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Original Article

A Cross Sectional Study of Nutritional Status of Patients with Iron Deficiency Anemia from 1-5 Years of Age

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ABSTRACT

Nutritional deficiency disorders constitute a major health problem in India. In addition to direct implications for morbidity and mortality, undernutrition predisposes children and adults to various infections[1]. Microcytic anaemia due to iron deficiency is the most common type of anaemia in children and is considered to be among the most important contributing factors for the global burden of the disease. Malnutrition is a major contributor to child mortality, present in half of all the cases globally, especially in children under 5 years of age. The nutritional status of an individual is often the result of many interrelated factors. Therefore, the present study was undertaken to determine the nutritional status of patients with iron deficiency anaemia from 1-5 years of age using anthropometric measurements and to determine if there is any correlation between the severity of malnutrition and the severity of anaemia.

Key Words: *Anaemia, Nutrional Anemia, Iron deficiency, Malnutrition.*

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INTRODUCTION

Nutritional deficiency disorders constitute a major health problem in India. In addition to direct implications for morbidity and mortality, undernutrition predisposes children and adults to various infections[1]. Anaemia resulting from lack of sufficient iron for the synthesis of haemoglobin is the most common haematological disease of infancy and childhood [2]. Globally, about 47.4% of children under five are suffering from anemia [3]. In developing countries, it affects 46–66% of children aged under five years [4]. The consequences of iron deficiency anemia are many and serious, affecting not only individual's health, but also the development of societies and countries [5]. Therefore, the present study was undertaken to determine the nutritional status of patients with iron deficiency anaemia from 1-5 years of age using dietary history and anthropometric measurements and to determine if there is any correlation between the severity of malnutrition and the severity of anaemia.

AIM

A cross-sectional study of nutritional status of patients with iron deficiency anaemia from 1-5 years of age.

OBJECTIVES

1. To study the nutritional status of patients with iron deficiency anaemia from 1-5 years of age using anthropometric measurements.
2. To determine if there is any correlation between the severity of malnutrition and the severity of anaemia.

MATERIALS AND METHODOLOGY

The present study was conducted in the Department of Pediatrics at a Tertiary Care Centre during a period of 1 year from February 2021 to February 2022 to assess the nutritional status of children with iron deficiency anemia from 1-5 years of age.

Study Design: This was a cross-sectional study.
Study Setting: Pediatric ward of tertiary health care centre in central India.
Study Population: All the children in the age between 1 to 5 years who were admitted in the pediatric ward of a tertiary health care centre and having IDA defined by Hb <11 gm% and MCV <70 were enrolled in the study.
Duration of Study: 1 year from February 2021 to February 2022
Sample Size: 165 children

Inclusion Criteria

- All the children in the age group of 1 to 5 years admitted in the pediatric ward with IDA (Hb<11 gm% and

MCV <70) as per WHO criteria.
- Patient's parents willing to give informed written consent.

Exclusion Criteria
- Child with known cause of anemia other than IDA or active bleeding.
- History of recent surgery or blood transfusion
- Lack of parental consent.

Ethical Consideration

This study was conducted in compliance with the protocol, the Institutional Ethical Committee (IEC), and informed consent regulations. Before initiating the study, the investigator had written and dated approval from the IEC for the following documents: study protocol/amendment(s), written informed consent form, Case Report Forms, and protocol summary. During the study, any amendment or modification to the study protocol was submitted to the ethics committee (IEC). It should also be informed of any event likely to affect the safety of patients. Progress report and study completion report also must be sent to IEC.

Informed consent

The investigator explained the benefits and risks of participation in the study to each patient's parents in detail in the language best known to them. Subsequently a written informed consent prior to the patient's entering the study (i.e., before initiation of routine tests) was obtained from the parents.

Methodology

A total of 165 children aged between 1 to 5 years, admitted in the pediatric ward of a tertiary health care centre with IDA, during a period of 1 year from February 2021 to February 2022 and who fulfil the inclusion and exclusion criteria were included in the study.

After obtaining written informed consent from parents or guardians, personal details and history were taken, demographic data (age and gender) and chief complaints were recorded. General, systemic, and complete clinical examination was performed on children admitted in the pediatric ward. Anthropometric measurements like height, weight, head circumference, chest circumference (CC), Mid-Upper Arm Circumference (MUAC) were measured. The indicators: height-for-age z scores (HAZ), weight-for-age z scores (WAZ), and weight-for-height z score (WHZ) were used to assess the nutritional status of children.

Blood samples of the patients included in this study were collected and examined for hematological investigations like Hb%, and peripheral smear.

Weight- The weighing scale was placed on the flat horizontal surface. The shoes or chappals were removed, and the child was made to stand on the weighing scale with minimum clothing. The weighing scale was calibrated regularly. Weight should be taken once the weighing scale is kept at zero level.

Height- A vertical wooden stick was used for measurement of height. Measurements were made by the side of the wall. The child with bare feet was made to stand with the heels, buttocks, shoulders and occiput touching the wall and looking straight in Frankfurt plane with hair being flattened completely. The measurement was read by placing the horizontally held wooden board touching the top of the head. Length was measured by infantometer for children less than 2 years.

Mid Upper Arm Circumference - Measurement was performed on the left arm, midway between the acromion and olecranon process. The clothing was uncovered over the arm. The measuring tape encircling the arm was held gently without pressing the soft tissues.

Head circumference- While measuring the head circumference, the maximum occipitofrontal circumference was measured by placing the flexible non-stretchable tape firmly over the most prominent region of the occipital and frontal crest. The measurement was taken accurate to the nearest 0.1 cm.

