Prevalence of Anemia in Children aged 6-36 Months and Dietary Determinants: A Cross-Sectional Study in Lahore, Pakistan

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Abstract

Background: Anemia has been acknowledged as worldwide problem, including in Pakistan. This cross-sectional study was conducted with objective to explore dietary determinants as risk factors for anemia in children aged 6–36 months living in the urban area of District Lahore, Pakistan.

Materials and Methods: The study was conducted in district Lahore, Pakistan. The Data was collected within two weeks in June, 2023–July 2023. A structured questionnaire for a 24-h recall and a semi-quantitative Food Frequency Questionnaire (FFQ) were used to collect the dietary intake data, and venous blood was withdrawn to determine the hemoglobin levels. Bivariate chi-square and multiple logistic regression tests were executed to explore the dietary determinant factors for anemia. We recruited 180 subjects.

Results: The average hemoglobin level was 11.4 ± 1.7 mg/dL, and 29.5% of the population had anemia. There was a strong correlation found between the following factors and an increased risk of anemia: not consuming cow's milk formula; insufficient consumption of lipids, protein, calcium, vitamin D, iron, zinc, vitamin A, vitamin C, vitamin B6, and vitamin B12. The only factors that were shown to be associated with anemia were the consumption of cow's milk formula and zinc intake.

Conclusion: In conclusion, 29.5% of children between the ages of 6 and 36 months had anemia. Zinc intake and the use of cow's milk formula were shown to be the two dietary determinants that were strongly linked to anemia as risk factors.

Key Words: Anemia, Dietary determinants, Risk Factors, Children, Pakistan

INTRODUCTION

It has been recognized that anemia is a global health issue to which young children are especially susceptible. The National Nutrition Survey 2018 confirms that micronutrient deficiencies are widespread in Pakistan. Anemia was common in non-pregnant women of reproductive age (43.0%) and among children 6-59 months of age (overall 53.7%; 54.2% in boys and 53.1% in girls). Over all 49.1% children were iron deficient. [1]. 2022 national figures from Pakistan likewise show a comparable anemic prevalence of 38.5% [2]. In 2009–2010, a different study conducted in a rural area of Pakistan revealed that the prevalence of iron deficiency anemia (IDA) and anemia in children aged 6–59 months was 29.4% and 56.9%, respectively [3]. The prevalence was higher than either the most recent national statistics from 2022 or the WHO data from 2000, which may point to a higher risk of anemia in rural areas.

Anemia comes in two forms: nutritional and non-nutritional. A person with nutritional anemia does not consume enough nutrients to meet their body's needs for erythrocyte production and hemoglobin. Since iron deficiency is the most common cause of anemia in children under five, special attention must be paid to the consumption of iron-rich or iron-fortified foods [4]. Worldwide, it is thought to be a factor in 42% of occurrences of anemia in children under the age of five. Deficits in vitamin A, B2 (riboflavin), B6 (pyridoxine), B12 (cobalamin), C, D, E, folate, and copper are additional nutrients that can cause anemia [5].

Poor dietary diversity, along with failure to flourish, food insecurity, and not having been dewormed, was revealed to be one of the predictors of anemia in children under the age of five by a systematic study [6]. A 2017 study conducted in Indonesia also indicated that following a three-month intervention period, a small dose of lipid-based nutritional supplement was helpful in raising hemoglobin levels and lowering the incidence of anemia in infants aged 6 to 12 months [7]. Given that it contains 6 mg of iron and 30 mg of vitamin C, the study found that this supplement might make up for any iron intake gaps [8]. This demonstrates the significance of nutrition as a deciding factor in childhood anemia.

OBJECTIVE OF THE STUDY

The study was conducted with objective to explore dietary determinants as risk factors for anemia in children aged 6–36 months living in the urban area of District Lahore, Pakistan.

MATERIALS AND METHODS

This study is an observational analytical cross-sectional study. The urban areas of the District Lahore were selected for the collection of data. Children aged 6–36 months were recruited from the selected areas after obtaining the signed informed consent from their parents. Those children who were seriously ill and/or needed special medication were excluded. It was calculated that at least 80 subjects were needed as a minimal sample

size, considering an anemia prevalence of 29.4%, with a 95% degree of significance (Zalpha = 1.96) and 90% degree of reliability.

Socio-demographic characteristics of the subjects, i.e., age, sex, general health status, parents' education, and family income were collected using a structured questionnaire. Macronutrient intake was determined using a dietary intake assessment of a one-day 24-h recall, while for the micronutrient intake data was collected using semi- quantitative food frequency questionnaire (FFQ) over a period of the past two weeks [9]. Inadequate intake was defined as an intake that was below the recommended daily allowance (RDA). Anemia was diagnosed using the cyanmethemoglobin method for venous blood to measure hemoglobin levels. The cut-off of hemoglobin level less than 11.0 g/dL is used, and we assumed that nutritional factors were likely to be the most important [10].

