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Original Article:

Prevalence of Anemia in Children-A Hospital-Based Study Conducted in Northern Kerala, India

Mohammed Fabin[1], **Jayakrishnan Jayakumar**[2], **Swathy Shanker**[3*]

1. Department of Emergency Medicine, KMCT Medical College, Mukkam, Kerala.
2. Department of Radiology, KMCT Medical College, Mukkam, Kerala.
3. Department of Pathology, KMCT Medical College, Mukkam, Kerala.

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*** Corresponding author:**

Swathy Shanker, MD
.

Address: Departemnt of Pathology, KMCT Medical college, Mukkam,Kozhikode, Kerala.

E-mail: id-swathyshanker.ss@gmail.com

Abstract

Introduction: Anemia is defined as a reduced hemoglobin content leading to minimized oxygen carrying capacity of the cell. Children are commonly affected by anemia which causes impaired development and cognitive defects in them. Among all the causes, iron deficiency is one of the most important contributing factors to the development of anemia. The prevalence of anemia varies in different regions. This study aims to find the prevalence of anemia among children in an urban population of Kerala.

Materials and Methods: This was a retrospective observational study involving 192 children. The children were diagnosed as anemic if hemoglobin value was less than 11g/dl for those younger than 5 years and less than 11.4g/dl in those aged 5-11 years. The children were further diagnosed with mild, moderate or severe anemia based on their hemoglobin levels. Data were retrieved from the hematology reports and tabulated in Microsoft Excel. Analyses were done using SPSS software version 16.0.

Results: This study showed the prevalence of anemia to be 54.7%. The majority of anemic children (48.6%) were mildly anemic while 34.3% were moderately anemic, with 17.1% being severely anemic.

Conclusion: In spite of active policy implementation for elimination of anemia, the prevalence of anemia continues to be high indicating the need for active intervention with early detection and treatment of anemia as a routine procedure.

Keywords: Anemia, Prevalence, Iron deficiency, Northern Kerala

1. Introduction

Anemia is defined as a reduction either in red blood cell count or in the hemoglobin concentration of the red blood cells which in turn leads to reduced oxygen carrying capacity of the cells. [1] The prevalence of anemia varies from region to region and among different age groups. Women in the reproductive age group and children are mostly affected by anemia.

WHO defines anemia as hemoglobin concentration less than or equal to 10.5g/dl for children aged 6 months to 5 years and hemoglobin values less than or equal to 11.4 g/dl for children in the age group 5-11 years. Anemia is classified into mild, moderate or severe based on the hemoglobin levels. For children aged younger than 5 years of age, WHO describes

hemoglobin value in the range of 10-10.9g/dl as mild anemia.7-9.9 g/dl of hemoglobin is described as moderate anemia and hemoglobin values less than 7 g/dl is described as severe anemia. For children in the age group of 5-11 years, hemoglobin level in the range of 11-11.4g/dl is taken as mild anemia, in the range of 8-10.9g/dl as moderate anemia, and less than 8g/dl as severe anemia. [2]

Children are commonly affected by anemia and this is particularly of importance as it leads to developmental issues in children. When the oxygen carrying capacity of the red blood cells is reduced, it can result in inadequate oxygenation of organs. This is the reason why anemic children most commonly present with complaints of reduced attention span, poor performance in school and impaired motor skill development. [3] The causes for the occurrence of anemia in children is mostly diet-related and seen in toddlers with poor food intake and in infants with incomplete breast feeding. The late and early initiation of complementary feeding has been assessed to be an important factor in the development of anemia.

