



## Original Article

## Prevalence of Iron Deficiency Anemia among Infants Consuming Cow's Milk

Anila Bai<sup>1</sup>, Farzana Shaikh<sup>1</sup>, Suresh Kumar<sup>2</sup>, Ayesha Ahmed<sup>1\*</sup>, Marium<sup>2</sup>, and Muhammad Akram Shaikh<sup>3</sup><sup>1</sup>Department of Paediatrics, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan<sup>2</sup>Liaquat University Hospital, Hyderabad, Pakistan<sup>3</sup>Department of Community Medicine, Muhammad Medical & Dental College, Mirpur Khas, Pakistan

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## \*Corresponding Author:

Ayesha Ahmed

Department of Paediatrics, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan  
[dr.ayashaahmedali@gmail.com](mailto:dr.ayashaahmedali@gmail.com)

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## ABSTRACT

Iron Deficiency Anemia (IDA) in children is a public health issue affecting child morbidity, mortality, and cognitive development. Infants fed cow's milk are at a higher risk of severe IDA due to calcium and iron absorption competition. **Objective:** To determine the frequency of Iron deficiency anemia among Cow Milk Fed Infants. **Methods:** This cross-sectional study was conducted at Paediatric wards of Liaquat University Hospital Hyderabad and Jamshoro from November 2020 to April 2021. All the full-term infants with age of up to 6 months either gender and having history of cow's milk consumption and clinically diagnosed to have anemia were included. Infants had 3ml intravenous blood samples taken to get a complete blood picture and ferritin level. All the mothers were interviewed regarding duration of cow's milk consumption. Data were collected via a predesigned proforma. **Results:** Total 323 infants were studied to assess the frequency of iron deficiency anemia among cow's milk infants up to 6 months and the mean age of infants was  $4.11 \pm 1.31$  months. Females were 56.3% and males were 43.7%. Overall average of hemoglobin was  $8.92 \pm 1.09$  g/dl, and overall mean of ferritin level was  $90.16 \pm 17.71$  ng/ml. Frequency of iron deficiency anemia was found to be 18.6%. **Conclusions:** As per study conclusion overall frequency of iron deficiency anemia was observed to be 18.6% and cow's milk consumption has been observed as a risk factor of infant's anemia.

## INTRODUCTION

Iron deficiency, with or without anemia, impacts around 30% of the global populace, marking it as the most common nutrient deficiency. It negatively affects central nervous functions, leading to delayed cognitive development [1]. Infants on a cow's milk diet face a higher risk of severe Iron Deficiency Anemia (IDA) as calcium in cow's milk competes with iron absorption. Cow's milk consumption has been found to diminish iron stores in infants and toddlers, a fact well-documented across various regions. Numerous factors contribute to iron deficiency in this demographic, with cow's milk's low iron content being a primary one, making it challenging for infants to meet their iron needs for growth. Recent data suggest a 13.5% prevalence of iron deficiency and a 2.7%

prevalence of IDA among toddlers aged 1 to 2 in the USA [2]. Iron plays a crucial role in numerous metabolic, oxidation reactions and is fundamental for mitosis. Persistent deficiency during childhood leads to serious health ramifications [3]. A national study revealed that 27% of mothers provided pre-lacteals, with salt water (44%) and cow's milk (26%) being the notable feeds [4]. Observed consequences include delayed psychomotor development, language acquisition challenges, substantial cognitive loss, heightened infection susceptibility, fatigue, and irritability [5, 6]. In Pakistan, the prevalence of IDA in children under five ranges from 40-70% [7, 8]. Pakistani children with IDA show growth retardation, impaired cognition, reduced physical activity, and are speculated to

contribute to the nation's high infant mortality rate [7, 9-11]. Serum Ferritin concentrations are utilized to measure iron deficiency due to their high sensitivity and specificity in identifying iron deficiency in individuals [1]. No such studies have been found at local level especially at Sindh on this objective. Therefore, this study has been conducted to determine the frequency of iron deficiency anemia among cow's milk infants up to 6 months of age at LUMHS. As per high frequency of iron deficiency anemia due to cow's milk, it is recommended that, the cow's milk consumption should be avoided and mother milk should be consumed to decrease the infant's morbidity. This study explored the current knowledge regarding prevalence of iron deficiency anemia among cow's milk consumed infants at local level.

