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Original Research Article

THE PREVALENCE AND PREDICTORS OF IRON DEFICIENCY ANEMIA IN TODDLERS: A POPULATION-BASED STUDY

Alluri Ashok Raju[1], Ashok Babu Boddu[2], D.S.S.K. Raju[3], Uday Shankar Surabhi[4]

[1]Assistant Professor, Department of Paediatrics, Maharajahs Institute of Medical Sciences, Vizianagaram, Andhara Pradesh, India.
[2]Assistant Professor, Department of Paediatrics, Maharajahs Institute of Medical Sciences, Vizianagaram, Andhara Pradesh, India.
[3]Associate Professor, Department of Biochemistry, Maharajahs Institute of Medical Sciences, Vizianagaram, Andhara Pradesh, India.
[4]Associate Professor, Department of Paediatrics, Maharajahs Institute of Medical Sciences, Vizianagaram, Andhara Pradesh, India.

Abstract

Background: Iron deficiency anemia (IDA) is a significant public health issue among toddlers, affecting their growth, cognitive development, and overall health. Identifying the prevalence and predictors of IDA can guide targeted interventions to mitigate its impact. This population-based study aimed to assess the prevalence of IDA among toddlers and identify demographic, dietary, and socioeconomic predictors that contribute to its development. **Material and Methods:** A cross-sectional analysis was conducted on a sample of 100 toddlers aged 12-36 months. Data on hemoglobin levels, dietary intake, socioeconomic status, and other health-related factors were collected and analyzed to determine the prevalence of IDA and its associated risk factors. **Results:** The prevalence of IDA in the study population was 20%. Age and gender were significant demographic predictors, with a higher prevalence observed in toddlers aged 24-36 months (30%) and females (22%). Dietary factors, including breastfeeding duration and dietary diversity, also influenced IDA prevalence, with exclusive breastfeeding for more than 6 months and high dietary diversity associated with lower prevalence rates. Socioeconomic predictors, such as family income and parental education level, showed a clear association, with lower income and education correlating with higher IDA prevalence. Additional parameters, including iron supplementation, birth weight, maternal anemia status, and access to healthcare, were identified as influential factors. **Conclusion:** The study highlights the multifaceted etiology of IDA among toddlers, emphasizing the importance of breastfeeding, dietary diversity, socioeconomic support, and healthcare access in preventing IDA.

INTRODUCTION

Iron deficiency anemia (IDA) is one of the most common nutritional deficiencies worldwide, particularly affecting young children in both developing and developed countries.[1,2] The condition arises when the body's iron stores are insufficient to meet its physiological needs, leading to impaired hemoglobin production, reduced oxygen-carrying capacity of the blood, and a myriad of clinical consequences. In toddlers, IDA is of particular concern due to its potential long-term impacts on cognitive development, behavioral outcomes, and overall growth. Despite the global recognition of IDA as a critical public health issue, its prevalence and determinants vary significantly across different populations, influenced by a complex interplay of dietary, socioeconomic, and health-related factors.[3,4]

The developmental phase of toddlers (aged 12-36 months) represents a period of rapid growth and significant dietary transition, which predisposes them to the risk of developing IDA.[5] During this critical window, dietary practices such as breastfeeding duration, introduction to solid foods, and dietary diversity play crucial roles in meeting the increased iron requirements6. Socioeconomic factors, including family income and parental education, further influence dietary choices and access to iron-rich foods or supplements, thus affecting the risk of IDA. Moreover, additional parameters such as birth weight, maternal anemia

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status, and access to healthcare services can also impact iron status in toddlers.[7]

Given the multifactorial nature of IDA and its significant implications for child health and development, this population-based study aims to elucidate the prevalence of IDA among toddlers and identify key demographic, dietary, and socioeconomic predictors. By understanding these determinants, the study seeks to inform the development of targeted interventions and policies to reduce the burden of IDA in this vulnerable age group, ultimately contributing to better health outcomes and improved quality of life.

The overarching goal of this introduction is to frame IDA within the context of global child health, highlight the importance of identifying its prevalence and predictors in toddlers, and set the stage for the detailed investigation that follows in the subsequent sections of this article.

MATERIALS AND METHODS

Study Design
This population-based cross-sectional study was designed to assess the prevalence and identify predictors of iron deficiency anemia (IDA) among toddlers. The study was conducted over a period from January 2022 to September 2022.

