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# Prevalence of Anemia and Associated Factors among Under-Five Children

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**ABSTRACT:**

Prevalence and Factors associated with Anemia in Children of Under Five Years age: A Cross-Sectional Study in Waghodia Taluka, Vadodara, Gujarat

Anaemia, particularly due to iron deficiency, is a widespread health concern globally, affecting around 1.62 billion individuals, which is approximately 24.8% of the global population. This condition is especially prevalent among children under five, with a global prevalence rate of 47%. Children's health is a critical indicator of a nation's overall health, and addressing anemia is crucial in this context.Aim:This study aimed to estimate the prevalence of anemia among children under five years of age and identify associated risk factors in Waghodia taluka, Vadodara, Gujarat.Materials and Methods:

A cross-sectional study was conducted with 276 children under five years of age in Waghodia taluka. The children's mothers were interviewed using a structured, pre-tested questionnaire to gather socioeconomic and demographic data. Anthropometric measurements and capillary blood samples were collected from each child. Multivariate logistic regression was used to calculate adjusted odds ratios (AOR) to identify factors associated with anemia.

Results:The study included 53.26% boys and 46.7% girls. The overall prevalence of anemia was 42.75%, with mild anemia at 61%, moderate at 35.5%, and severe at 3.4%. Significant factors associated with anemia included: Low socioeconomic Class(AOR: 14.01; 95% CI: 5.216-37.683), Lower middle class (AOR: 1.4; 95% CI: 0.525-3.650), Underweight children (AOR: 2.83; 95% CI: 1.731-4.656), Mothers with no formal education (AOR: 2.14; 95% CI: 0.273-16.814), Primary education (AOR: 2.02; 95% CI: 0.274-15.009), Secondary education (AOR: 0.15; 95% CI: 0.20-1.148), Maternal iron deficiency anemia (AOR: 8.32; 95% CI: 4.690-14.770) and Lack of maternal iron supplementation during pregnancy (AOR: 9.4; 95% CI: 5.43-16.243).

Conclusion:The study revealed a high prevalence of anemia among children under five years of children. Policymakers should focus on strategies to alleviate poverty, enhance maternal education, and raise awareness about breastfeeding, nutrition, and related factors to combat anemia. A multidisciplinary and multifaceted approach is essential to effectively address and reduce anemia in children.

Keywords: Anemia, Children under Five Years, Prevalence, Risk Factors, Socioeconomic Status, Maternal Education, Nutrition.

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## 1. Introduction

India has one of the highest prevalences of anemia, particularly among children, with rates over 70% in many regions. Despite longstanding policies and programs, anemia remains a significant issue due to its severe impact on child development and the availability of effective control measures. Anemia, defined by low hemoglobin levels, results from various factors, with poor nutrition being a primary cause. The WHO defines anemia in children under five as hemoglobin levels below 11 g/dl. According to the National Family and Health Survey (NFHS-5), 80% of children under five in Gujarat are anemic, marking a substantial increase from previous years. Anemia significantly contributes to child morbidity and mortality, impeding physical and cognitive development and economic progress. Various factors, including iron deficiency, maternal health, education, and socioeconomic status, are linked to anemia. This study aims to assess the prevalence and associated factors of anemia in children under five in Waghodia Taluka, Vadodara, and Gujarat.

## 2. Methodology

Study Design and Setting:
A cross-sectional community-based study was conducted to assess the prevalence and associated factors of anemia among children under five years in Waghodia taluka, Vadodara, Gujarat, and Sampling:
The study included 276 under-five children selected from randomly chosen villages in Waghodia taluka. The sample size was calculated using the formula: $n = (Z\alpha/2)^2 * P(1-P) / E^2$. With an 86.4% prevalence of anemia (according to the National Family Health Survey-5, 2019-20), a 95% confidence interval, and a 5% margin of error, the initial sample size was 248. Accounting for a 10% non-response rate, the adjusted sample size was 276. A cluster multi-stage random sampling technique was used to select participants. Children aged 12-59 months whose guardians consented to participate were included, while those with a history of hemolytic disorders, active infections, or fever >101°F were excluded and referred for usual management.

