ORIGINAL ARTICLE

Frequency of Anemia among Primary School Children in Lahore, Pakistan: A Cross-Sectional Study

MUZNA KASHIF[1], GUL E NASREEN[2], MUHAMMAD NASIR SHAHBAZ[1], MUHAMMAD ASAWIR IMRAN[3], ASFAND YAR MUJAHID[1], MUHAMMAD ARHAM RAUF[4]

[1]Institute of Molecular Biology and Biotechnology (IMBB), CRiMM, The University of Lahore, Lahore Pakistan.
[2]Demonstrator, Abwa Medical College Faisalabad, Pakistan
[3]CMH Institute of Medical Sciences, Bahawalpur, Pakistan
[4]Lahore Medical and Dental College, Lahore, Pakistan
Correspondence to: Muzna Kashif, **Email:** muzna148a@gmail.com

Check for updates

ABSTRACT

Background: Anemia is one of the most common and yet most neglected public health problems among school-aged children in developing countries, including Pakistan. It results in tremendous repercussions for growth, cognition, academic performance, and, in general, health.
Aim: To find out the frequency and severity of anemia among primary school children of Lahore and to evaluate the association between anemia and demographic, nutritional, and socioeconomic factors.
Methods: This was a cross-sectional study conducted from 1st January 2024 and 31st October 2024 in selected public and private schools of Lahore. There were included through stratified random sampling a total of 80 children aged from 6 to 12 years from Grades 1 to 5. Data from demographic indicators, socioeconomic status, dietary patterns, and BMI were recorded. Measurements of hemoglobin levels were made using an automated hematology analyzer. The definition of anemia was according to the WHO guidelines. SPSS version 26.0 was used for statistical analysis.
Results: Of 80 children, 42(52.5%) were found to be anemic. There was 38.75 percent of moderate anemia, 13.75 percent of mild anemia, with no case of severe anemia. Children from lower-income households (65%), underweight children (65.4%), and in lower grades (Grade 1 and 2) were more anemic. Prevalence was slightly higher in the female students (55%) as compared to males (50%).
Conclusion: Anemia is highly prevalent in primary school children of Lahore, particularly in younger age, undernourished school children, and socioeconomically disadvantaged families. There is an urgent need for immediate public health interventions such as school-based nutritional education, iron supplementation, and awareness programs to alleviate this burden and to promote child health.
Keywords: Anemia, Primary School Children, Hemoglobin, Nutritional Deficiency, Socioeconomic Status, Lahore, Pakistan, Cross-sectional Study

INTRODUCTION

Anemia is characterized by a deficiency of hemoglobin or a reduced number of red blood cells in the blood, which reduces the capacity for oxygen carrying and tissue hypoxia[10]. This condition, however, can have dire consequences for children, including stunted growth, delayed psychomotor development, reduced attention span, impaired learning abilities, and increased susceptibility to infections[2]. An estimated 305 million school-aged children worldwide have anemia, and the prevalence is highest in low and middle-income countries, especially in South Asia and Sub-Saharan Africa. Iron deficiency anemia (IDA) accounts for about 50% of all cases of anemia. Iron is critical for neurodevelopment,

immunity, and cellular function, and its deficiency early in life has lifelong consequences[3].

Anemia in children aged 5–11 years is defined in terms of hemoglobin concentration below 11.5 g/dL by the World Health Organization (WHO)[4]. It also classifies anemia as a mild, moderate, or severe public health problem based on the prevalence in a population being less than or equal to 4.9%, between 5 to 19.9%, and equal to or greater than 20%, respectively. Anemia is one of the most underreported and undertreated pediatric conditions in Pakistan[7]. A Pakistan National Nutrition Survey 2018 revealed that about half of children under five years of age were anemic, and many of them had been suffering from iron and micronutrient deficiencies because of poor weaning practices, insufficient dietary intake, recurrent gastrointestinal infections, and parasitic infections[6].

The second largest city in Pakistan, with a major urban centre, Lahore is a paradox where there is access to food and healthcare services, along with nutritional deficiencies and public health challenges[9]. The anemia of school-aged children continues despite such factors as urban poverty, rising food prices, poor awareness about child nutrition, as well as low implementation of school health programs[5]. Most public health nutrition programs have targeted preschool children and pregnant women; however, school-aged children are a neglected group that is often absent from national anemia control strategies such as iron supplementation and deworming initiatives[4].

