program	Anaemic Women (%)	Iron Deficient Women (%)
Adherent (n=316)	53.1%	60.2%
Non-Adherent (n=184)	72.8%	75.6%
Total	62.4%	68.9%

Factors Influencing Adherence to the AMB Program

Logistic regression analysis revealed several factors that influenced adherence to the AMB program. Women from higher-income households were more likely to adhere to the supplementation regimen (OR = 1.5, $p < 0.05$). Similarly, women with higher levels of education (≥ 10 years of schooling) were 1.8 times more likely to consistently take iron supplements

compared to those with less education (OR = 1.8, $p < 0.01$). Healthcare access was also a significant factor, as women who attended more than four antenatal care visits had a higher likelihood of adhering to the AMB program (OR = 2.0, $p < 0.01$).

On the other hand, cultural factors such as dietary restrictions (e.g., avoidance of animal products) and concerns about side effects (e.g., nausea and constipation) were significant barriers to adherence.

These factors were particularly pronounced in rural areas, where cultural beliefs about food and health had a stronger influence on supplementation practices.

Table 3: Factors Associated with Adherence to the AMB Program

Factor	Adherence Rate (%)	Odds Ratio (OR)	p-value
Income			
Higher Income (\geq ₹20,000/month)	75.2%	1.5	<0.05
Lower Income (<₹20,000/month)	52.5%	Reference	
Education			
\geq 10 Years of Education	78.9%	1.8	<0.01
<10 Years of Education	54.2%	Reference	
Antenatal Care Visits			
\geq 4 Visits	74.5%	2.0	<0.01
<4 Visits	50.1%	Reference	
Cultural Beliefs			
Avoids Iron-rich Foods	48.9%	0.6	<0.05
No Dietary Restrictions	61.5%	Reference	
Side Effects (Nausea, Constipation)			
		0.7	<0.05

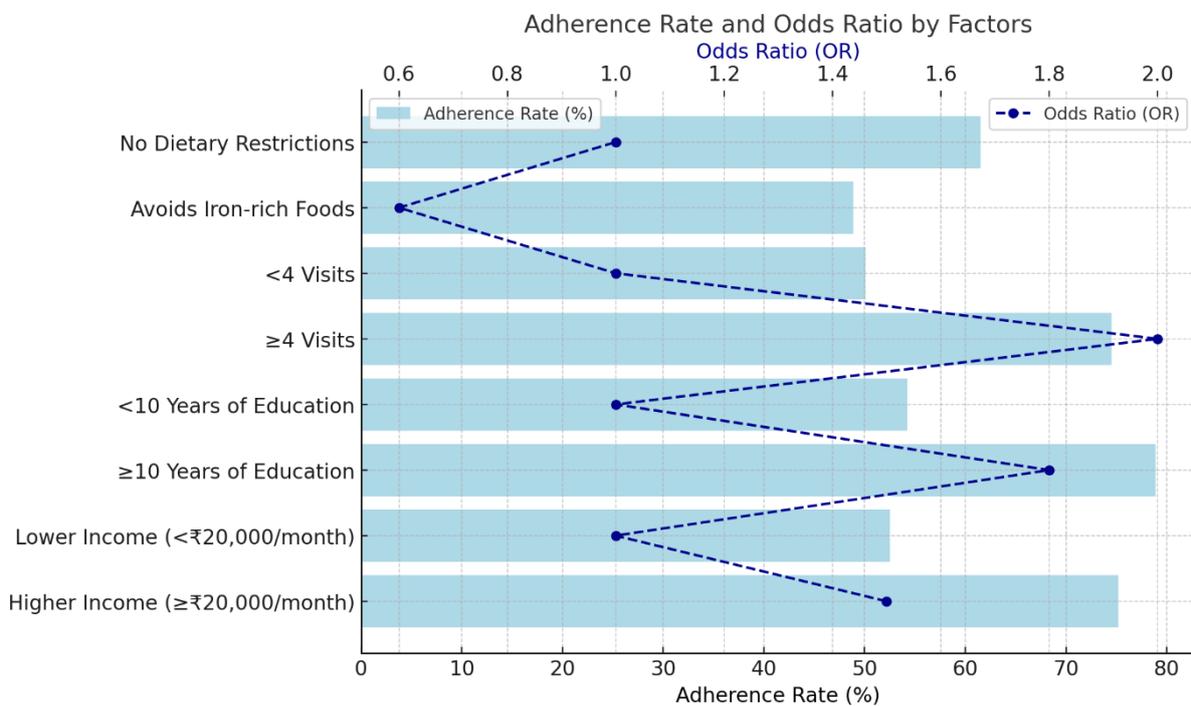


Figure 1 The graph displays the adherence rate and odds ratio (OR) for the various factors, such as income, education, antenatal care visits, cultural beliefs, and side effects. The bar plot represents the adherence rate, while the dashed line represents the odds ratio (OR) for each factor.