Data Collection Procedure:
Pretested and structured questionnaires were used to collect socioeconomic and demographic data from the family and child, as well as food access security and other associated factors, by interviewing the mothers/caregivers. The questionnaire was derived from previous studies and validated by public health experts. Nutritional status was assessed by measuring the weight and height of children under five and recording the data on the questionnaire. Anthropometric assessments (Height-for-Age, Weight-for-Height, and Weight-for-Age) were conducted using the WHO Anthro software, version 3.2.2. Children were classified as stunted, wasted, or underweight based on their Z-scores.
Capillary blood samples were collected to determine hemoglobin concentration using a digital hemoglobin meter with reagent-free microcuvette technology. One drop of capillary blood was collected from a finger prick and analyzed with the hemoglobin meter. Results were recorded on the questionnaire. The Haemo Cue method was used for its accuracy and precision, comparable to the International Council for Standardization in Hematology (ICS). Strict aseptic techniques and separate lancets for each child were employed.
According to WHO cut-off values, children with hemoglobin levels <11 g/dl were considered anemic. Anemia severity was classified as mild (Hb 10-10.9 g/dl), moderate (Hb 7-9.9 g/dl), or severe (Hb <7 g/dl).
Data Analysis Procedures:

All collected data were entered into IBM SPSS version 25.0 for analysis. Multivariate logistic regression was used to calculate adjusted odds ratios (AOR) and the corresponding 95% confidence intervals (CI). Statistical significance was indicated by a p-value < 0.05.

Ethical Considerations:

Ethical approval was obtained from the Chief District Health Officer of Vadodara District and the ICDS Officer, ICDS Block Office, Waghodia Taluka. The study's purpose was explained to the parents or guardians, and written informed consent was obtained before administering the questionnaire and collecting blood samples.

## 3. Result

Characteristics of Study Participants

A total of 276 children under five years of age participated in the study. Among the child-related factors, nearly half of the children, 145 (52.53%), were between the ages of 2-5 years, and 147 (53.2%) were male. The majority, 132 (47.82%), were introduced to a weaning diet after six months of age, and more than half, 178 (64.49%), had a birth weight of less than 2.5 kg. Regarding their nutritional status, 4 (2.7%) were stunted, 18 (6.52%) were wasted, and a majority, 141 (51.08%), were underweight. In terms of health history, 66 (23.91%) had experienced worm infestations, and 33 (11.95%) had a history of malaria. Adherence to iron-folic acid (IFA) supplementation and deworming with Albendazole was found in 241 (87.31%) and 243 (88%) of the children, respectively.

Concerning household factors, the majority of families, 136 (49.27%), fell into the lower-middle income class, and 116 (42.02%) experienced mild food insecurity. Additionally, 267 (96.7%) of the families had only one child under five years of age.

In terms of maternal factors, more than half of the mothers were underweight. The majority, 122 (44.02%), had secondary education. A significant portion, 93 (33.69%), had iron deficiency anemia during pregnancy, and 108 (39.13%) did not adhere to iron supplementation during pregnancy. Additionally, the majority, 172 (62.31%), of the mothers delivered before 36 weeks of gestation.

Table 1: Characteristics of Study Participants

| Sr.No | Characteristics | | Frequency | Percentage |
|---|---|---|---|---|
| 1 | Socio economic status | Middle Class | 33 | 12.0 |
| | | Lower Middle Class | 136 | 49.3 |
| | | Lower Class | 107 | 38.8 |
| 2 | Food Security Access | Food Secure access | 123 | 44.6 |
| | | Mildly Food insecure access | 116 | 42.0 |
| | | Moderately Food insecure Access | 37 | 13.4 |
| 3 | Number of Under Five Years of children in Family | One | 267 | 96.7 |
| | | Two | 9 | 3.3 |
| 4 | Maternal Education | No Formal Education | 44 | 15.9 |
| | | Primary education | 106 | 38.4 |
| | | Secondary Education | 122 | 44.2 |
| | | Higher Secondary Education | 4 | 1.4 |
| 5 | Maternal iron deficiency Anemia during Pregnancy | Yes | 93 | 33.7 |
| | | No | 183 | 66.3 |