Chest circumference - In children ≤ 5 years, chest circumference was measured in lying down position at the level of the nipple, preferably in mid inspiration, xiphisternum using a flexible non-stretchable tape.

Measurement of Z score for Nutritional Status

Z-score (or SD-score) = (observed value - median value of the reference population) / standard deviation value of reference population.)

Table 1: Z score value according to WHO classification for Nutritional assessment

Weight for age Z score	Classification
-1<WAZ<0	Normal weight
-2<WAZ-1	Mild underweight
-3<WAZ<-2	Moderate Underweight
WAZ<-3	Severely Underweight
Height for age Z score	**Classification**
-1<HAZ<0	Normal stunted
-2<HAZ<-1	Marginally Stunted
-3<HAZ<-2	Moderate Stunted
HAZ<-3	Severely stunted
Weight for Height Z score	**Classification**
-1< WHZ<0	Normal
-2<WHZ<-1	Marginally wasted
-3<WHZ<-2	Moderately wasted
WHZ<-3	Severely wasted

Statistical Analysis

Data entry and statistical analysis was performed with the help of SPSS version 21. Categorical variables were presented as number and percentage. Chi-square test was used to compare the differences in categorical variables. The p value <0.05 was considered significant and analysis of the data and Microsoft Word and Excel has been used to generate graphs, tables, etc. Frequency, simple proportion and percentage was used for data analysis.

RESULTS

This cross-sectional study was carried out in the Department of Pediatrics, at a Tertiary care hospital during a period of 1 year from February 2021 to February 2022. During this study period, a total of 165 children with IDA who fulfill the inclusion and exclusion criteria were enrolled and studied to assess the nutritional status of children with iron deficiency anemia from 1-5 years of age. The various data and test results of 165 children are being presented in the form of tables and figures.

Demographic data:

Table 2: Distribution of children according to age

Age group in years	No. of patients	Percentage
1 to 2 years	78	47.27
2 to 3 years	28	16.96
3 to 4 years	35	21.21
4 to 5 years	24	14.54
Total	165	100.0
Mean age	2.74 ± 1.40	

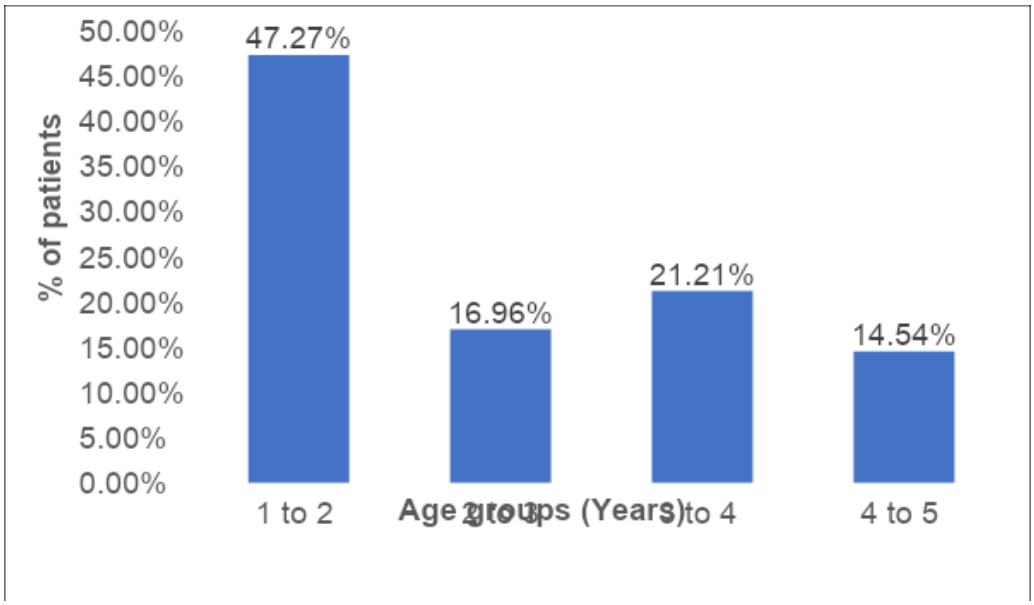


Figure 1: Distribution of children according to age

Table 2 and figure 1 show the distribution of children according to age. It was observed that the majority of children (47.27%) were from the age group of 1 to 2 years followed by 3 to 4 years (21.21%), 2 to 3 years (16.96%) and 4 to 5 years (14.54%). The mean age of the children was 2.74 ± 1.40 years, ranging from 1 to 5 years.