## METHODS

This cross-sectional research was conducted in the Pediatric Department of Liaquat University Hospital, Hyderabad & Jamshoro. The study spanned a duration of six months, from November 2020 to April 2021. Sample size was calculated via rao-soft software by taking the proportion of Iron deficiency anemia as 30.8% among children who consumed cow milk [11]. With 5% margin error and 95% confidential level, the sample size was calculated to be 323. The inclusion criteria encompassed all infants up to the age of six months, regardless of gender, provided they were full-term infants with a history of cow's milk consumption. Conversely, the exclusion criteria comprised patients who declined participation in the study, those with a history of preterm birth or severe acute malnutrition, children with any infectious disease or inflammation, children receiving iron therapy, and those on breastfeeding. Upon fulfilling the inclusion criteria, patients were selected for participation through the pediatric outpatient department (Paeds OPD). Written consent was obtained from all participants before proceeding. A thorough medical history was compiled and relevant investigations were conducted for each participant. Infants up to six months of age, having hemoglobin level < 9.5 g/dl and MCV < 74 were labelled as having Iron Deficiency Anemia. The severity of anemia was assessed via levels of serum ferritin. Serum ferritin levels in between 30 ng/dl to 50ng/dl was labelled as having mild anemia, while infants with range between 15ng/dl to 20ng/dl was labelled as having moderate anemia. Severe anemia was labelled when infant had serum ferritin levels less than 15ng/dl [12]. Mothers were interviewed to ascertain the duration of cow's milk consumption for their infants. A 3ml intravenous blood sample was collected from all infants to conduct a complete blood picture and determine ferritin levels. Information such as age, gender, length, weight, Z-score, heart rate, respiratory rate, signs

and symptoms, duration of cow's milk consumption, severity of anemia was assessed via levels of ferritin and IDA were meticulously collected using a pre-designed proforma. For data analysis, the acquired data were entered and evaluated using the statistical program SPSS version-20.0. Quantitative variables such as age, length, weight, Hb level, and ferritin level were analyzed to estimate their mean and standard deviation. Qualitative variables like gender, palmar pallor, irritability, severity of anemia, and iron deficiency anemia were assessed through simple frequency and percentage calculations.

## RESULTS

Total 323 infants were studied to assess the frequency of iron deficiency anemia among cow's milk infants up to 6 months. Mean age of infants was  $4.11 \pm 1.31$  months, minimum 1 month and maximum 6 months. In this study girls were 56.3% and boys were 43.7. Weight, length, standard deviation as per weight is given in table 1.

**Table 1:** Gender Distribution Along with Weight and Standard Deviation of Weight by Length(N=323)

Gender Distribution	Male	Female
	141 (43.7%)	182 (56.3%)
Weight Distribution	Less than 5 kg	More than 5 kg
	281 (87%)	42 (13%)
Standard Deviation of Weight by Length (Z-Score)	-1	-2
	156 (48.6%)	167 (51.4%)

As per sign and symptoms, 99.1% infants were pale or sallow (yellow) skin with 99.1% exhibited a paler appearance in the lining of the eyelids and nail beds than usual. Irritability was reported among 15.8% of the infants and 25.4% were presented with pale cheeks and lips, respiratory rate and heart rate while 3 infants were without sign and symptoms (Table 2).

**Table 2:** Signs and Symptoms of Infants(N=323)

Signs and Symptoms	Frequency (%)
Normal	03 (0.9%)
Pale or yellow skin	320 (99.1%)
Pale cheeks and lips	82 (25.4%)
Irritability	51 (15.8%)
Nail bed and conjunctiva look less pink than normal	320 (99.1%)

Most of the cases had moderate anemia 82.4%, 15.8% had mild anemia and 0.9% infants had no anemia and 0.9% had severe anemia. Overall average of hemoglobin was  $8.92 \pm 1.09$  g/dl, minimum 5.50 g/dl and maximum 12.00 g/dl (Table 3).

**Table 3:** Severity of Anemia of the Infants (N=323)

Anemia	Frequency (%)
No	03 (0.9%)
Mild Serum Ferritin (30 ng/dl to 50ng/dl)	266 (82.4%)
Moderate Serum Ferritin (15 ng/dl to 29ng/dl)	51 (15.8%)
Severe Serum Ferritin (< 15ng/dl)	3 (0.9%)

According to the duration of cow milk consumption, most of the infants 63.8% had duration of less than one month, 26.9% had duration of one month 4.6% were under consumption from 1.5 months and 4.6% from 2 months (Table 4).

**Table 4:** Duration of Cow Milk Consumption (N=323)

Duration (Months)	Frequency (%)
0.5 month	206 (63.8%)
1 month	87 (26.9%)
1.5 months	15 (4.6%)
2 months or more	15 (4.6%)

In this study overall frequency of iron deficiency anemia was found to be 18.6%. Frequency of iron deficiency anemia of the infants was statistically significant according to age ( $p=0.039$ ). Frequency of iron deficiency anemia of the infants was statistically significant according to gender ( $p=0.018$ ). Iron deficiency anemia was statistically significant according to Z-score ( $p=0.001$ ), while statistically insignificant according to weight, length, HR and RR ( $P \geq 0.05$ ).

