Consuming hemoglobin to predict id and to estimate the occurrence of anemia, low iron reserves, id, and ida in offspring joining in the special supplemental nutrition program

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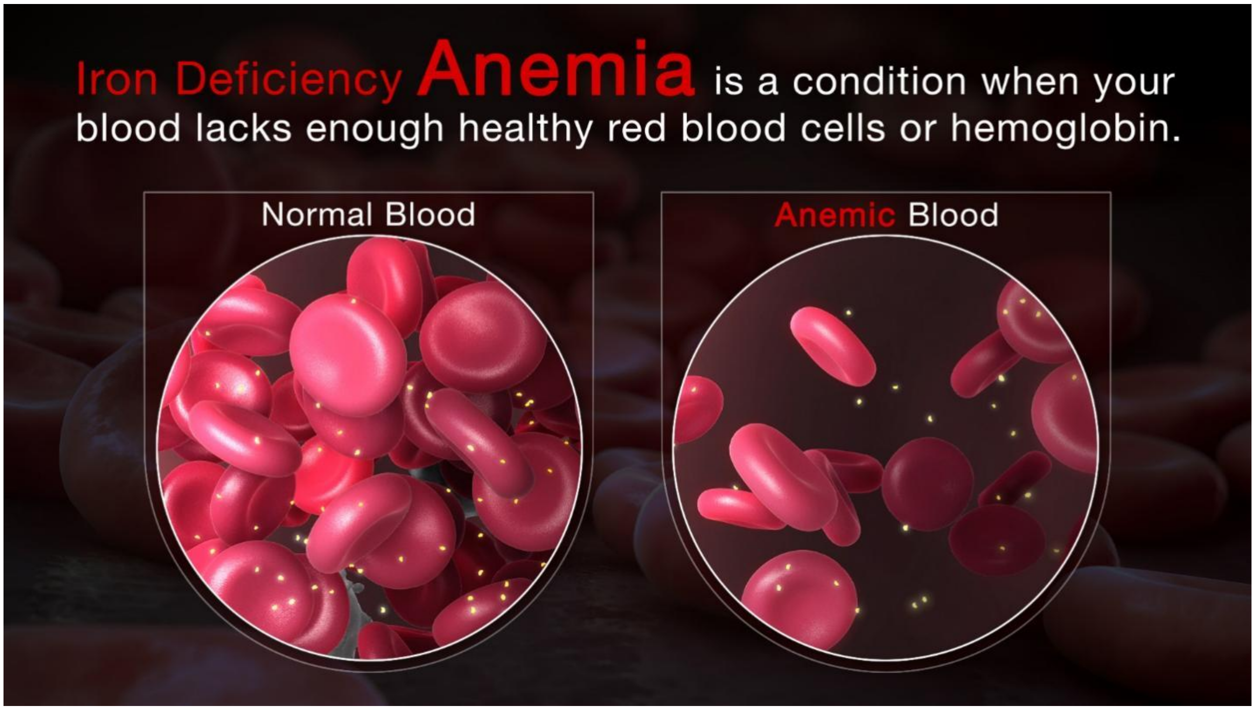
ABSTRACT:
Background: Iron deficiency is prevailing lack of necessary nutrients globally and continues to be prevalent among vulnerable populations in Pakistan. The exact occurrence of anemia, ID, in addition iron deficiency anemia in Punjab, Pakistan, is not yet established.
Aim: The aim was to ascertain the frequency of anemia, inadequate iron reserves, iron deficiency, and iron lack anemia (IDA) among offspring enrolled in Superior Supplemental Nutrition Program for Females, Children, and Offspring. Additionally, it sought to evaluate usefulness of hemoglobin as a predictive indicator for ID.
Methods: This study employed a cross-sectional design and included a representative sample of children aged 1 to 3 years who were attending WIC clinics in the province of Punjab.
Results: The prevalence of anemia was 12.2% among children aged 1 to 3 years (hemoglobin less than 120 g/L for 1 to 3-year-olds or less than 111 g/L for 2 to 4-year-olds). Abnormal values for iron measures, determined through study and literature, were as follows: serum ferritin below 9.8 or 12.1 μg/L, serum transferrin receptor above 9.5 or 12.1 μg/mL, and transferrin saturation below 14.3% or 12.1%, respectively. The occurrence rates of low iron stores remained 25.9% and 27.1%, iron deficiency were 17.3% and 9.9%, and iron lack anemia were 4.5% and 4.3% based on cutoff values determined by research and literature, individually. On basis of receiver operating characteristic curves produced by study and literature, the amount of hemoglobin was utilized to forecast the presence of iron lack. The warmth of low hemoglobin in expecting iron deficiency, as recognized by the research and literature, was low (24.3% and 41.2%, respectively).
Conclusion: Anemia and iron deficiency (ID) were widespread among the participants of the WIC program, but iron deficiency anemia (IDA) was not frequently observed. Low hemoglobin levels are not effective in predicting the occurrence of iron deficiency.
Keywords: Iron deficiency, Anemia, Iron Deficiency Anemia, Women, Infants, Punjab Pakistan.