Table 3: Distribution of children according to sex

Gender	No. of patients	Percentage
Male	93	56.36
Female	72	43.63
Total	165	100.0

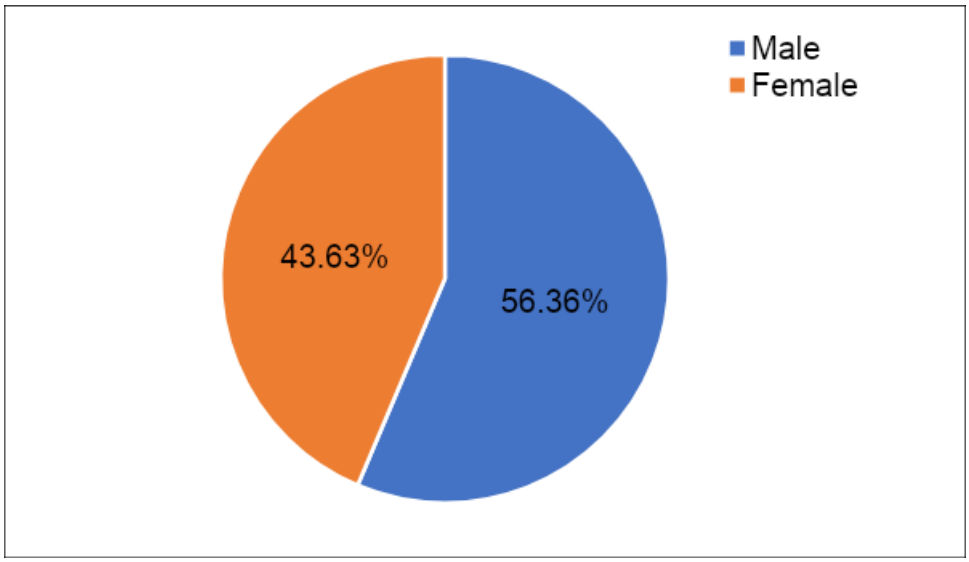


Figure 2: Distribution of children according to sex

Most of the children i.e., 93 (56.36%) were male and 72 (43.63%) were female. The male to female ratio was 1.29:1. Thus the male predominance was observed in this study.

ANTHROPOMETRIC MEASUREMENTS

Table 4: Distribution of children according to weight (kgs)

Weight (kgs)	No. of patients	Percentage
5 to 10	92	55.75
11 to 15	64	38.78
16 to 20	09	5.45
Total	165	100.0

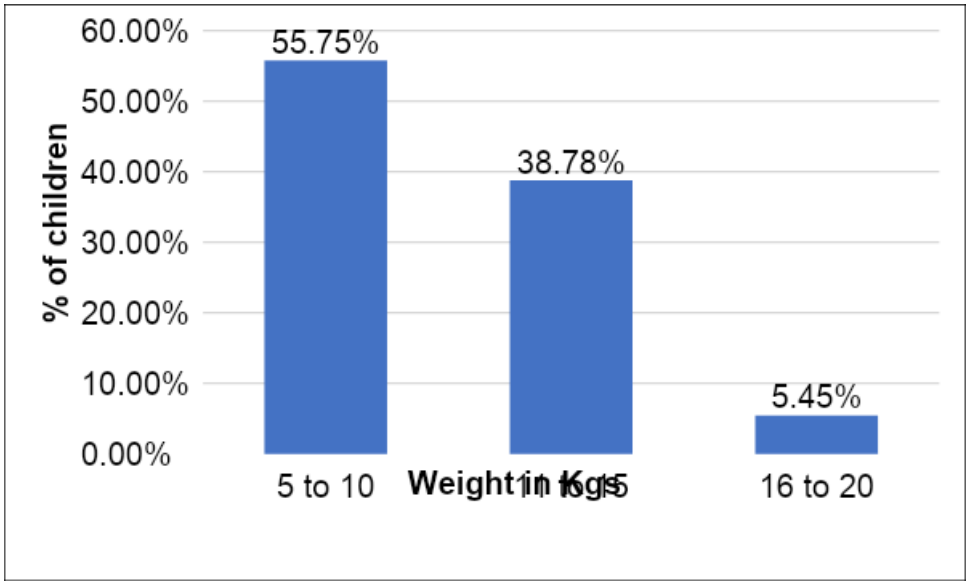


Figure 3: Distribution of children according to weight (kgs)

Most of the children had weight between 5 to 10 kgs followed by 11 to 15 kgs (38.78%) and 16 to 20 kgs (5.45%), (Table 4 and figure 3).

Table 5: Distribution of children according to height (CM)

Height (CM)	No. of patients	Percentage
55 to 80	48	29.09
81 to 90	44	26.66
91 to 100	44	26.66
101 to 110	23	13.93
111 to 120	05	3.03
121 to 130	01	1.0
Total	165	100.0

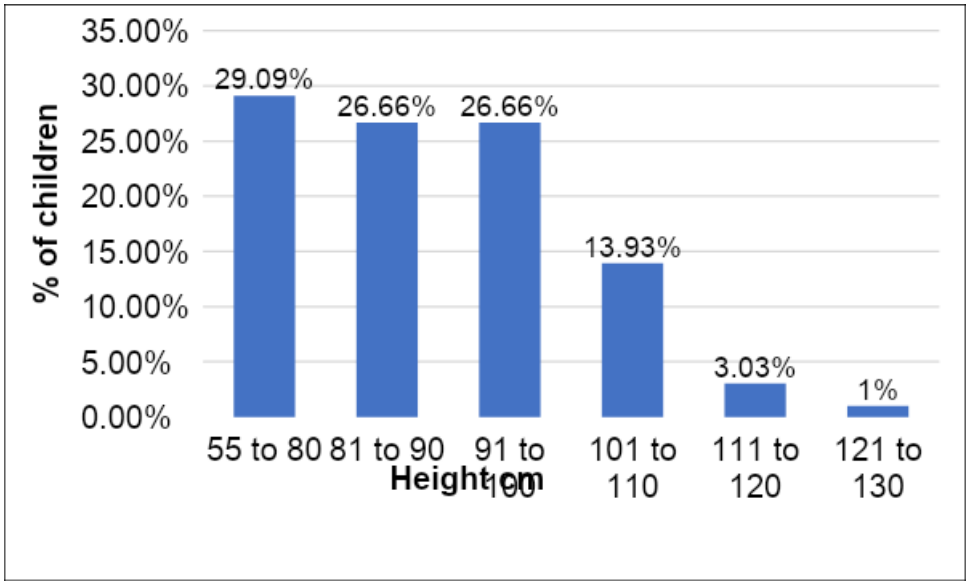


Figure 4: Distribution of children according to height (CM)

From the table 5 and figure 4, it was observed that most of the children had height between 55 to 80 cm (29.09%) followed by 81 to 90 cm (26.66%) and 91 to 100 cm (26.66%). Only one child had height between 121 to 130 cm.

