RESEARCH PAPER

Improving Anaemia Cure Outcomes Among School-Going Adolescents: A Longitudinal Cohort Study from a School-Based Intervention in Gujarat, India (2023–2026).

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ABSTRACT

Background::Anaemia among adolescents remains a persistent public health challenge in India, with disproportionate burden among girls. While national programs such as Anemia Mukt Bharat emphasize supplementation and screening, limited evidence exists on treatment completion and cure outcomes in real-world programmatic settings.

Objective:To evaluate longitudinal trends in anaemia cure rates and identify demographic predictors of recovery among school-going adolescents.

Methods:A retrospective cohort study was conducted using programmatic data from Project implemented by Deepak Foundation in Savli block, Vadodara district. Adolescents aged 10–19 years with a valid final haemoglobin (Hb) measurement were included. Cure was defined as Hb ≥12 g/dL. Outcomes were analyzed by financial year cohorts, gender, and age group.

Multivariable logistic regression was used to identify predictors of cure.

Results:Among 3,285 adolescents, cure rates improved from 71.3% (Year 1) to 78.2% (Year 3). Females had significantly lower odds of cure (AOR 0.74; 95% CI: 0.63–0.86; p<0.001).

Adolescents aged 10–14 years had lower odds of recovery compared to 15–19 years (AOR 0.69; 95%CI:0.58–0.81; p<0.001).

Conclusion:School-based anaemia interventions demonstrate strong potential for improving outcomes at scale. Targeted strategies addressing younger adolescents and gender disparities are essential.

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INTRODUCTION

Anaemia remains one of the most widespread nutritional disorders globally, with adolescents constituting a particularly vulnerable group due to rapid growth, increased iron requirements, and dietary inadequacies. According to the World Health Organization, anaemia in adolescence is associated with impaired cognitive development, reduced physical capacity, and adverse reproductive health outcomes in later life.

India carries a disproportionately high burden of anaemia, with national surveys indicating prevalence rates exceeding 50% among adolescent girls. The problem is further compounded by gender-based nutritional inequities, early onset of menstruation, and socio-cultural barriers limiting access to iron-rich diets.

To address this, the Government of India launched Anemia Mukt Bharat, which focuses on:

Iron and Folic Acid Supplementation

Deworming

Behaviour change communication

However, existing program evaluations largely focus on:

Coverage indicators (e.g., tablets distributed)

Prevalence reduction

There is **limited evidence on actual treatment outcomes**, particularly:

Cure rates (transition to non-anaemic status)

Longitudinal recovery patterns

Determinants of successful treatment

School-based platforms provide a unique opportunity to deliver structured interventions with high coverage and continuity. Project SPARSH, implemented by Deepak Foundation, integrates screening, treatment, and follow-up within schools, offering a model for scalable anaemia control.

This study aims to fill critical evidence gaps by:

Assessing longitudinal trends in anaemia cure rates

Examining differences by gender and age

Identifying predictors of successful recovery

Methodology

2.1 Study Design

A retrospective longitudinal cohort study was conducted using routinely collected program data over a three-year period (April 2023–March 2026).

2.2 Study Setting

The study was conducted in Savli block of Vadodara district, comprising rural and semi-urban schools with varying socio-economic profiles.

2.3 Program Description (Project SPARSH)

Project SPARSH is a school-based adolescent health initiative by Deepak Foundation, designed to address anaemia through:

Core Components:

Screening o Baseline haemoglobin estimation using point-of-care devices

Treatment o Daily supervised Iron–Folic Acid supplementation (as per national guidelines)

Counselling o Nutrition counselling and monitoring for comorbidities o Menstrual health awareness (for girls)

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Follow-up o Periodic Hb reassessment o Tracking of treatment adherence and compliance

2.4 Study Population
Inclusion Criteria:
Adolescents aged 10–19 years
Enrolled in the program
Available final Hb measurement

2.5 Outcome Definition
Cured: Hb ≥12 g/dL
Not cured: Hb <12 g/dL

2.6 Cohort Classification
Participants were grouped based on **date of final Hb measurement**:
Year 1: Apr 2023 – Mar 2024
Year 2: Apr 2024 – Mar 2025
Year 3: Apr 2025 – Mar 2026 This approach ensures:
Accurate attribution of outcomes
Alignment with program performance periods

2.7 Variables
Dependent Variable:
Cure status (binary) **Independent Variables:**
Age group (10–14, 15–19)
Gender (male, female)

Results
3.1 Overall Outcomes

Year	Cure Rate
Year 1	71.3%
Year 2	77.0%
Year 3	78.2%

Significant improvement over time
Indicates:
o Program learning curve o Improved adherence o Strengthened follow-up