| | | | | |
|---|---|---|---|---|
| 6 | Maternal BMI | Under Weight | 161 | 58.3 |
| | | Normal | 105 | 38.0 |
| | | Over weight | 10 | 3.6 |
| 7 | Maternal iron supplementation during pregnancy | Yes | 168 | 60.9 |
| | | No | 108 | 39.1 |
| 8 | Age of gestation at the time of delivery | Before 36 weeks | 172 | 62.3 |
| | | 36-40 weeks | 75 | 27.2 |
| | | After 40 weeks | 29 | 10.5 |
| 9 | Child Age | 1-2 Years | 131 | 47.5 |
| | | 2-5 Years | 145 | 52.5 |
| 10 | Gender of Child | Male | 147 | 53.3 |
| | | Female | 129 | 46.7 |
| 11 | Age o starting weaning Diet | Before 6 months | 101 | 36.6 |
| | | After 6 Months | 132 | 47.8 |
| | | Delayed Weaning | 43 | 15.6 |
| 12 | Birth weight of children | <2.5. Kg | 178 | 64.5 |
| | | Normal | 98 | 35.5 |
| 13 | Stunting | Yes | 4 | 1.4 |
| | | No | 272 | 98.6 |
| 14 | Wasting | Yes | 18 | 6.5 |
| | | No | 258 | 93.5 |
| 15 | Underweight | Yes | 141 | 51.1 |
| | | No | 135 | 48.9 |
| 16 | History of worm infestation | Yes | 66 | 23.9 |
| | | No | 210 | 76.1 |
| 17 | History of Malaria | Yes | 33 | 12.0 |
| | | No | 243 | 88.0 |
| 18 | Adherence to IFA Supplementation | Adhere | 241 | 87.3 |
| | | Less Adhere | 35 | 12.7 |
| 19 | Adherence to Deworming Tablet- Albendazole | Adhere | 243 | 88.0 |
| | | Less Adhere | 33 | 12.0 |

Prevalence of anemia among under-five Years of children

The overall prevalence of anemia was found to be 42.75%, with mild, moderate, and severe anemia was 72(61%), 42 (35.5%), and 4(3.4%), respectively.