INTRODUCTION:

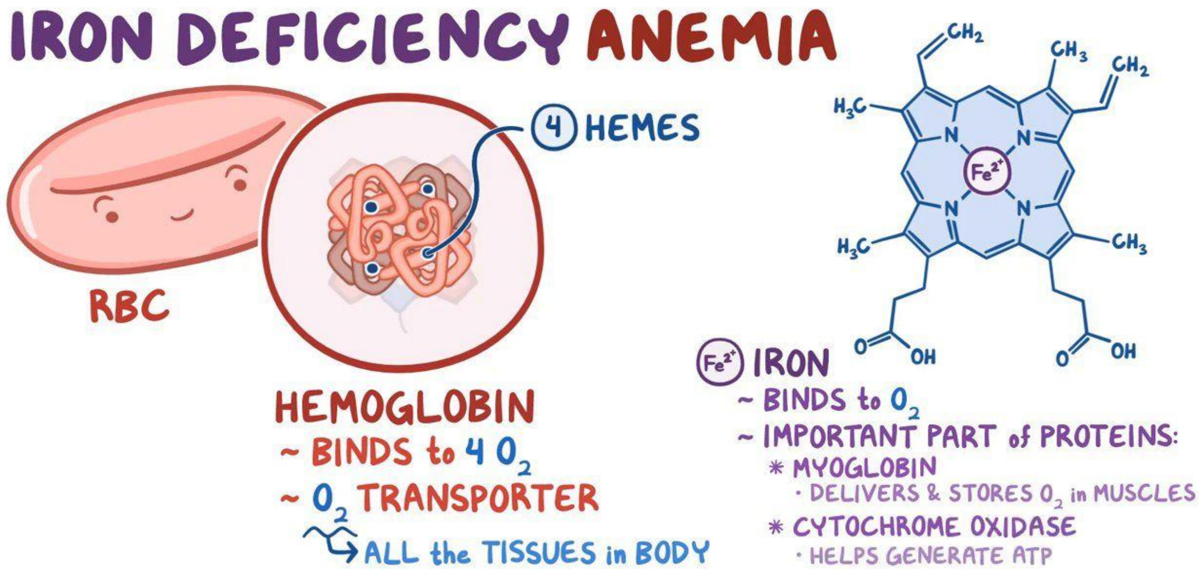
Iron insufficiency is the most common nutritional deficit international. Iron lack signs are mild and vague, frequently becoming apparent only in severe cases of anemia [1]. Children and babies through iron deficiency, whether through or without anemia, have delayed sensory pathway transmission [2]. Compared to well babies, those having iron deficiency anemia tend to exhibit extra cautious and hesitant behavior, increased fatigue, decreased attention span, and a tendency to stay close to their caregivers [3]. These changes in behavior are believed to pay to impaired expansion over functional isolation. Iron insufficiency affects the brain differently depending on the seriousness and timing of the shortage, and its detrimental consequences may or may not be reversible [4]. Despite rate of iron shortage anemia in Pakistan has reduced over last period, statistics from various surveys show that this remained very high within low-income preschool-age infants. Among all socioeconomic levels, the Centers for Illness Control and Anticipation stated that 8% among kids had iron insufficiency, and 3% of 2- to 3-year-olds had lack of iron anemia. In contrast, in Punjab, the prevalence of iron deficiency was 18% among 2- to 3-year-olds and 7% amongst 4- to 5-year-olds, particularly in low-income households [5]. One of the goals outlined in Healthy People 2020 was to decrease iron deficiency among 2- to 3-year-old children to 6% (compared to a baseline prevalence of 10%) and among 4- to 5-year-old children to 2% (compared to a baseline prevalence of 6%) in all children by 2020-2021 [6].

