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Iron Deficiency Anemia In Children: Prevalence, Gender Distribution, And Associated Socioeconomic Factors In Peshawar

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Abstract

Iron deficiency anemia is a condition during which the human body doesn't have enough iron level to produce healthy red blood cells (RBCs) which are required for oxygen transportation and ultimately cellular respiration. Iron deficiency anemia (IDA) is a significant public health concern that adversely affects behavior, work performance, and physical and mental development. Certain populations, including pregnant and nursing women, young children, and school-age children, are particularly vulnerable to this condition. Purpose of this particular study was to; To determine the frequency of Iron deficiency anemia (IDA) in anemic children between 1-14 years of age, check the impact of Iron deficiency anemia on public health, Understand Key factors that lead to IDA. This study employed a cross-sectional descriptive design to assess the prevenance of iron deficiency anemia among young children. This study was conducted across various hospitals in the Peshawar District and assessed the prevalence of IDA among 385 children. Findings revealed that iron

deficiency anemia was present in 43.4% of the cases studied. The prevalence was slightly higher in males (43.7%) compared to females (43.1%). Among the age groups, children aged 9-12 years exhibited the highest incidence of iron deficiency anemia at 28.6%, followed by those aged 1-5 years at 26%. Socioeconomic factors also played a critical role in the prevalence of iron deficiency anemia. The data indicated that iron deficiency anemia was most common among children from the lowest socioeconomic class (56.6%), followed by the middle class (38.0%) and the upper class (32.3%). Of the 216 preschoolers identified as anemic, 110 were male and 106 were female. The severity of IDA varied by gender, with 22.6% of anemic boys experiencing mild iron deficiency anemia, 20.3% moderate iron deficiency anemia, and 7.8% severe iron deficiency anemia. In girls, the figures were 20.8% for mild iron deficiency anemia, 18.9% for moderate iron deficiency anemia, and 9.2% for severe iron deficiency anemia. Parental education level was also correlated with the prevalence of IDA cases. Children of illiterate parents showed the highest rates of iron deficiency anemia (57.6%), followed by those whose parents had completed matriculation (45%), bachelor's degrees (37.4%), and master's degrees (36.2%). The primary causes of iron deficiency anemia identified in this study include poverty, low parental education, and low socioeconomic status. Considering the numbers it is clear that the conditions must be dealt with with some proper strategies to avoid serious health deficits. Parents must be educated about nutritional requirements because children need a balanced diet during their juvenile phase of life.

Keywords: IDA, Parental education, psychological development, socioeconomic status

Introduction:

Iron deficiency anemia (IDA) is one of the most common nutritional deficiencies worldwide and remains a major public health concern, particularly among children in developing countries. It is characterized by insufficient iron levels in the body, resulting in reduced hemoglobin production and impaired oxygen transportation to body tissues. Iron plays an essential role in hemoglobin synthesis, cellular metabolism, immune function, and neurological development (Camas Chella et al., 2015; WHO, 2020). Children are particularly vulnerable to iron deficiency due to their increased nutritional requirements during periods of rapid growth and development. Globally, anemia continues to affect millions of children, especially those living in low- and middle-

income countries (Kassebaum et al., 2014; Stevens et al., 2013). Iron deficiency during childhood can have serious consequences for physical growth, cognitive development, behavioral performance, and academic achievement. Insufficient iron availability may interfere with brain development, neurotransmitter function, and myelination, potentially resulting in long-term developmental complications (Lozoff, 2007; McCann and Ames, 2007; Georgieff, 2011). Furthermore, iron deficiency can weaken immune responses and reduce children's physical activity and overall well-being (Beard, 2001).