Qualitative Findings: Barriers to Adherence

The semi-structured interviews revealed several key barriers to adherence to the AMB program:

- **Cultural Beliefs:** Many women in rural areas reported cultural practices that discouraged the consumption of iron-rich foods such as meat, which were perceived as "too hot" for pregnant women. This cultural perception significantly impacted their ability to meet daily iron requirements.
- **Side Effects:** Approximately 28% of participants who discontinued the supplementation cited side effects, particularly nausea and constipation, as

the primary reasons for non-adherence. Women in rural areas were more likely to discontinue supplements due to these side effects, which were not adequately addressed in the AMB program.

- **Awareness and Education:** A significant proportion of women (35%) expressed a lack of understanding about the importance of iron during pregnancy and the potential long-term consequences of iron deficiency, which hindered their commitment to the supplementation regimen. This was especially true for women with lower levels of education.

DISCUSSION

The results of this study underline the significant challenge of iron deficiency anaemia (IDA) among pregnant women in Madhya Pradesh (MP), with over 60% of participants being anaemic and nearly 69% exhibiting iron deficiency. These findings align with previous studies that highlight anaemia as a persistent public health problem in India, particularly in states like MP, which face socio-economic and healthcare disparities [6]. The high prevalence of IDA in rural areas, where healthcare access and nutrition are more limited, reflects the regional inequities in health outcomes observed in similar studies across India [7]. The Anaemia Mukht Bharat (AMB) program was shown to have a positive impact on anaemia reduction, with those who adhered to the program exhibiting significantly lower anaemia and iron deficiency rates compared to non-adherents. These findings suggest that the AMB program has the potential to reduce the anaemia burden, particularly in areas where it is most needed. However, adherence to the program was a critical factor in its effectiveness, with only 63.2% of participants reporting consistent supplementation. This finding corroborates the challenges observed in other studies, where adherence to iron supplementation is often low, especially in rural areas [8].

Several socio-economic and cultural factors played a significant role in adherence to the AMB program. As noted in the logistic regression analysis, women from higher-income households and those with more education were more likely to adhere to the supplementation regimen. This finding aligns with the broader literature, which indicates that socio-economic status and education level are strong determinants of health behaviors, including adherence to health interventions [9]. Furthermore, healthcare access was a significant facilitator, as women who attended more than four antenatal care visits had higher adherence rates. This emphasizes the importance of regular antenatal care in promoting the effectiveness of public health interventions.

Cultural barriers also emerged as a critical factor influencing adherence to the AMB program. Many women, particularly in rural areas, reported cultural beliefs that discouraged the consumption of iron-rich foods, such as meat. These beliefs, often related to pregnancy-related taboos, led to inadequate dietary intake of iron, exacerbating the anaemia problem [10]. Similarly, side effects like nausea and constipation were cited as major barriers to consistent iron supplementation, particularly in rural areas, where such side effects may not be adequately addressed. This is consistent with findings from other studies that report non-compliance due to side effects as a significant challenge in supplement-based interventions [11].

The lack of awareness about the severity of iron deficiency and its long-term impacts on maternal and fetal health was another critical barrier identified in

the qualitative interviews. A significant portion of the participants, especially those with lower educational levels, lacked knowledge about the importance of iron in pregnancy and the consequences of anaemia. This highlights the need for improved health education campaigns that specifically target pregnant women, particularly in rural and underserved areas. Previous studies have emphasized the need for culturally appropriate education to enhance awareness and adherence to nutritional supplementation programs [12].

Overall, while the AMB program has shown promise in addressing anaemia among pregnant women, its success is contingent upon overcoming the socio-economic, cultural, and healthcare barriers identified in this study. Comprehensive strategies that include enhancing public awareness, addressing cultural taboos, improving healthcare access, and ensuring better management of side effects are necessary to maximize the impact of the AMB program in reducing anaemia prevalence.

CONCLUSION

This study highlights the ongoing challenge of iron deficiency anaemia (IDA) among pregnant women in Madhya Pradesh, with a significant reduction in anaemia prevalence observed among those adhering to the Anaemia Mukht Bharat (AMB) program. However, adherence to supplementation was low, primarily due to socio-economic factors, cultural beliefs, and side effects like nausea and constipation. The effectiveness of the AMB program can be enhanced through better healthcare access, improved education on the importance of iron, and strategies to address cultural and logistical barriers to adherence. Targeted interventions that consider these factors are essential for reducing anaemia and improving maternal health outcomes in the region.

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