Setting
The research took place at Maharajah's Institute of Medical Sciences, located in Vizianagaram, Andhra Pradesh, India. This setting was chosen due to its comprehensive pediatric healthcare services and its accessibility for the local population, making it an ideal location for recruiting a representative sample of toddlers.

Participants
The study population consisted of toddlers aged 12-36 months who were brought to the outpatient department (OPD) of the pediatric unit for routine health check-ups or minor health complaints. A total of 100 toddlers were recruited using a convenience sampling method. Inclusion criteria were toddlers in the specified age range whose parents or guardians provided informed consent for participation. Exclusion criteria included children with chronic diseases affecting iron metabolism, such as thalassemia or chronic renal failure, and those already receiving treatment for IDA.[8]

Data Collection
Data were collected through a structured questionnaire administered to the parents or guardians of the toddlers. The questionnaire covered demographic information (age, gender), dietary habits (breastfeeding duration, introduction of solid foods, dietary diversity), socioeconomic status (family income, parental education), and health-related factors (birth weight, maternal anemia status, access to healthcare services). Additionally, a venous blood sample was obtained from each toddler to measure hemoglobin and serum ferritin levels, using standard laboratory methods to diagnose IDA according to World Health Organization (WHO) guidelines.

Ethical Considerations
The study protocol was reviewed and approved by the Institutional Ethics Committee of Maharajah's Institute of Medical Sciences. Informed consent was obtained from all parents or guardians before enrollment in the study. All procedures were carried out in accordance with ethical standards for research involving human participants.

Statistical Analysis
Data were analyzed using statistical software. Descriptive statistics were used to summarize the demographic characteristics, dietary practices, and socioeconomic status of the study population. The prevalence of IDA was calculated as a percentage of the total sample. Logistic regression analysis was performed to identify predictors of IDA among the toddlers, with results expressed as odds ratios (ORs) with 95% confidence intervals (CIs). A p-value of less than 0.05 was considered statistically significant.

RESULTS

Our population-based study assessed the prevalence and predictors of iron deficiency anemia (IDA) in toddlers, encompassing a diverse cohort of 100 toddlers. The study aimed to elucidate demographic, dietary, and socioeconomic factors that may contribute to the risk of developing IDA in this vulnerable age group. Herein, we present the findings categorized into overall prevalence, demographic predictors, dietary predictors, socioeconomic predictors, and additional parameters.

Overall Prevalence of IDA
The prevalence of IDA among the study population was found to be 20%, indicating that 20 out of 100 toddlers were diagnosed with this condition. This finding highlights the significance of IDA as a public health concern within the surveyed population.

Demographic Predictors
Analysis of demographic data revealed age and gender as notable predictors of IDA. A higher prevalence was observed in toddlers aged 24-36 months (30%) compared to those aged 12-23 months (10%). Additionally, female toddlers exhibited a slightly higher prevalence (22%) than male toddlers (18%).

Dietary Predictors
Dietary habits played a crucial role in the incidence of IDA. Toddlers who were breastfed for more than 6 months showed a lower prevalence of IDA (15%) compared to those who were breastfed for 6 months or less or not exclusively breastfed (25%). Furthermore, toddlers with a high dietary diversity score had a lower prevalence of IDA (10%) versus those with a low dietary diversity score (30%).

Socioeconomic Predictors

Socioeconomic factors, including family income and parental education, were strongly associated with IDA prevalence. Toddlers from lower-income families had a higher prevalence of IDA (30%) compared to those from higher-income families (10%). Similarly, toddlers whose parents had lower educational levels faced a higher prevalence of IDA (30%) in contrast to those with parents possessing higher educational levels (10%).

Additional Parameters

Further analysis identified additional parameters influencing IDA prevalence. Iron supplementation was significantly associated with a reduced prevalence of IDA, with only 5% of toddlers receiving supplementation being affected, compared to 28% of those not receiving supplementation. Birth weight also emerged as a critical factor, with a 40% prevalence of IDA in toddlers born with low birth weight (<2500 grams) compared to a 15% prevalence in those with a normal birth weight (≥2500 grams). Moreover, maternal anemia status and access to healthcare services were important predictors. Toddlers whose mothers had anemia exhibited a higher prevalence (35%) compared to those whose mothers did not have anemia (10%). Limited access to healthcare services was associated with a higher prevalence of IDA (30%) versus adequate access (10%).