All data were recorded using a clinical record form before being entered into the spreadsheet using SPSS version 25.0. After data cleaning, data were analyzed using descriptive and inferential statistical tests to explore possible determinants of anemia using chi-square, and logistic regression analyses were performed in those with p-value < 0.020 according to the chi-square test [11]. A statistically significant level was determined using p-value less than 0.05. Data collection was done after receiving ethical approval and obtaining informed consent from the parent.

RESULTS AND DISCUSSIONS

Table 1: Background Characteristics

Socio-Demographic Characteristics	Total Subject (200)
Age, month	**22 (6–36)**
Age group, *n* (%)	
6–11 month	30 (15)
12–23 month	70 (35)
24–36 month	100 (50)
Sex, *n* (%):	
Boy	86 (43)
Girl	114 (57)
Education of Father, *n* (%):	
Up to Junior high school	**74 (37)**
Senior high school and over	**126 (63)**
Education of Mother, *n* (%):	
Up to Junior high school	**82 (41)**
Senior high school and over	**118 (59)**
Occupation of Father, *n* (%)	
Not permanent	**124 (62)**
Permanent	**76 (38)**
Occupation of Mother, *n* (%)	
Not permanent	**189 (94.5)**
Permanent	**11 (5.5)**
Household income, *n* (%)	

Less than minimal income	**157 (78.5)**
Fulfill to minimal income	**43 (21.5)**

When it comes to the sociodemographic attributes of parents, the majority of fathers and mothers were senior high school graduates (63% and 59%, respectively), held non-permanent jobs (62% and 94.5%, respectively), and had household incomes below the minimum income that the province recommended (78.5%). These circumstances were similar to those of an urban slum, where residents live in cramped, densely populated neighborhoods in very small, usually rented houses.

Table 2. Feeding Practice of Children aged 6-36 months (n= 200)

Feeding Practice	N (%)
Exclusive BF practice for 6 months, n (%)	154 (77%)
Intake of cow's formula milk, n (%)	123 (61.5%)
Taking supplement, n (%)	45 (22.5%)

Table 2 reveals that 77% of respondents reported exclusively breastfeeding for six months, 61.5% of subjects drank growing-up formula made from cow's milk, and only 22.5% baby subjects received vitamin and mineral supplements.

Table 3. Nutrient intake of children aged 6-36 months (n= 200)

Nutrients	Mean ± SD or Median (Min-Max)	Inadequate Intake
Dietary energy intake, in Kcal/day	939.4 (90.5–2230.0)	143 (71.5)
Carbohydrate to total energy, in %	55.3 ± 9.7	159 (79.5)
Fats to total energy intake, in %	32.0 (8.0-51.0)	117 (58.5)
Protein to total energy intake, in %	12.0 (6.0-25.0)	47 (23.5)
Protein intake, in g/kg body weight	2.9 (0.6–8.3)	
Dietary calcium intake, in mg/day	481.5 (35-3381.8)	99 (49.5)
Dietary iron intake, in mg/day	7.4 (0.4)-74.0)	60 (30)
Dietary zinc intake, in mg/day	4.5 (0.6-54.9)	39 (19.5)
Dietary vitamin A intake, in mcg/day	1021.8 (62.4-7041.4)	183 (91.5)
Dietary vitamin D intake, in mcg/day	2.9 (0-119.8)	41 (20.5)
Dietary B6 intake, in mg/day	0.8 (0.1-119.9)	124 (62)
Dietary B9 intake, in mcg/day	132.9 (15.7-597.8)	57 (28.5)
Dietary B12 intake, mcg/day	2.5 (0.2-2004.5)	66 (33)
Dietary vitamin C intake, mg/day	60.6 (4.1-445.4)	99 (49.5)

Data in Table 3 reveals that more than 50% of the subjects had insufficient dietary intake of energy, carbohydrate, fats, calcium, vitamin D, and folate according to the RDA. Insufficient dietary intake of iron and vitamin C were found in 30% and 49.5% of the subjects, respectively.