The World Health Organization emphasizes the importance of early identification, prevention, and treatment of iron deficiency to minimize its adverse health consequences (WHO, 2016; WHO, 2024). In Pakistan, iron deficiency anemia represents a significant nutritional and public health challenge, particularly among children from economically disadvantaged households. Findings from the National Nutrition Survey 2011–2012 reported a considerable burden of IDA among children under five years of age, with nutritional deficiencies and household food insecurity identified as important contributing factors (Habib et al., 2016). Similarly, the National Nutrition Survey 2018 reported that approximately 28.6% of children had iron deficiency anemia (UNICEF and Government of Pakistan, 2019; Habib et al., 2023). Previous research conducted in Peshawar also demonstrated a high prevalence of anemia among young children (Paracha et al., 1997). Studies from Khyber Pakhtunkhwa have further highlighted the association of childhood anemia with poverty, inadequate dietary intake, and limited parental education (Rahman et al., 2019; Sohaib et al., 2023). Several socioeconomic and demographic factors contribute to the development of IDA in children, including household income, parental education, nutritional practices, dietary diversity, and access to healthcare services. Children belonging to low-income families are more likely to consume diets deficient in iron-rich foods, while inadequate nutritional awareness among parents may further increase their susceptibility to iron deficiency (Stoltzfus, 2001; Black et al., 2013; Habib et al., 2023). Gender may also influence the distribution of anemia, although findings vary across populations and age groups (Habib et al., 2016; Sohaib et al., 2023). Laboratory investigations, particularly complete blood count (CBC), mean corpuscular volume (MCV), and serum ferritin measurements, are important for identifying iron deficiency and assessing the hematological status of affected children

(WHO, 2020; Pasricha et al., 2024). Despite existing research, further investigation is needed to understand the prevalence, gender distribution, and socioeconomic determinants of IDA among children in Peshawar. Therefore, the present study aims to determine the frequency of iron deficiency anemia among children aged 1–14 years, assess its distribution according to gender and age groups, and investigate its association with socioeconomic status and parental educational background. The findings may help identify vulnerable populations and provide evidence for developing effective nutritional awareness programs, early screening strategies, and preventive interventions to reduce the burden of childhood iron deficiency anemia in Peshawar.

Material and Methods

This study employed a cross-sectional descriptive design to assess the prevalence of iron deficiency anemia (IDA) among children aged 1–14 years in District Peshawar over a period of six months following research board approval. A total of 385 participants were included, with the sample size calculated using the standard prevalence formula, \(n = Z^2P(1-P)/E^2\), considering an expected prevalence of 50%, a 95% confidence level, and an appropriate margin of error. Random sampling was used to select participants from secondary data obtained through the electronic medical records (EMRs) of selected tertiary care hospitals in Peshawar, including Hayatabad Medical Complex (HMC), Lady Reading Hospital (LRH), and Khyber Teaching Hospital (KTH). Children aged 1–14 years with Khyber Pakhtunkhwa domicile and available parental or guardian consent were included, while those with chronic illnesses, recent iron supplementation, premature birth, low birth weight, recent blood transfusions, or genetic disorders affecting iron metabolism were excluded. Demographic and clinical information, including age, gender, nutritional status, dietary habits, and medical history, was extracted from patient records. Laboratory findings, including complete blood count (CBC) and serum ferritin levels, were reviewed to assess IDA based on the study criteria of hemoglobin (Hb) below 10 g/dL, mean corpuscular volume (MCV) below 70 fL, and serum ferritin below 15 ng/mL. CBC parameters, including hemoglobin, hematocrit, MCV, and red cell distribution width (RDW), were evaluated alongside serum ferritin as an indicator of iron stores. Ethical approval was obtained from the relevant institutional review board, and participant confidentiality was maintained through data

anonymization. Statistical analysis was performed using SPSS version 26.0. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the data, while chi-square tests were applied to assess associations between IDA and potential risk factors, including age, gender, and socioeconomic status. A p-value of less than 0.05 was considered statistically significant.

Result

A total of 385 young children (1-14 years) belonging to both sexes (Males and Females) were tested clinically for the presence of iron deficiency anemia (IDA) from different areas of district Peshawar, Khyber Pakhtunkhwa. Among 385 young children, 197 were male while the rest were female. Among the males, 111 were tested normal while in females, 107 were tested normal. The number of male anemic children was 86 while the number of female anemic children was 81 (Figure 3.1).