Table 6: Distribution of children according to Head circumference (HC) (CM)

HC (CM)	No. of patients	Percentage
40 to 45	51	30.90
46 to 50	101	61.21
51 to 55	12	7.27
>55	01	1.0
Total	165	100.0

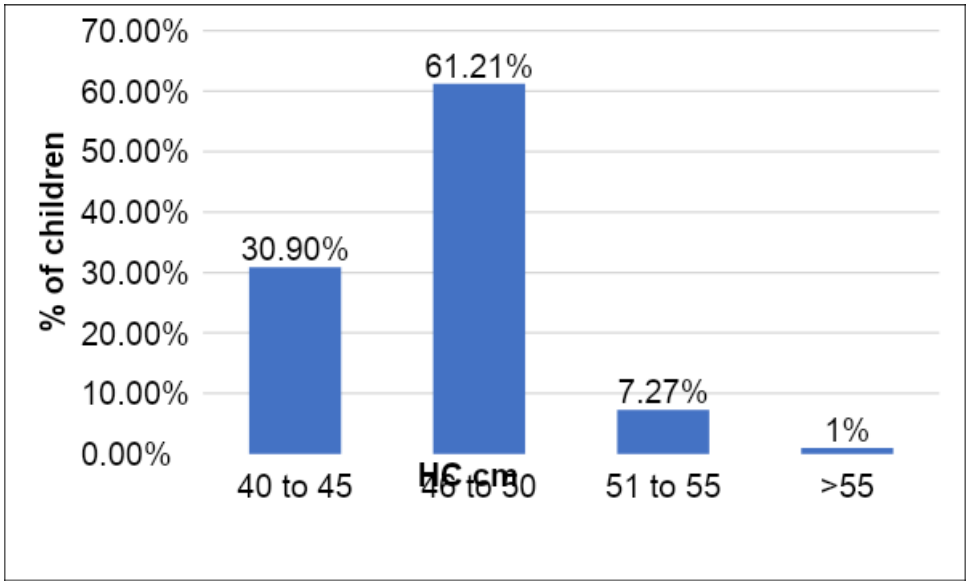


Figure 5: Distribution of children according to Head circumference (HC) (CM)

Maximum number of children had head circumference between 46 to 50 cm (61.21%) followed by 40 to 45 cm (30.90%).

Table 7: Distribution of children according to chest circumference (CC) (Cm)

CC (CM)	No. of patients	Percentage
36 to 45	28	16.96
46 to 50	83	50.30
51 to 55	44	26.66
56 to 65	10	6.06
Total	165	100.0

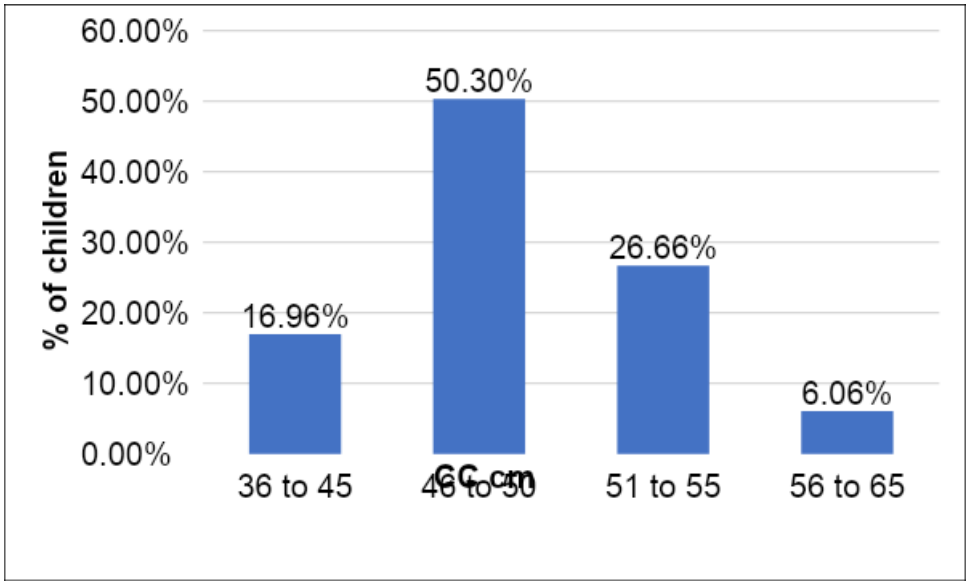


Figure 6: Distribution of children according to chest circumference (CC) (Cm)

From the table 7 and figure 6, it was observed that most of the children had calf circumference between 46 to 50 cm (50.30%) followed by 51 to 55 cm (26.66%), 36 to 45 cm (16.96%) and 56 to 65 cm (6.06%).