Table 4. Hemoglobin and Anemia Status of Children aged 6-36 months (n=200)

Sociodemographic Characteristics	n	Hemoglobin Level	Anemia Prevalence n (%)
Total	200	11.4 ± 1.7	58 (29.5)
Age group, n (%)			
6–11 month	30	10.9 ± 1.6	14 (46.7)
12–23 month	70	11.5 ± 1.6	22 (31.4)
24–36 month	100	11.3 ± 1.8	27 (27)
Sex, n (%)			
Boy	86	11.3 ± 1.7	35 (40.7)
Girl	114	11.4 ± 1.7	39 (34.2)
Education of Father, n (%)			
Up to Junior high school	74	10.9 ±1.7*	29 (39.2)
Senior high school and over	126	11.6 ± 1.7	33 (26.2)
Education of Mother, n (%)			
Up to Junior high school	82	11.1 ± 1.7	17 (20.7)
Senior high school and over	118	11.5 ± 1.7	24 (20.3)
Occupation of Father, n (%)			
Not permanent	124	11.3 ± 1.8	19 (15.3)
Permanent	76	11.4 ± 1.6	26 (34.2)
Occupation of Mother, n (%)			
Not permanent	189	11.4 ± 1.7	63 (33.3)
Permanent	11	10.7 ± 1.7	4 (36.4)
Household income, n (%)			
Less than minimal income	157	11.2 ± 1.7*	59 (37.8)
Fulfill to minimal income	43	12.0 ± 1.4	9 (20.9)

p-value < 0.05.

As shown in Table 4, the mean hemoglobin level was 11.4 ±1.7 mg/dL, and the lowest hemoglobin value was found among subjects aged 6–11 months (10.9 1.6 mg/dL). The prevalence of anemia (i.e., hemoglobin less than 11.0 mg/dL) was 29.5%, and the highest prevalence was found among those aged 6–11 months (46.7%). Significant difference of hemoglobin level was found related to the fathers' education and household income. However, there is no significant difference in anemia prevalence based on socio-demographic characteristics.

Table 5. Dietary Determinants of Anemia among the Children aged 6-36 Months

Determinant Factors	*n*	Anemia *n* (%)	*p*-Value	OR (CI95%)	OR (Logistic Regression)*
Energy intake					
Adequate	64	15(23.4)	0.164		
Inadequate	136	49 (36)			
Carbohydrate intake					
Adequate	48	14 (29.2)	0.634		
Inadequate	152	48 (31.6)			
Fats intake					
Adequate	86	19 (22)	0.006	2.657	
Inadequate	114	43 (37.7)		(1.316–5.366)	
Protein intake					
Adequate	158	44 (27.85)	0.001	3.526	
Inadequate	42	22 (52.4)		(1.601–7.764)	

Calcium intake					
Adequate	81	13 (16)	<0.001	4.663	
Inadequate	119	49 (41.2)		(2.102–10.347)	
Vitamin D intake					
Adequate	23	3 (13)	0.074		
Inadequate	177	57 (32.2)			
Iron intake					
Adequate	104	19 (18)	<0.001	3.681	
Inadequate	96	39 (40.6)		(1.852–7.315)	
Zinc intake					
Adequate	134	28 (20.9)	<0.001	3.960	4.262
Inadequate	66	32 (48.5)		(2.000–7.842)	(p = 0.042)
Vitamin A intake					
Adequate	155	37 (24.3)	<0.001	4.525	
Inadequate	45	23 (51.1)		(2.087–9.811)	
Vitamin C intake					
Adequate	137	34 (24.8)	0.003	2.797	
Inadequate	63	27 (42.8)		(1.415–5.528)	
Vitamin B6 intake					
Adequate	155	41 (26.5)	0.006	2.860	
Inadequate	45	20 (47.6)		(1.334–6.130)	
Folate intake					
Adequate	90	23 (25.5)	0.134		
Inadequate	110	40 (36.4)			
Vitamin B12 intake					
Adequate	143	33 (23)	0.001	3.290	
Inadequate	57	26 (45.6)		(1.631–6.637)	
Type of milk consumed					
Cow's milk formula	123	17 (13.8)	<0.001	9.849	8.651
Non-cow's milk formula	77	42 (54.5)		(4.695–20.662)	(p < 0.001)

Legend: The first OR is the result from the bivariate analyses (chi-square test), while the second OR is the result from the logistic regression analysis, which was performed among those with p-value < 0.020 from the bivariate analyses (chi-square test). * Including p-value of <0.020 from the bivariate analysis after controlling for sex, father's education status and household income status.

Based on further analysis using the logistic regression (Table 5) after controlling for fathers' education and household income, this study found still two dietary determinant factors that significantly contributed to anemic status among children aged 6–36 months: inadequate dietary intake of zinc (OR = 4.262) and not consuming cow's milk formula (OR = 8.651).

DISCUSSION

The sociodemographic features of the research region were similar to those of an urban slum. Almost all macro and micronutrient intakes, including those of carbohydrates, lipids, calcium, vitamin D, folate, iron, and vitamin C, were found to be prevalently inadequate. The incidence of anemia in children between the ages of 6 and 36 months was 29.5%. The two main nutritional determinant factors that were substantially connected with anemia were the consumption of zinc and the absence of cow's milk formula.