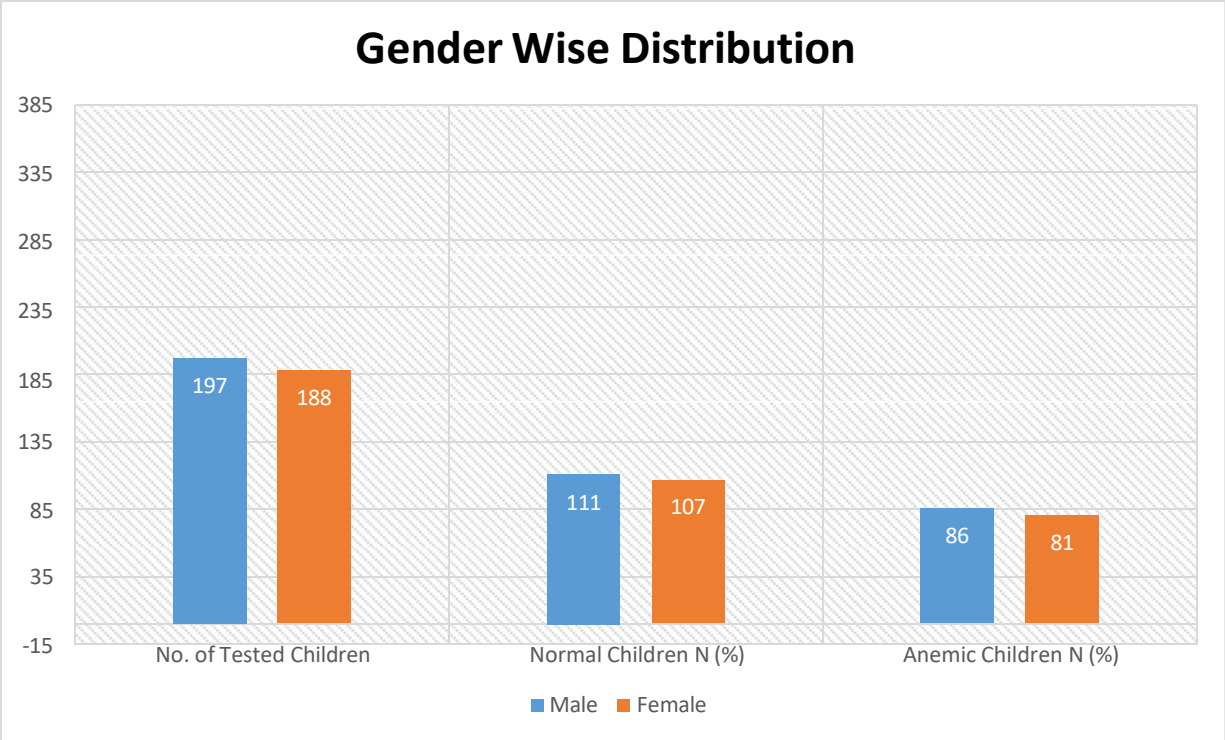


Figure 3. 1 Gender Wise Distribution of Iron deficiency anemia in Young Children

Gender-wise iron deficiency anemia in young children based on their testing was as follows: The total number of males was 197 of which 56.3% were normal while the

average children were 43.7% iron deficiency anemic. The total number of females was 188 of which 56.9% were normal while the rest 43.1 were anemic (Table 3.1)

Table 3.1: *Gender-wise distribution of Iron deficiency anemia (IDA) in district Peshawar children (1-14 years).*

Gender	No. of Tested Children	Normal Children N (%)	IDA Children N (%)
Male	197	111 (56.3)	86 (43.7)
Female	188	107 (56.9)	81 (43.1)
Total	385	218 (56.6)	167 (43.4)

The age-wise distribution of the 385 patients is categorized into four age groups: 1-5 years, 6-8 years, 9-12 years, and 12-14 years. The largest group consists of patients aged 9-12 years, accounting for 28.6% (110 patients) of the total population. This is followed by the 1–5-year age group, which makes up 26% (100 patients). The 6–8-year age group constitutes 24.7% (95 patients), and the 12–14-year age group represents the smallest portion, with 20.7% (80 patients). This distribution highlights that the majority of the patients fall within the 9–12-year age range.