3.3 Gender-wise Analysis

Gender	Cure Rate
Female	73.0%
Male	78.7%

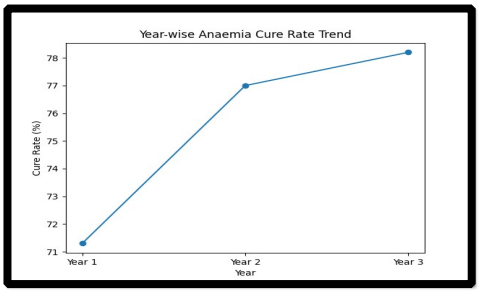
Interpretation
Persistent gender gap (~5–6%)
Reflects:
o Biological factors (menstruation) o Nutritional inequities
• However:
o Gap **reduced over time**, suggesting program effectiveness

3.4 Age-wise Analysis

Age Group	Cure Rate
10–14	74.6%
15–19	up to 85%

Interpretation
Older adolescents show better recovery

Year of outcome
2.8 Statistical Analysis
Step 1: Descriptive Analysis
Frequencies and proportions
Cure rates by year, gender, and age
Step 2: Stratified Analysis
Year × Gender
Year × Age
Step 3: Multivariable Logistic Regression
Outcome: Cure (yes/no)
Predictors: Age, gender, year **Outputs:**
Adjusted Odds Ratios (AOR)
95% Confidence Intervals
p-values
Statistical significance was set at p<0.05.



A total of **3,285 adolescents** with valid final Hb measurements were included. **3.2 Year-wise Trends**
Younger group faces:
o Adherence challenges o Dependency on caregivers

3.5 Year × Gender Interaction

Year	Female	Male
Year 1	67.1%	75.5%
Year 2	74.3%	80.0%
Year 3	76.3%	80.4%

Interpretation
Strong improvement among females
Gender gap narrowing over time

3.6 Year × Age Interaction

Year	10–14	15–19
Year 1	68.5%	76.0%
Year 2	76.5%	78.2%
Year 3	76.8%	85.2%

Interpretation
Major improvement in both groups
Highest gains in **older adolescents**

3.7 Multivariable Analysis

Predictor	AOR	Interpretation
Female	0.74	Lower odds of cure
Age 10–14	0.69	Lower recovery likelihood
Year 3	1.42	Higher probability of cure

DISCUSSION
This study provides robust evidence that **school-based anaemia interventions can achieve high cure rates and improve over time**, even in resource-constrained settings.
Program Maturity Effect
The steady improvement across years reflects:
Better implementation fidelity
Strengthened monitoring systems
Increased community acceptance
Gender Disparities

Lower cure rates among females align with:
Menstrual iron loss
Nutritional inequities
Social barriers
However, the observed improvement suggests:
Effectiveness of counselling
Improved adherence

Age-related Differences

Lower cure rates in younger adolescents indicate:
Need for caregiver engagement
School-based supervised supplementation

Hidden Determinant: Follow-up

By including only cases with final Hb:
The study captures **true treatment completion outcomes**
Highlights importance of **continuity of care**

Policy Relevance

Findings strongly support:
Scaling school-based models
Integrating risk stratification
Strengthening follow-up systems

CONCLUSION

This study provides robust real-world evidence that **school-based anaemia interventions can achieve substantial and sustained improvements in cure outcomes among adolescents**, even within resource-constrained settings. The progressive increase in cure rates from 71.3% to 78.2% over a three-year period highlights the critical role of **program maturity, consistent follow-up, and system strengthening** in improving treatment effectiveness.

Importantly, the findings reveal persistent inequities in recovery outcomes. Female adolescents and those in the younger age group (10–14 years) demonstrated significantly lower likelihood of achieving normal haemoglobin levels, underscoring the influence of **biological, behavioural, and socio-cultural determinants** on treatment success. However, the observed narrowing of gender disparities over time suggests that targeted programmatic strategies—such as menstrual health integration, nutrition counselling, and adherence support—can meaningfully improve outcomes among vulnerable groups.

The study also emphasizes the importance of **treatment completion as a critical but often overlooked program indicator**. By focusing on adolescents with documented follow-up haemoglobin measurements, the analysis provides a more accurate reflection of effective cure rather than mere service delivery coverage. This distinction has significant implications for program evaluation frameworks, which often prioritize inputs and outputs over outcome-based indicators.

From a policy and programmatic perspective, these findings strongly support the expansion of structured, school-based models within national initiatives such as Anemia Mukt Bharat.

Integrating **risk stratification approaches**, strengthening follow-up mechanisms, and prioritizing high-risk subgroups—particularly younger adolescents and girls—will be essential for achieving equitable and scalable impact.

In conclusion, Project SPARSH demonstrates that **well-designed, school-linked health interventions can move beyond anaemia control toward measurable cure outcomes**, offering a replicable and scalable model for adolescent health programs in India and other low- and middle-income settings.

Policy Implications

Integrate with Anemia Mukt Bharat
Scale similar models nationally
Strengthen monitoring and follow-up.

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