Table 1: Overall Prevalence of IDA

Parameter	Result
Overall Prevalence of IDA	20% (20 out of 100 toddlers)

Table 2: Demographic Predictors

Demographic Factor	Prevalence
Age: 12-23 months	10% (5 out of 50 toddlers)
Age: 24-36 months	30% (15 out of 50 toddlers)
Gender: Female	22% (11 out of 50 toddlers)
Gender: Male	18% (9 out of 50 toddlers)

Table 3: Dietary Predictors

Dietary Factor	Prevalence
Breastfeeding: >6 months	15% (7 out of 47 toddlers)
Breastfeeding: ≤6 months or not exclusively	25% (13 out of 53 toddlers)
Dietary Diversity: High	10% (5 out of 50 toddlers)
Dietary Diversity: Low	30% (15 out of 50 toddlers)

Table 4: Socioeconomic Predictors

Socioeconomic Factor	Prevalence
Family Income: Lower	30% (15 out of 50 toddlers)
Family Income: Higher	10% (5 out of 50 toddlers)
Parental Education: Higher	10% (5 out of 50 toddlers)
Parental Education: Lower	30% (15 out of 50 toddlers)

Table 5: Additional Parameters

Parameter	Prevalence
Iron Supplementation: Yes	5% (2 out of 40 toddlers)
Iron Supplementation: No	28% (17 out of 60 toddlers)
Birth Weight: <2500 grams	40% (8 out of 20 toddlers)
Birth Weight: ≥2500 grams	15% (12 out of 80 toddlers)
Maternal Anemia: Yes	35% (14 out of 40 toddlers)
Maternal Anemia: No	10% (6 out of 60 toddlers)
Access to Healthcare: Limited	30% (15 out of 50 toddlers)
Access to Healthcare: Adequate	10% (5 out of 50 toddlers)

DISCUSSION

Our study identified a 20% prevalence rate of IDA among toddlers, which aligns with global estimates but highlights a significant public health concern within the local context. The variation in prevalence by age and gender suggests targeted interventions might be necessary, particularly for older toddlers and females, who appear more vulnerable to IDA in this population.[9]

The strong association between dietary factors and IDA prevalence underlines the critical role of early nutritional interventions. Specifically, the protective effect of exclusive breastfeeding beyond 6 months and the importance of dietary diversity reinforce WHO's recommendations for infant and young child feeding practices.[10]

Socioeconomic predictors, including family income and parental education levels, were significantly associated with IDA, indicating that broader socio-economic strategies could play a vital role in mitigating this condition. These findings suggest that IDA is not merely a nutritional issue but also a socio-economic one, requiring multifaceted strategies for its prevention and management.[11]

The additional parameters, such as the impact of iron supplementation, birth weight, maternal anemia, and access to healthcare, provide further insights into potential points of intervention. For instance, the significant reduction in IDA prevalence among toddlers receiving iron supplementation highlights the potential benefits of such programs.[12]

Comparison with Existing Literature
Our findings are consistent with other studies conducted in similar settings, which also report high prevalence rates of IDA among toddlers and emphasize the importance of dietary and socioeconomic factors.[13] However, our study contributes to the literature by offering detailed insights into the specific context of Vizianagaram, Andhra Pradesh, where limited data were previously available.[14]

Implications for Practice and Policy
The study's results support the need for comprehensive public health strategies that include nutritional education for parents, support for exclusive breastfeeding, promotion of dietary diversity, and socioeconomic interventions to improve access to nutritious foods. Furthermore, the positive impact of iron supplementation highlights the potential of public health programs to distribute iron supplements as a preventive measure against IDA.

There is also a clear implication for policymakers to consider health interventions that address the socio-economic determinants of health, such as education and income, as part of the strategy to combat IDA among toddlers.

Recommendations for Future Research
Further research should explore longitudinal designs to understand the causal relationships between identified predictors and IDA. Additionally, qualitative studies could provide deeper insights into the barriers and facilitators to adopting recommended dietary practices and accessing healthcare services in this population.

Limitations
The study's reliance on convenience sampling and its cross-sectional design limits the ability to infer causality between predictors and IDA prevalence. Moreover, the specific context of the study may limit the generalizability of the findings to other settings.

CONCLUSION

This study highlights the significant prevalence of IDA among toddlers in Vizianagaram, Andhra Pradesh, and identifies key demographic, dietary, and socioeconomic predictors. Addressing these factors through integrated public health interventions could significantly reduce the burden of IDA in this vulnerable population, with implications for their long-term health and development.

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