Table 8: Distribution of children according to Mid-Upper Arm Circumference (MUAC)

MUAC	No. of patients	Percentage
<12.5	34	20.60
12.5 to 13.5	46	27.87
>13.5	85	51.51
Total	165	100.0

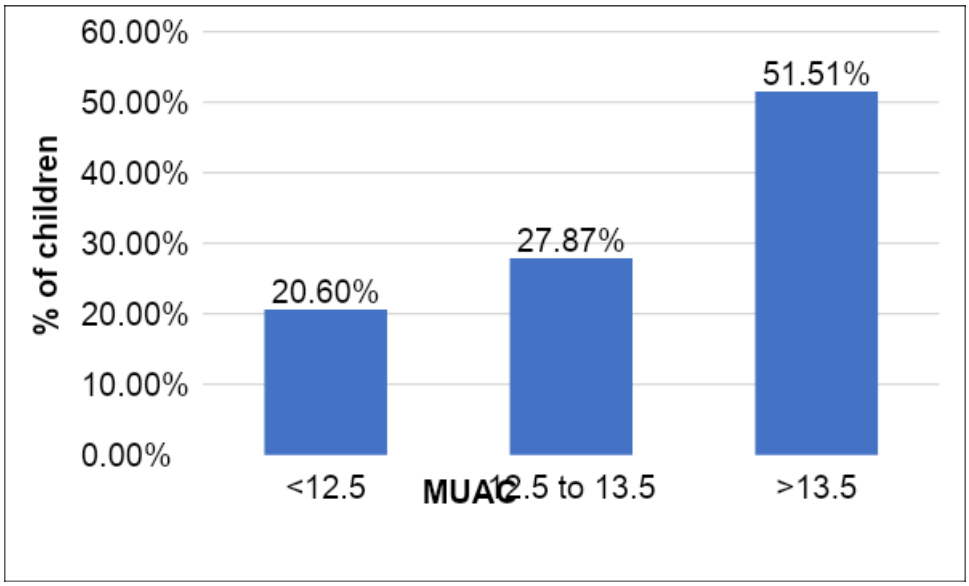


Figure 7: Distribution of children according to Mid-Upper Arm Circumference (MUAC)

Most of the children had mid arm circumference within normal limits (more than 13.5 cm) (51.51%) while 46 (27.87%) had MUAC between 12.5 to 13.5 cms (mild malnutrition), and 34 (20.60%) had MUAC below 12.5 cms (moderate to severe malnutrition) as shown in table 8 and figure 7.

INTERPRETATION OF ANTHROPOMETRY

Table 9: Underweight and malnutrition derived from the weight and height of children relative to their age (n=165)

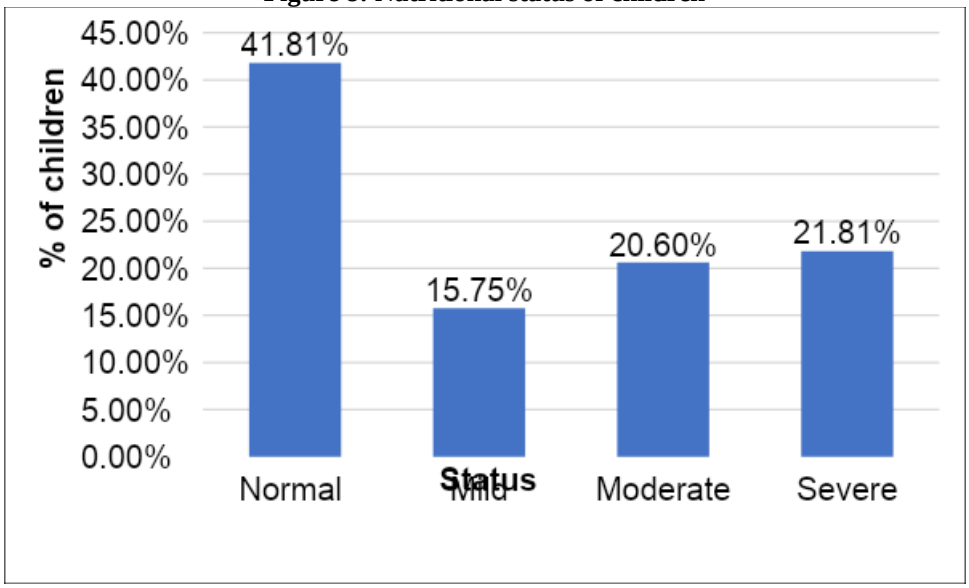
Index	Cut-off value based on SD	Terms of status Malnutrition	No. of patients
Weight-for-age Z score	>-2 WAZ	Mild underweight	01 (1.0%)
	< -2 and > -3 WAZ	Moderate underweight	17 (10.30%)
	< -3 WAZ	Severe underweight	59 (35.75%)
	0 to -2 WAZ	Normal	88 (53.33%)
Height-for-age Z score	2 to 1.01 HAZ	Mild stunting	12 (7.27%)
	< -2 and > -3 HAZ	Moderate stunting	13 (7.87%)
	< -3 HAZ	Severe stunting	33 (20.0%)
	0 to -2 WAZ	Normal	107 (64.84%)
Weight-for-height Z score	>-2 WHZ	Mild wasting	12 (7.27%)
	-3 to -2.01 WHZ	Moderate wasting	28 (16.96%)
	<-3 WHZ	Severe wasting	33 (20.0%)
	0 to -2 WAZ	Normal	92 (55.75%)

From table 9, we show that in the case of WAZ 1 percent of children were mildly underweight, 10.30% were moderately underweight, 35.75% were severely underweight and 53.33% children were of normal weight. In case of HAZ, 7.27% children were mildly stunted, 7.87% were moderately stunted, 20.0% children were severely stunted, and 64.84% children were of normal height. In case of WHZ, 7.27% children were mildly wasted,16.96% were moderately wasted, 20% were severely wasted and 55.75% of children were of normal weight and height.