Image 1:



Iron levels in people or communities are measured using a variety of ways. Although employing numerous tests to measure iron status in a population is a feasible technique, this is least feasible and is not widely utilized in medical environments [7]. Iron deficiency anemia is commonly diagnosed in medical centers using 2-3 markers, but most cases depending on hemoglobin or hematocrit readings to identify anemia. As a consequence, the true frequency of iron deficiency and anemia in low-revenue offspring aged 1-3 years remains unknown [8]. In this study, iron levels were assessed using a variety of iron position markers, with serum ferritin, serum transferrin receptor, and transferrin saturation. The existence of anemia remained detected using hemoglobin [9]. Iron shortage and iron shortage anemia remained assessed in an easy example involving kids aged 1-3 years from low-income households using Superior Supplemental Nutrition Program for Females, Newborns, and Offspring hospitals [10]. The information that remained collected remained planned to enumerate the prevalence of iron lack and anemia, and also to assess usage of hemoglobin in detecting iron deficit [11-13].

Image 2:



METHODOLOGY:

Children between the ages of 1 and 3 were enrolled in the study by recruiting them from the waiting rooms of WIC clinics in Punjab from May 2020 to April 2021. The urban community of Lahore has a population of approximately 1,002,000, while Faisalabad and Multan have populations of 900,542 and 876,000, individually. Hispanics and Latinos constitute around 28%, 76%, and 89% of inhabitants in Lahore, Faisalabad, and Multan, individually. The median household profits in Lahore, Faisalabad, and Multan are approximately $45,500, $35,200, and $25,500, respectively. Additionally, 14%, 22%, and 39% of families in these three cities fall under scarcity level. The Lahore hospital has approximately 6,900 WIC participants, Multan has 1,700 WIC members, and Faisalabad has 3,900 WIC donors.

The interviewers remained trained to present themselves, provide a brief overview of our research, and inquire if the women had the child aged 1 to 3 years. To determine the flexible cutoff points in children, their serum samples were examined, ensuring there were no signs of hemolysis and that CRP levels (above 11 mg/L) were not elevated. The prevalence of low iron stores (indicated by low serum ferritin levels), iron shortage, and iron shortage anemia remained associated to earlier researches by means of both cutoff values recognized in the current study and those reported in the literature. According to the literature-based criteria, low iron stores remained definite as serum ferritin levels below 10 μg/L. Iron shortage, as per the literature-based criteria, was defined as having at least two out of three abnormal values for ferritin, transferrin receptors, and transferrin capacity (below 10%). Because hemoglobin levels decline once abnormal values are achieved, a regression model was used to derive cutoff values (flex points) for the iron measurements. Hemoglobin is the main late sign of iron insufficiency, and this may remain suggested that the cutoff value lower than the current biological threshold might be less clinically relevant.

RESULTS:

Figure 1 provides an overview of the subjects examined in the analysis. Among them, 35 children had high levels of CRP in their blood, 34 children showed signs of hemolysis, and 4 children had both conditions. A total of 438 themes providing information on anemia, and 361 subjects providing information on their iron levels. Topics who had normal CRP levels and not any signs of hemolysis but only had 2 out of the 3 measures of iron were included in the study if they might remain evidently categorized as either lacking or adequate in iron based on cutoff values determined in the current study and values found in existing literature. Only 3 subjects couldn't remain classified and remained excluded from examination. Regarding ethnic distribution, the sample consisted of 405 individuals (93.2%) who identified as Punjabi or Saraiki, 16 individuals (4.6%) as Pathans, 6 individuals (2.3%) as Sindhi, 4 individuals

(0.8%) as Urdu speakers, 3 individuals (0.6%) as Hindko speakers, 4 individuals (0.6%) as Balochi, and 3 individuals (0.6%) with unknown ethnicity. The average age of the participants was 24.3 ± 7.8 months (ranging from 13.1 to 36.9 months), and the sample consisted of 53.4% boys and 48.5% girls. The occurrence of anemia was 14.2% (49 out of 432 children with available hemoglobin values). Table 1 shows occurrence of anemia, little iron stores, iron lack, and iron lack anemia based on both cutoff values recognized in the study and the cutoff values found in the literature for boys and girls. Boys had real suggestively higher occurrence of low iron stores and iron lack compared to girls, as resolute by both research and literature cutoffs. The prevalence estimates for anemia, low iron stores, iron lack, or iron lack anemia did not significantly differ between children aged 1-2 years and those aged 2-4 years. However, excluding children with high CRP levels may have influenced occurrence estimates for iron lack.