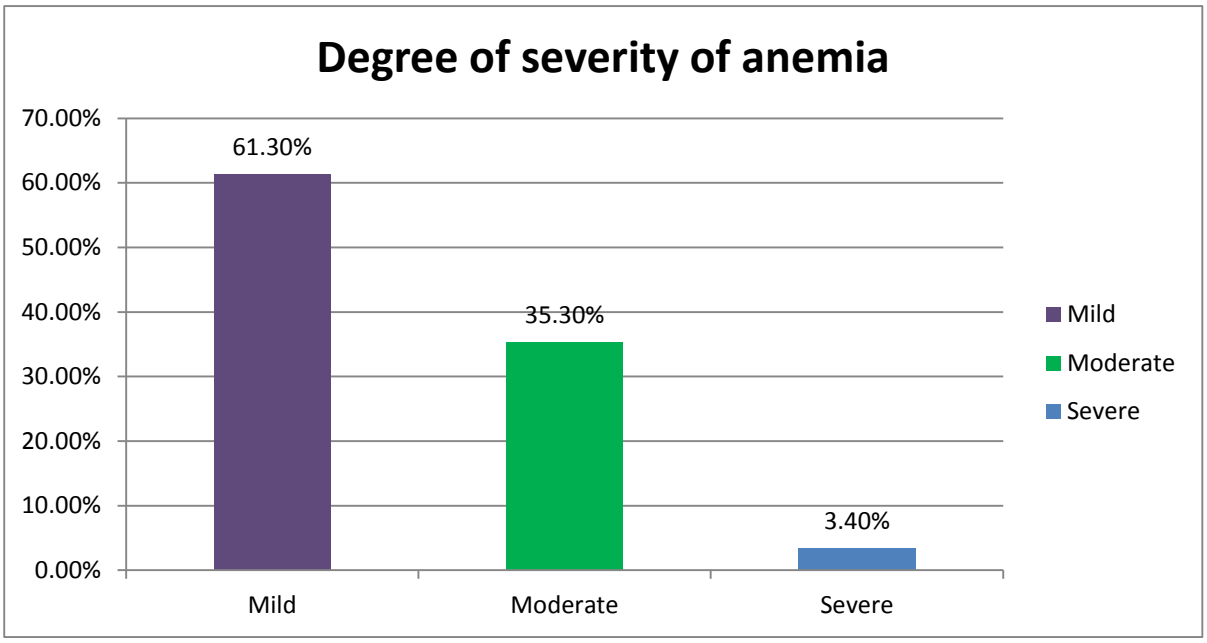


Fig 1. Distribution of anemia by severity among the under five years of children with anemia

Table 2: Distribution of anemia prevalence by Household factors, Maternal Factors & Child factors

| Sr.No | Characteristics | | Status of Anemia | | P value* |
|---|---|---|---|---|---|
| | | | Yes n. (%) | No n (%) | |
| 1 | Socio economic status | Middle Class | 6 (5%) | 27 (17.2%) | 0.01* |
| | | Lower Middle Class | 32 (26.9%) | 104 (66.2%) | |
| | | Lower Class | 81 (68.1%) | 26 (16.6%) | |
| 2 | Food Security Access | Food Secure access | 20 (16.8) | 103 (66.6%) | 0.423 |
| | | Mildly Food insecure access | 83 (69.7%) | 33 (21%) | |
| | | Moderately Food insecure Access | 16 (13.4%) | 21 (13.4%) | |
| 3 | Number of Under Five Years of children in Family | One | 111 (93.3%) | 156 (99.4%) | 0.251 |
| | | Two | 8 (6.7%) | 1 (0.6%) | |
| 4 | Maternal Education | No Formal Education | 30 (25.2%) | 14 (8.9%) | 0.005* |
| | | Primary education | 71 (59.7%) | 35 (22.3%) | |
| | | Secondary Education | 16 (13.4%) | 106 (67.5%) | |
| | | Higher Secondary Education | 2 (1.7%) | 2 (1.3%) | |
| 5 | Maternal iron deficiency Anemia during Pregnancy | Yes | 70 (58.8%) | 23 (14.6%) | 0.04* |
| | | No | 49 (41.2%) | 134 (85.4%) | |