Table 10: Nutritional status of children

Status	No. of patients	Percentage
Normal	69	41.81
Mild	26	15.75
Moderate	34	20.60
Severe	36	21.81
Total	165	100.0

Figure 8: Nutritional status of children



From the table 10 and figure 8, it was observed that most of the patients were severely malnourished (21.81%) followed by moderately malnourished (20.60%) and mild malnourished (15.75%).

ROUTINE INVESTIGATIONS

Table 11: Hemoglobin level defining anemia (HB gm/dl)

HB gm/dl	No. of patients	Percentage
<7 (severe anemia)	23	13.93
7 to 9.99 (Moderate anemia)	67	40.60
10 to 10.99 (Mild anemia)	75	45.45
Total	165	100.0
Mean	9.12±1.67	

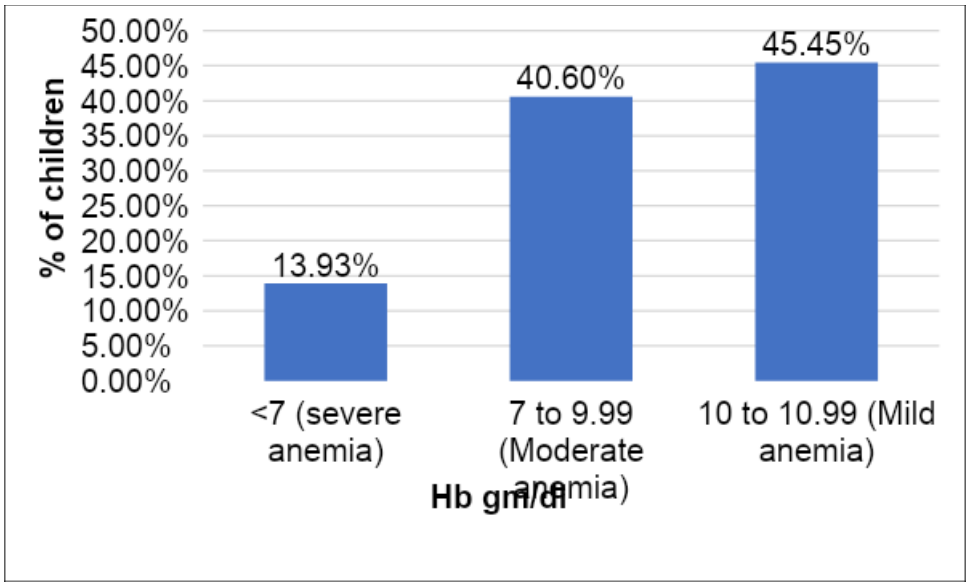


Figure 9: Hemoglobin level defining anemia (HB gm/dl)

Maximum children had Hb between 10 to 10.99 gm/dl, defined as mild anemia (45.45%) followed by moderate anemia with Hb between 7 to 9.99 gm/dl and 13.93% of children had Hb <7 gm/dl defined as severe anemia. The mean Hb level was 9.12±1.67 gm/dl, (Table 20 and figure 22).

Table 12: Peripheral blood smear examination (Morphological types of anemia)

Peripheral smear	No. of patients	Percentage
Microcytic hypochromic anemia (MHA)	144	87.27
Normocytic normochromic anemia (NNA)	20	12.12
Total	158	100.0

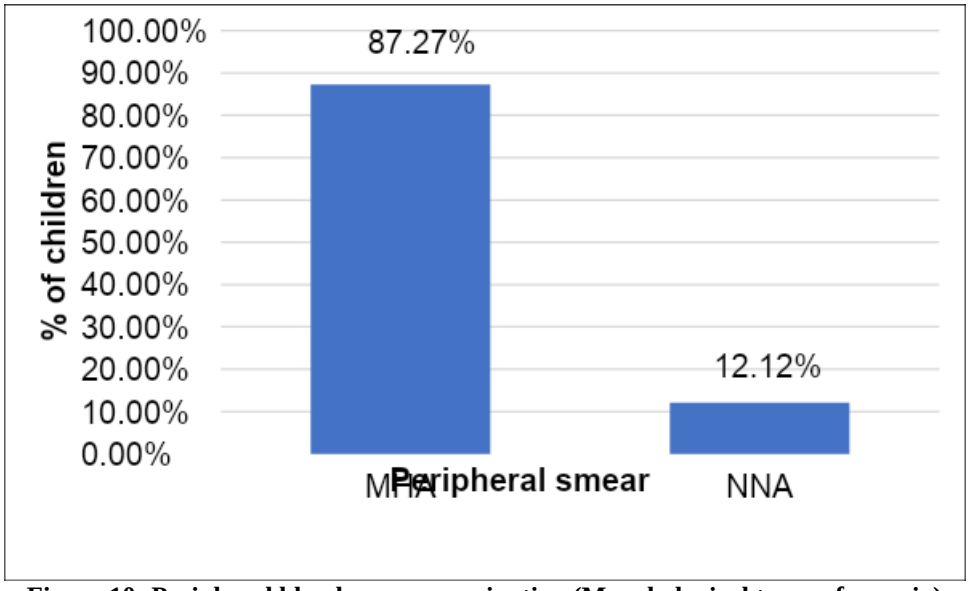


Figure 10: Peripheral blood smear examination (Morphological types of anemia)

Table 12 and figure 10, show the peripheral blood smear examination. Microcytic hypochromic anemia (Iron deficiency Anemia) was the most common anemia found in 87.27% of children followed by normocytic normochromic anemia (NNA) (12.12%).