Numerous policies have been implemented by the government to ensure early detection and intervention for the treatment of anemia in children. Periodical surveys and studies are required to assess the efficacy of the policies and to evaluate the need for other methods to ensure that the end goal of reduction in the burden of anemia is achieved. [4] The prevalence of anemia is higher in countries with low socioeconomic status due to poor dietary iron intake and limited availability of nutritional supplements. Enrichment of food, availability of nutritional supplements and monitored dietary intake are measures that have been taken to reduce the prevalence of anemia. [5] Maternal nutrition is also an important factor in development of anemia in children, especially infants.[6]

The most common subtype of anemia seen in children is iron-deficiency anemia. Its early detection and treatment can prevent long-term complications of the disease and ensure proper development of the child. When left untreated, anemia can lead to heart failure and even death. [7] Hemoglobinopathies, infections, kidney and gastrointestinal diseases are other common causes of anemia seen in children. [8]

In this study, we aim to find the prevalence of anemia among children aged less than 12 years in the urban community of Kerala, India.

2. Materials and Methods

This was a retrospective study conducted in a tertiary care hospital in northern Kerala.

Sample size was calculated using the formula n= $(Z_{\alpha/2})^2$x pq /d^2. Prevalence (p) was taken as 76%, q=24% and absolute error (d) was taken as 7%. Total of 192 children were included in the study. All children, aged less than 12 years, who got admitted into the hospital for minor ailments during the month of January in 2024, were included in the study. Children who were known cases of hemoglobinopathies, suffering from renal or gastrointestinal diseases, or presenting with fever and also those aged less than 6 months were excluded from the study.

Complete blood count results were obtained by running the blood samples through Auriba abx Penta XLR hematology analyser Hemoglobin value less than 11g/dl is described as anemic for children in the age group of 6 months- 5 years. Based on the hemoglobin levels, the anemic children in the age group were classified into mild (hemoglobin level in the range of 10-10.9g/dl), moderate (the range of 7-9.9g/dl) and severe anemia (less than 7g/dl). For children in the age group 5-11 years, hemoglobin level greater than or equal to 11.4g/dl were considered non anemic. Based on the hemoglobin levels, the anemic children in the age group with hemoglobin levels in the range of 11-11.4g/dl, the range 8-10.9g/dl, and less than 8g/dl were classified into mild, moderate and severe anemia, respectively.

Statistical analysis

In this study, all the indices obtained from the hematology reports were entered in Microsoft Excel, and data were analyzed using SPSS software version 16.0. Prevalence was calculated by dividing the number of children diagnosed with anemia with the total number of children included in the study and was expressed as percentage.

Prevalence (%) = (Number of children with anemia / Total number of children included in the study) x 100

3. Results

A total of 192 children were included in the study.

The total number of children diagnosed with anemia was 105 which constituting 54.7 % of the study population.

The study population showed a predominance of boys. There were 108 boys and 84 girls in the study. Among these, 55 boys and 50 girls were diagnosed as anemic. This showed a slight predominance of boys in the anemic population. (Figure 1).

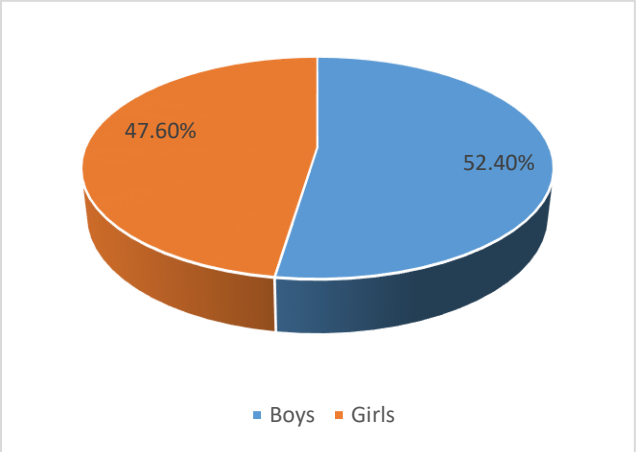

Figure 1. Sex distribution among the children diagnosed with anemia

Majority of children diagnosed with anemia were in the age group of 5-11 years (45.7%). The age distribution of the study population is given in Table 1 and Figure 2. The age distribution among the anemic children is depicted in Figure 3.