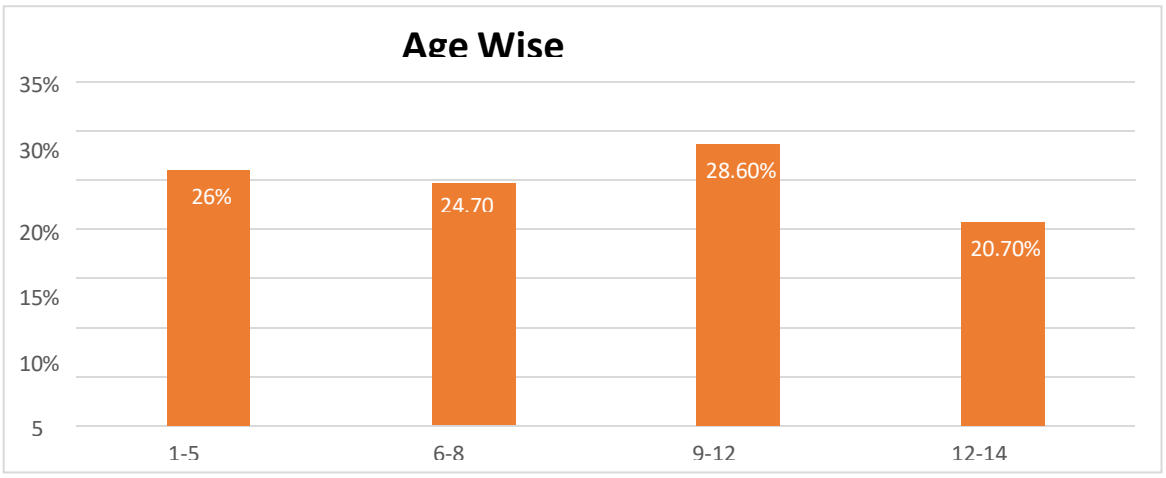


Figure 3. 2 Age wise distribution of study participants

Table 3.2: *Age wise distribution of study participants*

Age wise Children Distribution	No. of IDA Patient Tested	Percentage of IDA Patient

1-5 Years Age Group	100 Patient	26%
6-8 Years Age Group	95 Patient	24.7%
9-12 Years Age Group	110 Patient	28.6%
12-14 Years Age Group	80 Patient	20.7%

According to the parents' socioeconomic status, the following results were obtained. Among 152 children from the lower class, 86 (56.6%) were iron deficiency anemic and 66 (43.4%) were normal. From the middle class, 137 children were observed, out of them 52 (38.0%) were found iron deficiency anemic and 85 (62.0%) were normal. Similarly, 96 children were analyzed from the upper class, out of which 31 (32.3%) were iron deficiency anemic and 65 (67.7%) were found to be normal. Thus, the highest prevalence was found in the lower class (56.6%) followed by the middle class (38.0%) and then by the upper class (32.3%) (Table 3.3).