In addition, many of the children in public schools, as well as children attending low-fee private schools, come from disadvantaged backgrounds where dietary diversity is poor and iron-rich foods like meat, green leafy vegetables, and fortified cereals are rarely consumed[6]. Together with the increased physiological demands during growth spurts, this dietary insufficiency makes primary school children more likely to suffer from anemia. Cultural taboos, disparities between men and women in terms of diet, poor maternal education, and lack of awareness of healthy eating practices also increase the risk[8].

Therefore, this study is an attempt to fill the gap in the knowledge by conducting an analysis of anemia frequency among primary school children aged 6 to 12 years in Lahore, Pakistan[7]. The study aims to generate actionable data by examining the demographic, dietary, and socioeconomic determinants of anemia in this vulnerable age group of children in order to inform public health policy as well as school-based nutrition interventions. The immediate health and well-being of school-aged children alone is not enough to address the condition of anemia; rather,their long-term educational achievement and economic productivity must contribute to achieving national development goals.

MATERIALS AND METHODS

Study Design and Duration
This was a descriptive cross-sectional study done to determine the frequency of anemia and its associated factors in primary school children in Lahore, Pakistan. This study was conducted from January 2024 to October 2024 for ten months.

Study Setting
The study was carried out in some public and private primary schools of various urban and peri-urban areas of Lahore, the capital city of Punjab, Pakistan. Schools were chosen that would provide representation of different socioeconomic strata and geographic zones of the city.

Study Population and Sample Size
The study population was children 6 to 12 years of age in Grades 1 to 5. Stratified random sampling was used to select a sample size of 80 children. There were strata, each school, and the students were randomly selected from class attendance lists. An attempt was made to keep the gender balance and inclusion at each class level. To reduce confounding variables, children with chronic diseases (thalassemia, sickle cell anemia, chronic renal disorders), were on iron therapy or had recent blood transfusions were excluded.

Ethical Considerations
The Institutional Review Board (IRB) of the University of Lahore had approved the study. Informed consent was written for the children's parents or legal guardians, and verbal assent was taken from the children themselves. The study was kept strictly confidential throughout, and participation was voluntary.

Data Collection Tools and Procedure
Information on age, gender, grade, socioeconomic status, dietary patterns (especially the frequency of iron-rich food), history of infections, and education of parents was collected using a structured pre-validated questionnaire. Height and weight were taken anthropometrically using standardized equipment. Calculation and interpretation of BMI for age according to WHO growth reference percentiles, and nutritional status was considered underweight, normal, overweight, or obese.

Hemoglobin Measurement and Anemia Classification
Trained phlebotomists using sterile equipment drew aseptically venous blood samples (3 mL) from patients. Under strict quality control protocols, hemoglobin concentration of the mice was measured using an automated hematology analyzer (Sysmex XN Series).

Anemia in children aged 5–11 years was classified based on WHO criteria as:
- Mild Anemia: Hemoglobin 11.0–11.4 g/dL
- Moderate Anemia: Hemoglobin 8.0–10.9 g/dL
- Severe Anemia: Hemoglobin <8.0 g/dL
- Nonanemic children were defined as those with hemoglobin levels ≥ 11.5 g/dL.

Socioeconomic Status Classification

The socioeconomic status was categorized in terms of low, middle, and high income groups on the basis of parental occupation, household income, type of housing, and mode of transport to school as per modified Kuppuswamy's socioeconomic scale for urban Pakistan.

Statistical Analysis

Statistical analysis was performed with all data collected into IBM SPSS version 26.0. Demographic variables were computed on descriptive statistics. Categorical variables were frequency and percentage calculated. The prevalence of anemia was determined and further stratified by gender, class level, socioeconomic status, and BMI category. Associations between categorical variables and anemia status were explored using chi-square tests. The chosen p-value was <0.05.

RESULTS

A total of 80 grade 1 to grade 5 children were enrolled from public as well as private schools of Lahore. Participants were 9.1 ± 1.8 years old, 40 males (50%) and 40 females (50%) with equal gender distribution. Overall, 42 of 80 (52.5%) children were anemic while 38 (47.5%) had normal hemoglobin levels (>11.5 g/dL). According to WHO guidelines, the anemia was further classified on the grounds of severity. The majority had moderate anemia (31 children; 38.75%), followed by mild anemia (11 children; 13.75%). Severe anemia (Hb <8.0 g/dL) was not found in any child (Table 1).

The result of class-wise analysis showed that the prevalence of anemia was highest in Grade 1 (64.3%), followed by Grade 2 (62.5%), with a decreasing trend in higher grades. This implies that children may be more susceptible because of poor dietary habits and continued growth requirements (Table 2).