Table 1. Age distribution of the study population

Age group	Number of children	Percentage of the study population	Number of children with anemia	Percentage of children with anemia in the particular age group
6 months-1 year	28	14.6%	12	11.4%
1-5 years	78	40.6%	45	42.9%
5-11 years	86	44.8%	48	45.7%

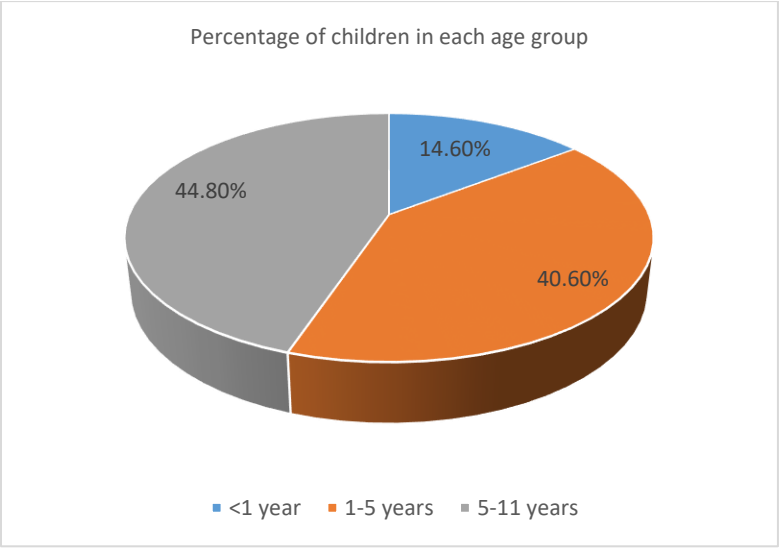

Figure 2. Age distribution of the study population

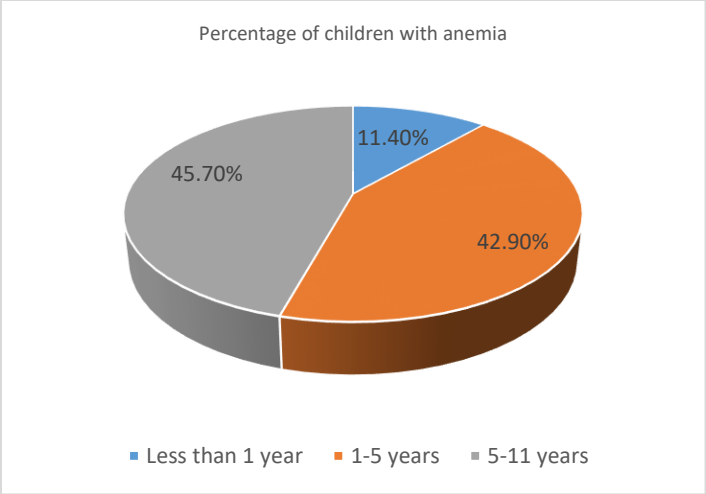

Figure 3. Age distribution among the anemic children

Children were diagnosed with mild, moderate or severe anemia based on the hemoglobin levels (Table 2). Among children aged less than 5 years, 46.2% had normal hemoglobin levels. 29.2% had mild anemia, and 17% had moderate anemia. Just 7.6% had severe anemia (Table 3, Figure 4).

Table 2. Classification of anemia according to hemoglobin values

Severity of anemia	Hemoglobin concentration (for children less than 5 years)	Hemoglobin concentration (for children in the age group 5-11 years)
Non anemic	≥11g/dl	>11.4g/dl
Mild anemia	10-10.9g/dl	11-11.9g/dl
Moderate anemia	7-9.9g/dl	8-10.9g/dl
Severe anemia	<7g/dl	<8g/dl

Table 3. Distribution of the study population according to hemoglobin levels in children aged less than 5 years

Hemoglobin level	Number of children	Percentage of children
<7g/dl	8	7.6%
7-9.9g/dl	18	17.0%
10-10.9g/dl	31	29.2%
>/= 11 g/dl	49	46.2%