| | | | | | |
|---|---|---|---|---|---|
| 6 | Maternal BMI | Under Weight | 73 (61.3%) | 88 (56.1%) | 0.435 |
| | | Normal | 42 (35.3%) | 63 (40.1%) | |
| | | Over weight | 4 (3.4%) | 6 (3.8%) | |
| 7 | Maternal iron supplementation during pregnancy | Yes | 31 (26.1%) | 137 (87.3%) | 0.000* |
| | | No | 88 (73.9%) | 20 (12.7%) | |
| 8 | Age of gestation at the time of delivery | Before 36 weeks | 54 (45.4%) | 118 (75.2%) | 0.115 |
| | | 36-40 weeks | 50 (42.0%) | 25 (15.9%) | |
| | | After 40 weeks | 15 (12.6%) | 14 (8.9%) | |
| 9 | Child Age | 1-2 Years | 43 (36.1%) | 88 56.1%) | 0.417 |
| | | 2-5 Years | 76 (63.9%) | 69 (43.9%) | |
| 10 | Gender of Child | Male | 48 (40.3%) | 99 (60.1%) | 0.512 |
| | | Female | 71 (59.7%) | 58 (36.9%) | |
| 11 | Age o starting weaning Diet | Before 6 months | 69 (58.0%) | 32 (20.4%) | 0.056 |
| | | After 6 Months | 23 (19.3%) | 109 (69.4%) | |
| | | Delayed Weaning | 27 (22.7%) | 16 (10.2%) | |
| 12 | Birth weight of children | <2.5. Kg | 69 (58%) | 109 (69.4%) | 0.986 |
| | | Normal | 50 (42.1%) | 48 (30.6%) | |
| 13 | Stunting | Yes | 1 (0.8%) | 3 (1.9%) | 0.763 |
| | | no | 118 (99.2%) | 154 (98.1%) | |
| 14 | Wasting | Yes | 14 (11.8%) | 4 (2.5%) | 0.379 |
| | | No | 105 (88.2%) | 153 (97.5%) | |
| 15 | Underweight | Yes | 78 (65.5%) | 63 (40.1%) | 0.01* |
| | | No | 41 (34.5%) | 94 (59.9%) | |
| 16 | History of worm infestation | Yes | 32 (26.9%) | 34 (21.7%) | 0.849 |
| | | no | 87 (73.1%) | 123 (78.3%) | |
| 17 | History of Malaria | Yes | 16 (13.4%) | 17 (10.8%) | 0.941 |
| | | No | 103 (86.6%) | 140 (89.2%) | |
| 18 | Adherence to IFA Supplementation | Adhere | 96 (80.7%) | 145 (92.4%) | 0.281 |
| | | Less Adhere | 23 (19.3%) | 12 (7.6%) | |
| 19 | Adherence to Deworming Tablet-Albendazole | Adhere | 109 (91.6%) | 134 (85.4%) | 0.473 |
| | | Less Adhere | 10 (8.4%) | 23 (14.6%) | |

High prevalence of anemia found in children whose family is of Lower class 81(68.1%), mother having only primary level of education 71 (59.7%) having iron deficiency anemia in pregnancy 70 (58.8.5) had no iron supplementation in pregnancy 88(73.9%) and children who were underweight 78 (65.5%).

Factors associated with anemia

Multivariate logistic regression analysis identified several independent risk factors for anemia. Children from low and lower middle socioeconomic classes were 14.01 times (AOR: 14.01; 95% CI: 5.216-37.683) and 1.4 times (AOR: 1.4; 95% CI: 0.525-3.650) more likely to be anemic, respectively. Underweight children were 2.83 times (AOR: 2.83; 95% CI: 1.731-4.656) more likely to be anemic. Maternal education levels also influenced anemia risk, with children of mothers with no formal education, primary education, and secondary education being 2.14 times (AOR: 2.14; 95% CI: 0.273-16.814), 2.02 times (AOR: 2.02; 95% CI: 0.274-15.009), and 0.15 times (AOR: 0.15; 95% CI: 0.20-1.148) more likely to be anemic,

respectively. Children whose mothers had iron deficiency anemia during pregnancy were 8.32 times (AOR: 8.32; 95% CI: 4.690-14.770) more likely to be anemic, and those whose mothers lacked iron supplementation during pregnancy were 9.4 times (AOR: 9.4; 95% CI: 5.43-16.243) more likely to be anemic.