Table 13: Correlation between the severity of malnutrition and the severity of anemia

Nutritional Status	Anemia			
	Severe	Moderate	Mild	P value
Normal	06 (8.69%)	27 (39.13%)	36 (52.17%)	-
Mild	07 (26.92%)	10 (38.46%)	09 (34.61%)	0.211
Moderate	05 (14.70%)	16 (47.05%)	13 (38.23%)	0.062
Severe	05 (13.88%)	14 (38.88%)	17 (47.22%)	0.053
Total	23	67	75	-

In the present study, there was no significant association between nutritional status and severity of anemia with p value of >0.05 as shown in table 13.

DISCUSSION

Nutritional deficiency disorders constitute a major health problem in India. In India, 74% of children have anemia according to the NFHS survey. Iron deficiency is a global nutritional problem, which mainly affects infants, children and women of childbearing age[6]. However, iron deficiency in young children can impair their physical growth and cognitive functions such as learning memory and attention process and adversely increase the childhood morbidity and mortality[7]. Therefore, nutritional assessment in the community is essential for the accurate planning and implementation of intervention programs to reduce the morbidity and mortality associated with undernutrition[8]. Nutritional status can be determined with the help of clinical examination of symptoms of nutritional deficiencies, dietary intake, and anthropometry. When these methods are used in combination like anthropometry and clinical examination, they provide a better picture of assessment of nutritional status of children. Clinical examination is the simplest and the most practical method of ascertaining nutritional status. Anthropometry measurements such as height, weight, mid upper arm circumference, skin fold thickness, head and chest circumference are readily available indicators of nutritional status. Hence, we studied the nutritional status of patients with iron deficiency anaemia from 1-5 years of age using anthropometric measurements and also determined if there was any correlation between the severity of malnutrition and the severity of anaemia.

Age Distribution

In the present study, anemia with malnutrition was observed to be prevalent in children between the age group of 1 to 2 years (47.27%) followed by 3 to 4 years (21.21%). The mean age of the children was 2.74 ± 1.40 years, ranging from 1 to 5 years. This observation is comparable to the study done by **Kanchana et al[9]** in their study a higher number of anemic children were seen in the age group of 2–5 years (61%). In **Joshi HS et al** study most of the patients were in the age group of 3 to 6 years (57.7%)[10]. Similarly in **Imran M et al** study, the prevalence of anemia with malnutrition was more in 3-4 years age group (59.5%)[11]. The higher incidence of anemia in <5 years age group is commonly due to inadequate iron intake in the diet and the weaning practices which are undertaken. One example for this is excessive consumption of cow's milk before 6 months of age, which has low iron content. It may also be due to poverty, maternal anemia, and improper complimentary diet. As the age advances, there is a decrease in the incidence of anemia probably due to introduction of proper feeding.

Gender Distribution

In current study, anemia with malnutrition was observed in higher proportion in males (56.36%) than females (43.63%) with male to female ratio of 1.29:1 which is comparable with previous studies done by **Shah NS et al[12]**, **Imran M et al,[11] Tripathi MS et al[13]** and **Harishankar et al[14].** In their studies, malnutrition was more prevalent in male children. While in studies by **Joshi HS et al[10] and Sandeep B et al[15]**, a higher proportion of malnutrition was observed in females. Since no gender predominance was observed, it can be said that anemia with malnutrition can occur equally in either male or female children. Whereas the higher incidence of anemia with malnutrition in male children may be due to the prevailing custom of caring more for the male child who were being brought to hospital for treatment more frequently. Also, the male preponderance observed, is in all probability a reflection of social bias against the girl child. An association with boys may be due to the faster growth and more demand of pre-school boys compared to girls. However, further studies are necessary to better understand this factor.

Anthropometric Measurements

Most of the children had weight between 5 to 10 kgs with the mean weight of children being 10.81±2.95 kgs. Maximum children had height between 55 to 80 cm (29.09%) and the mean height was 88.59±12.68 cm. While **Desalegn A et al** study reported the mean weight and height of the children were 27.3 (5.84) kg and 131 (0.12) cm, respectively[16]. However, in current study, the maximum number of children had head circumference between 46 to 50 cm (61.21%) followed by 40 to 45 cm (30.90%). The maximum children had chest circumference between 46 to 50 cm (50.30%). Most of the children had mid arm circumference within normal limits (more than 13.5 cm) (51.51%). 46 (27.87%) had MUAC between 12.5 to 13.5 cms (mild malnutrition), and 34 (20.60%) had MUAC below 12.5 cms (moderate to severe malnutrition). These findings are similar to those of **Joshi et al**[10] and **Asha Arya and Rohini Devi**[17] but are healthier than those reported by **Ghai et al**[18] Similarly, in **Kapilashrami MC et al** study 62 (26.95%)

of the children had mid upper arm circumference (MUAC) between 12.5 to 13.5 cms (mild malnutrition), and 8 (3.47%) had MUAC less than 12.5 cms showing moderate to severe malnutrition. The mean chest circumference of 41.67 cms was lesser than the mean head circumference of 41.82 cms[19].

In the present study, in case of WAZ, 1 percent of children were mildly underweight, 10.30% were moderately underweight, 35.75% were severely underweight and 53.33% children were of normal weight.

In case of HAZ, 7.27% children were mildly stunted, 7.87% were moderately stunted, 20.0% children were severely stunted, and 64.84% children were of normal height.