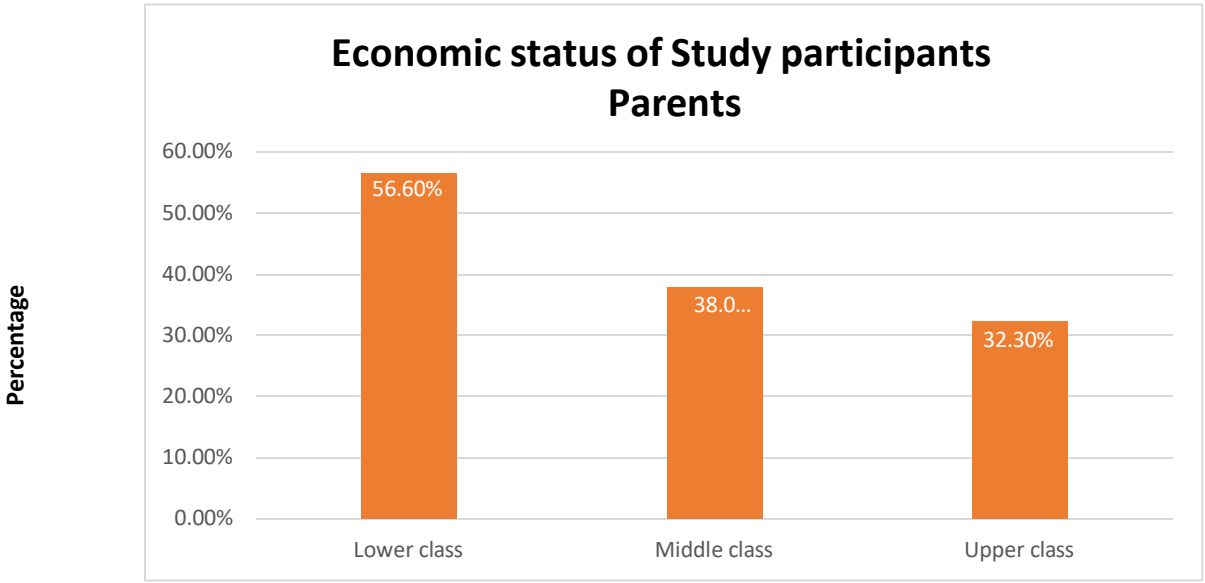


Figure 3. 3 Shows the economic status of the parents of study Participants

Table 3.3: *Percentage of Iron deficiency anemia (IDA) in young children (1-14years) according to socioeconomic status of parents*

Economic Status	No. of Children Tested	Anemic Non-IDA Children N (%)	Anemic IDA Children N (%)
Lower class	152	66 (43.4)	86 (56.6)
Middle class	137	85 (62.0)	52 (38.0)
Upper class	96	65 (67.7)	31 (32.3)
Total	385	216 (56.1)	169 (43.9)

The educational status of parents was classified into four categories, i.e., Illiterate, Matric, Bachelor, and Master. A total of 92 children of illiterate parents were studied, out of which 53 (57.6%) were iron deficiency anemic and 39 (42.4%) were normal. Among 100 children of matriculated parents, 45 (45.0%) children possessed IDA, and 55 (55.0%) were normal. 99 children of Bachelor level parents were observed, 37 (37.4%) out of them were iron deficiency anemic, and 62 (62.6%) were declared as normal. Similarly, 94 children of master-level parents were tested for IDA, 34 (36.2%) children possessed iron deficiency anemia, and 60 (63.8%) were normal. Thus, the incidence of iron deficiency anemia was high (57.6%) in children of illiterate parents, followed by children of matriculates (45.0%), bachelors (37.4%), and Master level parents (36.2%) (Table 3.4).

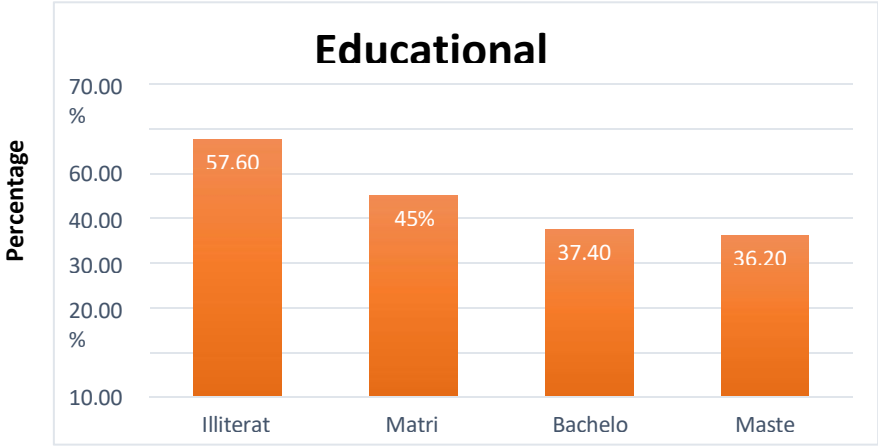


Figure 3. 4 Prevalence of IDA in young children in relation to parents' educational status

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Table 3.4: *Prevalence of IDA in young children in relation to parent's educational status*