Table: 3: Factors associated with Anemia

| Variable | Anemia | | AOR (95% CI) |
|---|---|---|---|
| | Yes n (%) | No n (%) | |
| Socioeconomic Status | | | |
| Lower Class | 81 (68.1%) | 26 (16.6%) | 14.01 (5.216- 37.683) |
| Lower Middle Class | 32 (26.9%) | 104 (66.2%) | 1.4 (0.525- 3.650) |
| Middle Class | 6 (5%) | 27 (17.2%) | 1 |
| Maternal Education | | | |
| No Formal Education | 30 (25.2%) | 14 (8.9%) | 2.14 (0.273-16.814) |
| Primary Education | 71 (59.7%) | 35 (22.3%) | 2.02 (0.274-15.009) |
| Secondary Education | 16 (13.4%) | 106 (67.5%) | 0.15 (0.20 – 1.148) |
| Higher Secondary Education | 2 (1.7%) | 2 (1.3%) | 1 |
| Maternal Iron Deficiency Anemia | | | |
| Yes | 70 (58.8%) | 23 (14.6%) | 8.32 (4.690- 14.770) |
| No | 49 (41.2%) | 134 (85.4%) | 1 |
| Maternal Iron Supplementation during Pregnancy | | | |
| No | 88 (73.9%) | 20 (12.7%) | 9.4 (5.43- 16.243) |
| Yes | 31 (26.1%) | 137 (87.3%) | 1 |
| Under Weight | | | |
| Yes | 78 (65.5%) | 63 (40.1%) | 2.83 (1.731- 4.656) |
| No | 41 (34.5%) | 94 (59.9%) | 1 |

AOR- Adjusted Odds ratio, CI- confidence Interval, 1= Reference

## 4. Discussion

This study aimed to assess the prevalence and associated factors of anemia among children under five years of age. The overall prevalence of anemia was found to be 42.75%, which is lower than the 86.4% reported in the NFHS-5 (2019-20) for Vadodara, Gujarat, and studies conducted in Nepal (49.5%) , South-East Nigeria (49.2%), Hohoe municipality and Volta Regional Hospital of Ghana (47.5% & 55.0%), and Limpopo Province, South Africa (75.0%). However, the prevalence is similar to the 2016 Ethiopian DHS report for the Amhara Region (42%). Disparities in prevalence may stem from differences in study design, sampling techniques, sample size, geographical location, and socio-demographic characteristics.

Regarding anemia severity, most anemic children in this study had mild anemia (61%), followed by moderate anemia (35.5%) and severe anemia (3.4%). These findings align with studies from Nepal, Hohoe municipality, Ghana, and India, but differ from the EDHS 2016 reportand a study in Volta Regional Hospital of Ghana, which reported higher rates of moderate anemia.

Sex differences did not show an association with anemia in this study, similar to reports from South-East Nigeriaand Volta Regional Hospital of Ghana. However, other studies have found

higher anemia prevalence in boys than girls, and in girls than boys. This discrepancy might be due to social norms affecting dietary intake, warranting further research.

The study found an association between maternal education levels and child anemia, consistent with other studies. Children of mothers with low educational levels were 0.15 to 2.14 times more likely to be anemic than those of mothers with higher education. Education enhances maternal knowledge about child health and feeding practices, improving nutritional status. This finding contrasts with a study in Northwest Ethiopia.

Children from lower socioeconomic classes were 14.01 to 1.4 times more likely to be anemic than those from middle-class families, similar to findings in other regions. Low-income families often cannot afford nutrient-rich foods and healthcare, contributing to higher anemia rates, and indicating anemia as a marker of socioeconomic disadvantage.

Underweight children were 2.83 times more likely to be anemic than those with normal weight, consistent with studies from Northern Ethiopia and Brazil. Usually Causes of anemia and underweight (malnutrition) are often similar and exacerbated by poverty and food insecurity, which compromise dietary intake quality and quantity.

Limitations

This study's cross-sectional design does not establish causality between independent variables and anemia. Due to resource constraints, serum ferritin, soluble transferrin receptor, folate, vitamin B12 levels, thalassemia, and G6PD deficiency were not measured, which could have provided deeper insights into anemia's causes. Despite these limitations, the study determined anemia prevalence and assessed important associated factors among under-five children in Waghodia taluka, Vadodara, Gujarat.

## 5. Conclusions

The study revealed a high prevalence of anemia among children under five, indicating a severe public health issue. Socioeconomic class, maternal education, maternal anemia and iron supplementation during pregnancy and child’s nutritional status were significantly associated with anemia. Policymakers should strategize to reduce poverty, encourage women's education, and raise awareness about breastfeeding, nutrition, and other factors to mitigate anemia's burden.

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