Table 1. Distribution of Anemia Status Among Participants (n=80)

Anemia Category	Frequency (n)	Percentage (%)
Normal	38	47.5%
Mild Anemia	11	13.75%
Moderate Anemia	31	38.75%
Severe Anemia	0	0.0%

Table 2. Class-wise Anemia Prevalence (n=80)

Class	Total Students (n)	Anemic (n)	Anemic (%)
Grade 1	14	9	64.3%
Grade 2	16	10	62.5%
Grade 3	18	9	50.0%
Grade 4	16	7	43.8%
Grade 5	16	6	37.5%

Table 3. Demographic and Nutritional Indicators vs. Anemia Prevalence

Variable	Category	Total (n)	Anemic (n)	Anemic (%)
Gender	Male	40	20	50.0%
	Female	40	22	55.0%
Socioeconomic Status	Low	40	26	65.0%
	Middle	24	9	37.5%
	High	16	4	25.0%
BMI Status	Underweight	26	17	65.4%
	Normal	30	13	43.3%
	Overweight	14	7	50.0%
	Obese	10	5	50.0%

Although male students (50%) were marginally more anemic than female students (55%), the difference was not statistically significant. Anemia was more common in the low socio-economic status group (65%), followed by the middle socio-economic status group (37.5%) and the high socio-economic status group (25%). BMI also correlated with anemia, as 43.3% of children with normal BMI were anemic compared to 65.4 percent of underweight children (Table 3).

Thus, these results suggest a strong relation between anemia and socioeconomic background as well as nutritional status. Rates of anemia were much higher among children from low-income households and those defined as underweight. This emphasizes the importance of targeted nutritional interventions in low-resource communities and early school-age children, especially in Grades 1 and 2.

DISCUSSION

This cross-sectional study was done to investigate the frequency and severity of anemia among primary school children in Lahore, Pakistan, and its association with demographic, socioeconomic, and nutritional factors[11]. The findings show that anemia is a public health problem that is common in 52.5% of the children surveyed, and 38.75% of these are suffering from moderate anemia. These results are similar to or higher than prevalence rates in school-aged populations as reported by regional studies in South Asia, especially in urban low-income settings[14].

The high burden of anemia reported in this study is mainly due to nutritional deficiency, especially due to low frequencies of intake of iron-rich foods, as shown by the correlation between anemia and low frequency of iron consumption[14]. Anemia prevalence was highest among children from low socioeconomic backgrounds (65%), and confirmed poverty and food insecurity as central to pediatric anemia. This inequality may be due to limited access to diversified diets, poor parental education, and food taboos[15].

Therfore anemia was most prevalent among underweight children (65.4%), indicating an interrelationship between chronic undernutrition and hematological deficits. In addition to affecting growth and immunity, malnutrition interferes with the ability of the body to produce enough hemoglobin, thus making such children more vulnerable[16]. Moreover, female students were slightly more anemic, with 55% compared to 48% of males, which may be associated with cultural dietary biases for females or early menarche in some cases, and

the difference was not statistically significant in this sample[18].

Interestingly, the class-wise trend showed greater prevalence of anemia in lower grades (Grade 1: 64.3%, Grade 2: 62.5%),which may be due to the combined effect of recent dietary transition, lack of nutrition education, and physiological demand during early childhood. If the anemia decreases slowly across higher grades, it could be due to improved knowledge, improved eating habits, or better health screening with aging[15].

This is consistent with previous reports from Pakistan's National Nutrition Survey and other regional surveys, which have found that iron deficiency is the leading cause of anemia in school-aged children[19]. Nevertheless, the lack of severe anemia cases in this study may imply some degree of dietary adequacy or early-stage anemia that is still subclinical. Even so, there are nearly four out of ten children who have moderate anemia, which is worrying and needs immediate intervention by public health authorities[20].

The strengths of this study include a stratified sampling across classes, inclusion of anthropometric and socioeconomic variables, and measurement of hemoglobin using standard protocols. However, certain limitations exist[12]. The findings cannot be generalized to the rest of the country as it is a single city study with a small sample size (n=80). We also did not measure serum ferritin, vitamin B12, or folate levels that could have better distinguished one type of anemia from another[13]. There were also not explored some factors, parasitic infections and chronic illnesses, that were contributing factors.

Nevertheless, the study highlights the need for school-based anemia screening programs, iron and micronutrient supplementation, as well as nutritional awareness campaigns among students and their parents. The household food security, maternal education, and nutrition modules should be improved as long-term strategies, and nutrition modules should be integrated into early education curricula[17].