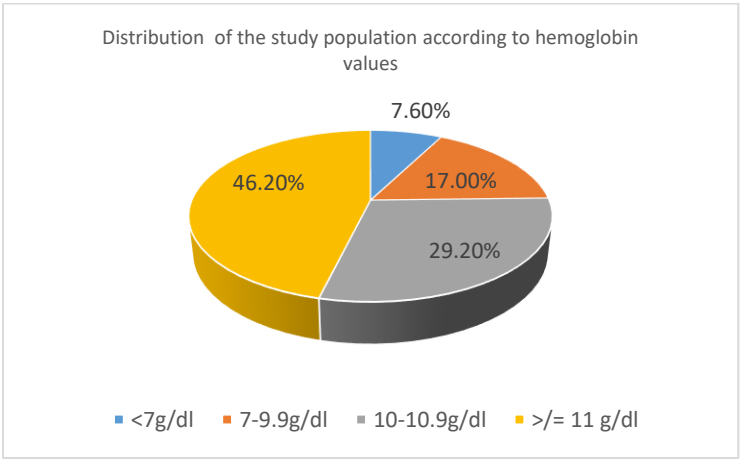

Figure 4. Distribution of children aged less than 5 years according to hemoglobin values.

Among those in the age group of 5-11 years, 44.2% had normal hemoglobin values. 23.2% had mild anemia, while 21% had moderate anemia. 11.6% had severe anemia (Table 4, Figure 5).

The mean Red Blood Cell indices of the study population were calculated and analysed. (Table 5).

Table 4. Distribution of the study population according to hemoglobin levels in children aged 5-11 years

Hemoglobin level	Number of children	Percentage of the study population
<8g/dl	10	11.6%
8-10.9g/dl	18	21.0%
11-11.4g/dl	20	23.2%
>/= 11.4 g/dl	38	44.2%

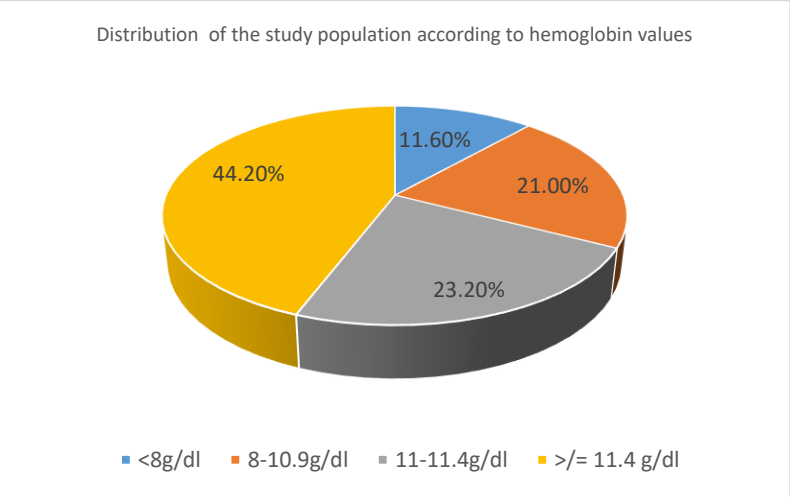

Figure 5. Distribution of children aged 5-11 years according to hemoglobin values.

Table 5. Mean values of the red blood cell indices in the study population

Red Blood Cell indices	Mean values
Red blood cell count (RBC count)	$4.58x10^6$/microlitre
Hemoglobin (Hb)	11.9 g/dl
Packed cell volume (PCV)	35.9%
Mean Corpuscular volume (MCV)	74.3 fl
Mean corpuscular hemoglobin (MCH)	26.5pg
Mean corpuscular hemoglobin concentration (MCHC)	33.6 g/dl
Red cell distribution width -Coefficient of variance (RDW-CV)	12.9%
Red cell distribution width- standard deviation (RDW-SD)	38.3 fl

RBC count of the study population ranged from 2.62 million/microlitre to 5.65 million/microlitre with a mean value of 4.58million/microlitre. Hemoglobin values ranged from 7.2g/dl to 14.5g/dl with a mean value of 11.9 g/dl. The PCV of the study population ranged from 24.5% to 42.8% with a mean value of 35.9%. MCV values ranged from 61.2 fl to 104 fl with a mean value of 74.3fl. MCH ranged from 19.2 pg to 36.4pg (mean=26.5pg), while MCHC ranged from 29g/dl to 35.7 g/dl(mean=33.6g/dl). Red cell distribution width varied greatly with RDW-CV ranging from 10.3% to 38% and RDW-SD ranging from 29.5 fl to 85 fl. Mean value of RDW CV was 12.9% while that of RDW-SD was 38.3 fl.