Table 1: Anemia, poor iron reserves, and iron deficiency are common in low-income male and female infants aged 1-4 years:

	Girls	Boys
Iron deficiency anemia	3.7 (6 of 163)	3.2 (6 of 185)
Anemia2	12.4 (25 of 202)	9.9 (22 of 223)
Low iron stores7	22.38 (37 of 166)	34.9 (66 of 189)
Low iron stores3	19.94 (33 of 166)	29.1 (55 of 189)
Iron deficiency anemia10	3.7 (6 of 163)	2.7 (5 of 185)
Iron deficiency	12.1 (20 of 165)	19.8 (37 of 187)
Iron deficiency	7.3 (12 of 165)	10.2 (19 of 187)

The 35 participants who submitted both capillary and venous samples had mean hemoglobin concentrations of 123.4 11.7 g/L and 118.1 9.3 g/L, correspondingly (p 0.027, paired t-test). The odds ratios for anemia, poor iron reserves, and iron deficiency weren't substantially higher in low-birth-weight infants (birth weights less than 2600 g) as opposed to normal-birth-weight children (birth weights greater than 2600 g); nevertheless, overall were only 29 youngsters who had birth weights less than 2600 g. There existed no statistically important variance in gender or age among low-birth-weight and normal-birth-weight offspring. Table 1 shows the odds ratios for anemia in iron-deficient broods versus iron-sufficient infants based on both research and literature-determined estimates. Infants with iron shortage, low ferritin levels, high transferrin receptors, and low transferrin saturation had a greater risk of anemia than infants through appropriate ferritin, transferrin receptors, and transferrin immersion. Utilizing receiver operating individual curves, level of hemoglobin was employed to predict iron deficiency. The sensitivity at anemia threshold remained 24% for iron insufficiency assessed by experiment and 42% for iron deficiency based on literature. While the average level of transferrin among kids having high CRP levels was considerably lower than in individuals having normal CRP levels, there was actually not a substantial disparity in average.

Table 2: ORs and 96% confidence intervals for anemia, poor iron reserves, and iron deficiency in low-birth-weight versus normal-birth-weight infants:

	OR (95% CI)	NBW offspring through abnormal values	LBW offspring through abnormal values
		n	n
Anemia1	0.68 (0.16, 3.92)	44 of 395	2 of 26
Iron deficiency3	2.81 (1.00, 7.83)	50 of 331	6 of 18
Low iron stores2	2.58 (0.58, 5.28)	79 of 334	6 of 18

DISCUSSION:

Based on the findings of this study, relying solely on hemoglobin levels as a screening measure for infants may not effectively recognize altogether individuals whom are iron deficient [14]. While low hemoglobin levels are indicative of iron lack in regions through high prevalence, the reduction in iron deficiency cases in Pakistan has reduced the accuracy of anemia screening for detecting iron insufficiency [15]. In our research, ROC curves were utilized to assess prognostic capability of hemoglobin for iron insufficiency. Though a correlation remained found among low hemoglobin levels and iron insufficiency, hemoglobin demonstrated little sympathy in identifying iron shortage (24% and 42% for research-defined and literature-defined cutoffs, individually) [16]. Consequently, a significant proportion of iron-deficient infants (78% and 61% based on the study-defined and literature-defined cutoffs, individually) could have remained undetected [17]. It is essential to emphasize that our research findings were based on blood samples obtained from medical centers through venous collection, whereas hemoglobin levels are typically measured using finger prick samples at nearby WIC sites where we gathered information. Since hemoglobin readings from capillary specimens tend to be higher, there is a possibility that additional children could have been misinterpreted as having sufficient iron levels if we had used capillary samples [18]. The average difference in hemoglobin levels between offspring through capillary and venous models remained 4.3 g/L [19]. Assuming that we had increased all venous hemoglobin readings by 5.4 g/L, incidence of anemia could have reduced from 13.2% to 7.5%. Consequently, more children would have been labeled as having sufficient iron levels when they were actually deficient, regardless of whether they had anemia or not [20].

In our study, we observed a 12% prevalence of anemia, which is different from the 15-18% prevalence reported by the Pediatric Nutrition Surveillance System (PedNSS) for 2-4-year-olds in Pakistan in 2021, as well as the national prevalence of 14.2% for children under 6 years old in 2021. It is essential to take into account that PedNSS describes anemia based on low hemoglobin or low hematocrit values in addition collects data from capillary, venous, or a combination of both sample types [21]. These methodological distinctions are critical when comparing the prevalence of anemia between researches since the hemoglobin values may vary depending on method of sample collection. Hence, the prevalence data we obtained might diverge from the figures reported by PedNSS due to the usage of different blood collection methods across various clinics contributing to PedNSS [22]. Furthermore, our prevalence estimation might be subject to bias since we were unable to gather models from offspring whose mothers failed to join, constituting 27% of eligible participants [23]. If those non-participating offspring had the higher likelihood of anemia associated to those who took part, the reported prevalence of 12% could underestimate the actual prevalence [24].