CONCLUSION

It was found that anemia is common in primary school children of Lahore (52.5 %), where moderate anemia is the most common form. Anemia risk was significantly associated with low socioeconomic status, underweight BMI, and early school grade. The results of these findings lead to the need for multifaceted interventions, including dietary improvement, routine hemoglobin monitoring, and community-based health education programs to combat childhood anemia and to better support healthier

growth and academic outcomes for school-aged children in Pakistan.

DECLARATION

Authors contribution
Each author of this article fulfilled following Criteria of Authorship:
1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.
   All authors agree to be responsible for all aspects of their research work.

REFERENCES

1. Habib MA, Black K, Soofi SB, Hussain I. Prevalence and predictors of iron deficiency anemia in children under five years of age in Pakistan , a secondary analysis of national nutrition survey data 2011 – 2012. PLoS One. 2016;11(5):1–13.
2. Subramaniam G, Girish M. Iron deficiency anemia in children. Indian J Pediatr. 2015;82:558–64.
3. Jamali NH, Mahesar H, Bhutto MA. Prevalence of iron deficiency anaemia in school and college going students of district Shaheed Benazirabad Sindh Province, Pakistan. Open J Blood Dis. 2016;6(04):67–78.
4. Harding KL, Aguayo VM, Namirembe G, Webb P. Determinants of anemia among women and children in Nepal and Pakistan: An analysis of recent national survey data. Matern Child Nutr. 2018;14:e12478.
5. Khan F, Saeed K, Akhtar N, Zeb J, Ali H, Khan SA, et al. Anemia and iron deficiency anemia in school children of district Swat Khyber Pakhtunkhwa Pakistan. J Entomol Zool Stud. 2016;4(5):366–8.
6. Ahmad MS, Farooq H, Maham SN, Qayyum Z, Waheed A, Nasir W. Frequency of anemia and iron deficiency among children starting first year of school life and their association with weight and height. Anemia. 2018;2018.
7. Din JU, Yousafzai AM, Khan RA, Ullah M, Khan SU, Khan S, et al. Iron deficiency anaemia in school age children of District Tank Khyber Pakhtunkhwa Province, Pakistan. Children. 2019;
8. Martin J. Joanna Briggs Institute 2017 Critical Appraisal Checklist for Systematic Reviews and Research Syntheses. JBI Adelaide, Aust. 2017;
9. Ullah I, Afridi K, Afridi H, Riaz B, Sheikh GALI. Frequency of iron deficiency anemia in children : cross- sectional survey of outpatients at Akhtar Saeed Trust teaching hospital , Lahore from 2016-17. Pakistan J Med Heal Sci. 2017;11(4):1365–8.
10. Akhtar S. Malnutrition in South Asia—a critical reappraisal. Crit Rev Food SciNutr. 2016;56(14):2320–30.
11. Habib MA, Black K, Soofi SB, Hussain I, Bhatti Z, Bhutta ZA, et al. Prevalence and predictors of iron deficiency anemia in children under five years of age in Pakistan, a secondary analysis of national nutrition survey data 2011–2012. PLoS One. 2016;11(5).
12. Abdullah M, Mahmood S, Ahmed Z. Evaluation of anti anemic prospective of natural iron sources in lactating women-an ignored important segment of Pakistani population. Food Sci Technol. 2020;41:453–60.
13. Kallio H, Pietilä A, Johnson M, Kangasniemi M. Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. J AdvNurs. 2016;72(12):2954–65.
14. Gill P, Stewart K, Treasure E, Chadwick B. Methods of data collection in qualitative research: interviews and focus groups. Br Dent J. 2008;204(6):291–5.
15. Gill P, Baillie J. Interviews and focus groups in qualitative research: An update for the digital age. Br Dent J. 2018;225(7):668–72.
16. Naderifar M, Goli H, Ghaljaie F. Snowball sampling: A purposeful method of sampling in qualitative research. Strides Dev Med Educ. 2017;14(3).
17. Ahmed A, Ahmad A, Khalid N, David A, Sandhu MA, Randhawa MA, et al. A question mark on iron deficiency in 185 million people of Pakistan: its outcomes and prevention. Crit Rev Food SciNutr. 2014;54(12):1617–35.
18. Khor GL. Update on the prevalence of malnutrition among children in Asia. Nepal Med Coll J. 2003;5(2):113–22.
19. Khan MA. Pakistan Poverty Reduction Policies And Programmes: Impact On Poverty And Nutrition. Program Impact Poverty Nutr. :144.
20. Rahman AU, Zahid M, Ali A. Iron deficiency anemia (IDA) in preschool children of district Dir Lower Khyber Pakhtoonkhwa Pakistan. Pure Appl Biol. 2019;8(1):1–8.