Parents' Education	No. of children Tested	No. and % of Non-IDA Children N (%)	No. and % of IDA Children N (%)
Illiterate	92	39 (42.4)	53 (57.6)
Matric	100	55 (55.0)	45 (45.0)
Bachelor	99	62 (62.6)	37 (37.4)
Master	94	60 (63.8)	34 (36.2)
Total	385	216 (56.1)	169 (43.9)

Discussion:

One of the most significant elements on this planet is iron, which is found in both trivalent ferric form (Fe+3) and bivalent ferrous form (Fe+2). For neurological processes including myelination, neurotransmitter synthesis, and metabolism, iron is a crucial mineral (Lozoff et al., 2000). The third trimester of pregnancy is when the iron is stored in the fetus. Since the amount of iron in a body is strongly correlated with its mass, low birth weight babies are iron deficient. Thus, it's critical to keep an eye on your iron levels when you're pregnant. Throughout the first year of life, the brain develops fast, and iron is required for neurogenesis and cell differentiation in several brain regions currently. Iron deficiency anemia (IDA) is a dangerous public health issue. Behavior, functional capacity, and psychological and physical development are all impacted by IDA. Globally, IDA impacts about 700 million people worldwide. The most susceptible age groups for iron deficiency anemia include newborns, preschoolers, teenagers, and women who are pregnant or lactating (Beard, 2008). The sample size for this study comprised 385 young children (ages 1-14), both male and female. During this study secondary data was gathered from the tertiary care hospital of Peshawar city. 167 of the 385 young children were diagnosed with IDA as per the study criteria. And according to the mentioned criteria, the prevalence rate of IDA was 43.1%. Which is regarded as high. The primary cause of this high prevalence is that children's varied circumstances prevented them from receiving the necessary dietary intake. There were differences in the prevalence of iron deficiency anemia in boys and girls among different districts in KPK. IDA was more

common in males (43.7%) than in females (43.1%). This may be due to the fact that most parents neglect to monitor the nutritional intake of their children, who are classified as males. It is possible that they are consuming unhealthy food that does not meet their nutritional needs. According to the current study, the incidence of iron deficiency anemia was highest (28.6%) in children 1-9 years old, followed by 1–5-year-olds (26%), 6-8 year-olds (24.7%), and finally 12-14-year-olds (20.7%). IDA is more common in children of lower-class parents (55.3%), followed by middle-class parents (37.7%), and upper-class parents (32.2%). Children from lower socioeconomic classes had a high frequency of iron deficiency anemia (56.6%), followed by middle-class children (38%) and upper-class children (32.3%). Children of laborers had the highest prevalence of iron deficiency anemia (60%) followed by children who worked (37.5%) and children of higher-income parents (25%). Offspring of illiterate parents have a high frequency of iron deficiency anemia (57.6%), whereas offspring of graduate-level parents have a low incidence (36.2%). Comparably, the rate was (37.4%) for children of parents with a bachelor's degree and (45%) for children of matriculating parents.

One study it was mentioned that when Brazilian women had completed nine years of education, their children's mean hemoglobin level was 11.5g/dl; when mothers had completed five to eight years of schooling, it was 11.2g/dl; and when mothers had completed fewer than four years of schooling, it was 10.8g/dl. Even in wealthy nations, a greater risk of iron deficiency anemia is linked to low literacy rates (Horton & Ross, 2003). Based on gender-criteria differences in the prevalence of IDA were observed during this study. Compared to females (43.1%), Males had a greater prevalence of IDA (43.7%). In district Karak, the prevalence of Iron deficiency anemia was higher in girls (38.9%) than in boys (31%). In current investigations, children from lower-class backgrounds had a high frequency of iron deficiency anemia (47%) followed by middle-class children (39.3%) and upper-class children (38%). In district Karak, the incidence of Iron Deficiency anemia was 17% in the elite class, 32.2% in the middle class, and 55.8% in the poor class (Ullah et al., 2013)

Conclusion

It was concluded from the current study \that the primary causes of iron deficiency anemia identified in this study include poverty, low parental education, and low

socioeconomic status. Considering the numbers it is clear that the conditions must be dealt with with some proper strategies to avoid serious health deficits. Parents must be educated about nutritional requirements because children need a balanced diet during their juvenile phase of life.

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