To ensure accurate identification of iron deficiency anemia, it is essential to consider iron actions in addition to hemoglobin levels. Typically, serum ferritin values ranging from 10-12 µg/L are considered as low. In line through most recent National Health and Nutrition Examination Survey focusing on iron deficiency occurrence in Pakistan, we selected a cutoff of 10 µg/L for serum ferritin. The deadline for transferrin capacity remained determined based on the findings of the NHANES report [25].

The available research regarding transferrin receptors in children aged 1-4 years is limited. However, a comprehensive study conducted in India and Bangladesh provided a reference point of 12 µg/mL as the cutoff for transferrin receptors in children aged 5-10 years. In an Indian study, infants aged 1 to 2 years exhibited an average transferrin receptor attention of 13.1 ± 5.7 µg/mL once their hemoglobin levels ranged from 100 to 109 g/L. For infants with hemoglobin levels below 100 g/L, the average concentration was 17.2 ± 8.8 µg/mL [26]. The researchers discovered that when transferrin receptor levels dropped below 10 µg/mL, there was very sensitivity of 67% and the specificity of 72% in diagnosing iron deficiency. Given that broods in the current research were older, we anticipated the lesser abnormal value for transferrin receptor concentration and adopted the literature cutoff of 10 µg/mL [27]. Approximately 31-36% of boys and 21-23% of girls were found to have low iron stores based on the respective cutoffs established by the study and literature. The frequency of inadequate iron reserves is markedly higher compared to the reported prevalence of 18% for insufficient iron levels among 2-5-year-old children attending routine check-ups at four pediatric clinics in Lahore [28]. This discovery is not unexpected given that our research participants were recruited from the Special Supplemental Nutrition Program for Women, Infants, and Children, which primarily serves children at a high likelihood of experiencing iron deficiency. A study conducted in Pakistan encompassed children from socioeconomic backgrounds ranging from lower to middle class, and only 41% of the population were of Hispanic descent. We did not detect an elevated risk of anemia, inadequate iron reserves, or iron deficiency in low-birth-weight children, although it is worth noting the notable odds ratio of 3 for iron deficiency (as shown in Table 2) [29]. Low-birth-weight infants exhibit reduced iron reserves compared to infants with normal weight. These reserves face additional strain due to following catch-up growth and the production of red blood cells. Our expectation was that low-birth-weight offspring must remain more prone to anemia, low iron reserves, or iron deficiency. Though, limited number of low-birth-weight infants (only 29 out of 439 subjects) resulted in low statistical power to identify a significant elevation in risk [30]. Table 2 shows that if the cutoffs were chosen by the research or the literature, kids with iron deficiency or aberrant iron test results were more inclined to suffer from anemia. Iron-deficient children displayed a notable increase in the risk of anemia when compared to children with sufficient iron levels. The research recognized and literature-gritty cutoffs revealed a threefold and sevenfold higher risk, respectively. The variations in anemia risk between the study and literature findings primarily resulted from the stricter cutoff of 10 µg/mL for transferrin receptors, as opposed to the 8.4 µg/mL cutoff. Furthermore, offspring having low ferritin levels remained extra susceptible to anemia according to both researches and literature cutoffs, compared to broods through sufficient ferritin levels [31].

CONCLUSION:

Infants having transferrin receptor amounts more than 10 g/mL had a six-fold greater risk of anemia than those with values less than 10 g/mL. Adolescents having elevated transferrin receptor concentration did not have a higher risk of anemia once the limit for transferrin receptor concentrations was decreased to 8.4 g/mL. The results presented suggest that transferrin receptors can be very decent diagnostic for iron insufficiency. It is critical to recognize kids that have iron deficit and depleted iron reserves prior to them acquire iron deficiency anemia. The focus on lowering anemia without recognizing and treating iron deficiency calls into question its legitimacy. It is particularly so given recent findings associating iron insufficiency without anemia to impairments in development. Further research reveals a link among low iron storage, as measured by low ferritin levels, and more serious signs of attention shortage hyperactivity illness (ADHD) in youngsters. Regarding the devastating implications of iron deficiency anemia, which includes impaired psychomotor development, decreased cognitive function, stunted growth, and higher mortality, it is obvious that more measures to address iron deficiency in at-danger groups are required. In adding to finding infants who are iron deficient, we urge that healthcare practitioners educate parents in general about iron-rich diets and iron preoccupation enhancers just like heme and vitamin C.

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