Anemia prevalence determined from serum hemoglobin levels between 20.0 to 39.9% is considered a substantial moderate public health problem by the World Health Organization (WHO), whereas prevalences exceeding 40% are considered to be of severe public health relevance [12]. As a result, the 29.5% anemia prevalence among children between the ages of 6 and 36 months identified in our study qualifies as somewhat relevant for public health. The frequency of anemia in this study was less common than the 56.9% that was recorded in 2014 among children ages 6 to 59 months in a rural area of Pakistan.

More concern should also be raised specifically for the age group 6–11 months because the prevalence of anemia in this age group reached 46.7%, what is classified by the WHO as of severe public health significance. The high anemia prevalence in this specific age group should also be carefully interpreted because the number of children in this age group was unfortunately much smaller than the other age groups. Furthermore, the study only provides a general description of anemia prevalence based on hemoglobin analysis with the assumption that nutritional factors were likely to be the most important factors. A shortcoming of our study design is the absence of other indicators of anemia, i.e., mean corpuscular volume (MCV), total count of erythrocytes, or reticulocyte count, thus limit the interpretation to a specific cause of anemia, i.e., iron deficiency anemia.

Parents had a sufficient level of education (i.e., graduated from senior high school), but more than 60% of the fathers and almost all the mothers had non-permanent jobs. Aligned with the parents' situation, more than 70% of the households had an income of less than the minimal recommendation for appropriate living in Punjab. Furthermore, the limited household incomes might affect the availability and affordability of nutritious foods and increase child malnutrition resulting in anemia. In this study it was revealed that children aged 6–36 months were at risk of anemia if they had inadequate dietary intake of both macro nutrients (i.e., fats, and protein), and micronutrients (i.e., calcium, iron, zinc, vitamin A, vitamin C, vitamin B6, and vitamin B12), and also if not consuming cow's milk formula. This showed that anemia among children aged 6–36 months old was not only associated with iron intake. Houghton et al. [13] concluded from a study among children aged 12–23 months in New Delhi that although iron deficiency was found to be the only nutrition factor significantly associated with anemia, most of the children who were classified as anemic were having multiple micronutrient deficiencies, including folate, vitamin D, vitamin B12, zinc, and vitamin A.

Anemia is mostly associated with iron deficiency status. There is a significant positive correlation between dietary iron intake and hemoglobin values among children aged 24–36 months from the same area [14]. This shows the importance of an appropriate dietary intake in the prevention of anemia. However, a study among preschooler children in Brazil found that there was no significant difference between dietary intake of iron, energy, and protein between those children with or without iron depletion or iron deficiency anemia status [15]. This finding suggests that besides paying attention to adequate intake of dietary

iron, other factors such as socio-economic of the household and childcare are also important as confounding variables [16].

In this study, inadequate dietary zinc was associated with anemia among children aged 6–36 months old, and it remained as one of the two determinant factors for anemia. The odds of anemia were 3.8 times greater for children with inadequate dietary zinc intake. Dietary zinc intake was also found to be associated with anemia in children less than 24 months of age in a study done in Guatemala, in which the odds of anemia were more than 3 times greater for infants/toddlers with zinc deficiency [17].

This study had odds of anemia 8.6 times greater for children not consuming cow's milk formula. The possible explanation was that cow's milk formula had been fortified with important micronutrients, including iron, to support child growth and development. Therefore, children that consumed cow's milk formula had a lower risk of anemia. Cow milk (unmodified) is known to have poor iron content and absorption, low vitamin C content, and in contrast, high casein and calcium content that could negatively influence iron absorption, and thus hemoglobin synthesis [18–20].

The current study contains a number of shortcomings. First, the prevalence of anemia was determined solely by measuring hemoglobin levels; additional anemia indicators, such as MCV, total erythrocyte count, or reticulocyte count, were not taken into consideration. Second, because of the limited time allotted by the authority for data collection, the semi-quantitative FFQ was modified from the current one without validation. Third, there is no way to verify if dietary intakes were reported accurately or excessively. Nonetheless, this study's strength was its ability to pinpoint important dietary components that contribute to anemia in a homogenous socioeconomic setting. This finding may be taken into account while attempting to reduce the incidence of anemia in impoverished metropolitan areas of Punjab.

CONCLUSION

This study concludes that anemia affects over 30% of newborns and toddlers in the sampled population. The two main causes of anemia in children between the ages of 6 and 36 months are not eating cow's milk formula and consuming insufficient amounts of zinc from their diet. As a result, the government ought to keep helping localities maintain a varied diet that would ensure a sufficient consumption of macro- and micronutrients. The ideal local diet for kids between the ages of six and thirty-six months has to be further investigated, particularly for kids who live in impoverished metropolitan areas.

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