## DISCUSSION

The intake of cow's milk (CM) by infants and toddlers negatively impacts their iron stores, a fact extensively documented in various regions. In this study total 323 infants were studied to assess the frequency of iron deficiency anemia among cow's milk infants up to 6 months and the mean age of infants was  $4.11 \pm 1.31$  months, minimum 1 month and maximum 6 months. Similarly, Burke et al., reported that the mean age of the infants was  $6.7 \pm 0.9$  months [13]. In another study of Siddique et al., examined the frequency of iron deficiency anemia in infants under exclusive breastfeeding, fortified milk, and cow milk feeding regimes, encompassing 150 infants—89 males and 61 females, with an average age of 7.77 months. It analyzed the impact of varying feeding regimes on iron status and anemia frequency among infants aged 6 to 9 months, while in this study out of all females were 56.3% and males were 43.7% [14] and Burke et al., also demonstrated that the male infants were 52% and remaining were females [13]. Although Patel et al., also reported that among anemic children males were 57.3% and females were 42.3% with male to female ratio as Male: female ratio was 1.3:1 [15]. In this study as per sign and

symptoms, 99.1% infants were pale or sallow (yellow) skin, with 99.1% exhibited a paler appearance in the lining of the eyelids and nail beds than usual. Irritability was among 15.8% of the infants and 25.4% were presented with pale cheeks and lips, while 3 infants were without sign and symptoms. In another study of Joo et al., it is demonstrated that the under-diagnosis of IDA in infants persists due to challenges in infant blood sampling and acquiring adequate blood volume for laboratory identification of IDA [16]. Typically, infants are not subjected to blood tests unless notable clinical events warrant them. Additionally, the symptoms of IDA, such as pallor, irritability, poor feeding, fatigue, lethargy, and pica, are non-specific. In this study most of the cases 82.4% has mild anemia, 15.8% had moderate anemia and 0.9% infants were severely anemic and overall average of hemoglobin was  $8.92 \pm 1.09$  g/dl, minimum 5.50 g/dl and maximum 12.00 g/dl. Similarly, Patel et al., reported that the average hemoglobin level in anemic infants was 9.3 g/dl. Among them, 54 (41.2%) exhibited mild anemia, 66 (50.4%) had moderate anemia, and 11 (8.4%) showed severe anemia [15]. On other hand in the study of Parkin et al., reported that the mean Hb was  $55.1 \pm 15.2$  g/l with a range of 13–79 g/l; and median serum ferritin was 4 (interquartile range 2–8)  $\mu\text{g/l}$  [17]. In this study overall frequency of iron deficiency anemia was found to be 18.6%. On other hand Qudisa et al., reported that among all, 113 infants were identified as anemic (75.3%), with iron deficiency attributed to cow milk feeding [18]. Common causes of IDA in infants include inadequate diet, whole cow's milk consumption, early introduction of cow's milk into an infant's diet, reduced total body iron at birth, Pica, and lead poisoning [19]. Above studies showed higher incidence of the anemia among cow milk consumption children as compared to this study and this may because of this has been conducted on limited age range of only 6 months, hence the duration of cow milk consumption is markedly less than other studies as in this study frequency of iron deficiency anemia of the infants was statistically significant according to age. Unmodified cow's milk is recognized for its low iron content and poor iron absorption, alongside a low vitamin C content. Conversely, it has high levels of casein and calcium, which could adversely affect iron absorption and, consequently, hemoglobin synthesis [20–22]. Iron deficiency can lead to a condition that may hinder an infant's mental, motor, and behavioral development, potentially resulting in issues that persist long after iron levels have returned to healthy levels. Infants from developing nations, those born preterm or with low birth weight, or those primarily fed unfortified cow's milk are deemed to be at high risk for iron deficiency [23, 24]. The intake of cow milk during infancy adversely impacts blood indices and serum ferritin levels. A

considerable number of uneducated mothers tend to feed their infants cow's milk, which is a significant risk factor for the development of IDA in infants [19].

## CONCLUSIONS

As per study conclusion overall frequency of iron deficiency anemia was observed to be 18.6% and cow's milk consumption has been observed as a risk factor of infant's anemia.

## Authors Contribution

ptualization: AB

Methodology: AB, FS, SK, MAK

Formal analysis: AB, SK, AA

Writing-review and editing: FS, SK, AA, MAK

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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