4. Discussion

54.7% of the study population were found to be anemic. Among these, 51 children showed mild anemia, and 36 children had moderate anemia. 18 children had severe anemia. This showed that the majority of anemic children (48.6%) were mildly anemic while 34.3% were moderately anemic, with 17.1% being severely anemic.

Similar studies conducted in China [9] and Ethiopia [10] have shown that the majority of children with anemia fell in the mildly anemic group. This may be due to the fact that these children are mostly asymptomatic and thereby fail to get the required medical attention and intervention.

According to a study conducted in 2021, the prevalence of anemia was found to be 41.2% in central Kerala among children of age 6 months to 5 years. [11] According to NFHS-4, the prevalence of anemia in the state was estimated to be 35.6%, while the national prevalence was 58.4%.[12]

According to a study conducted by P S Rakesh et al in 2015, [13] the prevalence of anemia in southern Kerala was estimated to be 31.4% among school children. From among these children, 18.5% had mild anemia, and 11.9 % had moderate anemia, with just 1% being severe anemic. In the same study, it was reported that the majority of children lacked meat, citrus fruits and green leafy vegetables in their daily diet. There was also a lack of iron and folic acid supplementation. Weekly supplementation of iron has been found to significantly raise iron stores in children.[14] A study conducted in 2015 among the tribal children of Wayanad showed a 95.7% prevalence of anemia.[15]

According to WHO, anemia from iron deficiency was an important factor in contributing to the global burden of diseases. It increases the mortality and morbidity of women and children, especially in the pre-school age group.[16]

According to this study, the majority of children were in the age group of 1-7 years. This was in concordance with other studies, [17,18] which showed that older children are less likely to develop anemia when compared to younger children/children in pre-school age group.

According to a study conducted by Malako BG et al, [19] there was a significant association between dietary diversity and development of anemia in children. Studies have also shCown that eradication of H. Pylori can lead to significant improvement of anemia in children. [20,21]

The status of maternal nutrition has been proven to be an important factor in the development of anemia in infants, thereby elevating the need for treatment of iron deficiency anemia in pregnant women. [22] Proper supplement intake as well as the awareness of its importance has to be monitored on a regular basis. According to a study conducted by Melku M et al, [23] 46.8% prevalence of anemia was noted among children of mothers who did not receive proper antenatal care.

The present study showed a slight predominance of boys among the study population (52.4%). In contrast to this finding, other studies show a female preponderance in the study population. [19,24-26]. Studies have shown that factors like prolonged breast feeding, inadequate complementary feeding, worm infestation and growth spurts can cause anemia in children.[27-29] The exact cause for the male predominance in this study could not be assessed.

The major limitation of the study is that the underlying causes for anemia in children could not be assessed and a follow-up could not be done due to the retrospective nature of the study.

5. Conclusion

According to the study, the prevalence of anemia was found to be 54.7%. Although many policies have been introduced by the government to ensure adequate dietary and supplementary intake in women and children, prevalence of anemia remains to be high. This emphasizes the need for active intervention by early detection and treatment of anemia. This goal can be achieved by conducting routine camps in schools and pre-schools/Anganwadis for detection of anemia and also for raising public awareness about the importance of dietary diversification and supplement intake. Those women who are expecting newborn babies also need to be educated on the need for proper antenatal care.

Ethical Considerations

Compliance with ethical guidelines

There were no ethical considerations to be considered in this research.

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Author's contributions

The authors equally contributed to preparing this article. All authors read and approved the final draft of the manuscript.

Conflict of interest

The author declares that there is no conflict of interest.

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