Whereas in the case of WHZ, 7.27% children were mildly wasted,16.96% were moderately wasted, 20% were severely wasted and 55.75% of children were of normal weight and height. These findings are correlated with the study conducted by **Nath JC et al** where in case of WAZ 19 percent children were underweight, 78.33% children were of normal weight, 1.33% children were overweight and 1.33% children were obese. In case of HAZ 10% children were stunted, 87.33% children were of normal height, 1.66% children had over the normal height. In case of WHZ 18% children were wasted, 81% children were of normal weight, 33% children were over the normal and .66% children were obese[20]. According to **Imran M et al,** 66 (27%) children had stunting (low height for age) out of them 54 (22%) of children had mild stunting and 12(4.9%) of children had severe stunting[11].

Nutritional status of children

Nutrition is the most common cause of anemia in the age group of 6 months–5 years as iron stores present at birth usually are sufficient only during the first 6–9 months of life after which the iron stores start depleting. Hence, if the nutrition is not adequate and rich in iron, it can lead to iron deficiency. Thus, malnutrition is an important risk factor for causing anemia. Around 45% of deaths among children under-5 years of age have been linked to undernutrition. These mostly occur in low- and middle-income countries. Poverty increases the risk of malnutrition. People who are poor are more likely to be affected by different forms of malnutrition[21,22]. In the present study, most of the patients were severely malnourished (21.81%) followed by moderately malnourished (20.60%) and mild malnourished (15.75%). This finding is in accordance with the study done by **Sandeep B et al** where 11.5% children were found to be severely malnourished[15].

Severity of anemia

Children's Hb level was used to determine the prevalence of anemia. Maximum children had Hb between 10 to 10.99 gm/dl defined mild anemia (45.45%) followed moderate anemia with Hb between 7 to 9.99 gm/dl and 13.93% of children had Hb <7 gm/dl defined severe anemia.

In **Sandeep B et al study**, there was a high prevalence of anemia in malnourished children where 30.8% were moderately anemic and 11.5% were severely anemic[15].

In Desalegn A et al study, the overall prevalence of anemia was 256 (43.7%) with mean Hb value of 12 (¡2.4) g/dl. Among anemic children, 15.6%, 49.2%, and 35.2% had severe, moderate, and mild anemia, respectively [16].

Kapilashrami MC et al haemoglobin estimation was carried out in 102 (33.88%) children. 61 (59.81%) of them had haemoglobin levels of 11 gm/dl or more and were therefore, not anaemic. 41 (40.19%) had mild to moderate anaemia, i.e., Haemoglobin less than 11 gm/dl. Of the anaemic children only 7 (17%) had haemoglobin levels of less than 9 gm/dl[19].

Simbauranga et al study the prevalence of anaemia was 77.2 % with mild, moderate and severe anaemia being 16.5, 33 and 27.7 % respectively[23].

Peripheral smear

In the present study, most of the peripheral blood smears seen were microcytic hypochromic (65.18%) mostly suggestive of the diagnosis of iron deficiency anemia. Second most anemia was normocytic normochromic anemia (NNA) (34.81%). Thus, iron deficiency anemia was a major cause of nutritional anemia which is in accordance with previous studies [24,25,26,27].

Correlation between the severity of malnutrition and the severity of anaemia

In the present study, there was no significant association between nutritional status and severity of anaemia with p value of >0.05. which is comparable with the study conducted by **Simbauranga et al,** in their study there was no significant association between nutritional status and severe anaemia[23]. Also, our finding was similar to the findings by **Ughasoro et al**[28]. **Li H et al** found no association between malnutrition with childhood anemia. This inconsistency might be due to the rates of stunting, underweight, and wasting of children were relatively low in their study, all of which were less than 5%; and each type of malnutrition was mainly moderate, with very little severity, so the relationship between malnutrition and anemia had not been discovered in their study[29]. While **Rahman MS et al** reported strong

associations between stunting and anemia in children, indicate that it is necessary to tackle both nutritional deficiency and anemia simultaneously[30]. **Awasthi S et al** found odds ratio of an underweight and stunted child having moderate to severe anemia was 1.66 and which was statistically significant[26]. This shows that anemia is influenced by nutritional status of the children. It can be due to the poor availability and intake of a high calorie diet and rising trend of consuming junk and snack food which supplies fewer calories.

CONCLUSION

The incidence of malnutrition is more common in male children age between 3 to 5 years. The commonest micronutrient deficiency in malnourished children is iron deficiency which leads to nutritional anemia. Thus, this study tells the importance of evaluating nutritional and anemia status in young children due to their high susceptibility. Anemic infants are susceptible to delayed cognitive development and at high risk of infectious diseases in childhood. The improvement of nutritional status would reduce the prevalence of anemia and protect infants from its complications. Hence, the child mortality and morbidity can be reduced drastically. Different measures for prevention and control of anemia including supplementation and fortification programmes should be reinforced.

LIMITATIONS

- The cross-sectional nature of the study is a limitation, particularly in relation to the prevalence of IDA and severity of anaemia in the study population.
- The cross-sectional design also limits to an extent the anthropometric data. The implications are that young children, who, at the time of data collection, were not stunted, might subsequently develop stunted growth as they age. Consequently, the proportion of children who will experience stunted growth at some stage during their development is underestimated in this population.
- There was limitation in diagnostic facilities to determine causes of anaemia. This included unavailable folate levels, B12 levels, thalassemia, G6PD deficiency and bone marrow biopsy for those with possible bone marrow failure.

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