New Risk Factors Defined for Anemia Among School-Going Children in Peshawar, Pakistan

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ABSTRACT

Background: Anemia, "a hidden hunger" is among one the major nutritional public health problems across the globe affecting both developed and developing countries. In children, it results in impaired cognitive performance, behavioral, linguistic development and scholastic achievement. The study aimed to estimate the frequency and new risk factors of anemia in school-going children of Peshawar.

Methods: A cross-sectional study was conducted from February 2020 to January 2022. A sample of 240 children between the ages of 5-15 years from eight different schools, were selected. The data was analyzed using SPSS version 20 for windows. Chi-square test was used to see association between different variables. $p \leq 0.05$ was taken as a minimum level of significance.

Results: Among a total of 240 school-going children, 93 (38.75%) were anemic and 147 (61.2%) were non-anemic. The anemia prevalence was higher in female children and younger age groups. The percentage of anemic children was significantly higher who don't take nutritional supplements (19.7%) compared to those who do (47.5%) ($p<0.001$). The anemic children with worm infestation history, were significantly higher (51.6%) in number compared to (25.4%) without infestation ($p<0.001$). Majority (66.6%) of children from lower socioeconomic groups were anemic ($p<0.001$).

Conclusion: Children, school-going, and vegetarian were found significantly anemic ($p<0.001$). Female children were more prone to anemia than male children.

Keywords: Anemia, School Going Children, Pakistan.

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INTRODUCTION

Anemia is defined as a condition in which the quantity of hemoglobin in blood is below than normal level due to deficiency of essential nutrients, excessive blood loss, worms' infestation and other hemolytic diseases[1]. According to WHO, cut-off values for anemia include a level of blood hemoglobin less than 11 g/dL for females and <12 g/dL for males[2,3].

Worldwide anemia is the most common issue, especially in a pediatric age group with an estimated prevalence of 43%. An estimated 1.62 billion people have affected annually throughout the globe. It is estimated that 30 to 50% of anemia is caused due to deficiency of iron in blood[4]. According to the Pakistan National Nutritional survey, in 2018 anemia among children is 53.7% (54.2% in boys and 53.1% in girls)[5]. Anemia is caused due to multifactorial reasons. Some of the important risk factors in the general population include; poor dietary habits, worm infestations and also sociodemographic factors like poverty and lack of education[6].

Anemia may occur at all stages of life but pregnant women and young children are more vulnerable due to their rapid growth and high iron demand[7]. One of the major reasons for anemia in children is a replacement of breast milk with formula milk which does not contain enough iron, vitamin B12 and folic acid[8]. The Consequences of anemia especially in school-age children are numerous including low IQ level, fatigue and poor performance academics[9,10].

Although anemia remains a serious public health concern, a limited number of studies are done to assess the levels of anemia in school-aged children. This study aimed to assess the prevalence of anemia in both rural and urban areas of Peshawar, Khyber Pakhtunkhwa Pakistan. This study is also important because it identified some novel risk factors that need to be addressed by policymakers. By assessment of burden, the distribution, etiology and contributory factors of anemia can be identified in school-going children, an important tool for adopting appropriate preventive measures.

METHODS

A cross-sectional study was carried out in schools of both rural and urban areas of district Peshawar, Khyber Pakhtunkhwa, Pakistan to measure the prevalence of anemia among school-going children and their associated determinants. The period of study was from February 2020 to January 2022. Ethical approval was taken from the institutional ethical committee. Consent was taken from the parents/guardians of the children. Students and school staff were assured of the confidentiality of all information. Children of sex, studying from class 1 to class 10 between 5-15 years of age and willing to participate were selected. Children with a history of any systemic illness or with any known drug allergy were excluded from the study. The net sample size for this study of 240 students was determined by using single population formula. The prevalence of anemia from the previous study (50%) was considered and the margin of error was kept at 5% with a 95% confidence interval. The sample size included a total of 30 students from each school and a total of eight schools were included. Data was collected by cluster random sampling method. Two towns were selected and then in each town, two union councils were selected. In each Union Council, a school was randomly selected and, in each school, every eight students were selected according to roll number.

A preliminary visit was done to each school before the data collection and the teachers were instructed to obtain consent from the parents or guardians. Written permission from the principal of each school was taken. The information regarding socio-economic status, nutritional status and dietary habits were collected with the help of junior residents and school teachers by a pre-tested structured questionnaire. For the Hb level, a complete medical examination was done and then blood samples were taken by a lab technician from each subject and submitted to a laboratory. The result of each Hb level was then filled in a questionnaire of that specific subject.

For operationalization of the variable, the cut-off values according to recent WHO criteria for anemia were considered. Hb levels <11 g/dL for girls and <12 g/dL for boys were labeled as anemic while for grading of anemia, children with Hb level 11-11.4 gm/dl were labeled as mild, moderate with Hb level 8-10.9 gm/dl and severe with Hb < 8 gm/dl. All the results were recorded and analyzed by Statistical Package for Social Sciences (SPSS) version 24 for windows. Data cleaning was done to check for frequency, accuracy, consistency and missing values. Any errors identified were rectified. Descriptive statistics mean (S.D) or proportion was recorded for age and Hb level. While for categorical variables Chi-square test was used for assessment. $p \leq 0.05$ was taken as a minimum level of significance.

RESULTS

Out of 240 school children who participated in this study, 57.5% were males with a mean age of (10.21 ± 1.89) years while the remaining 42.5% were female children with a mean age of (11.01 ± 2.56) years. Among 240 school-going children, 93 (38.75%) were found anemic and 147 (61.2%) were non-anemic (Figure 1). The sociodemographic characteristics of the students are shown in Table 1.
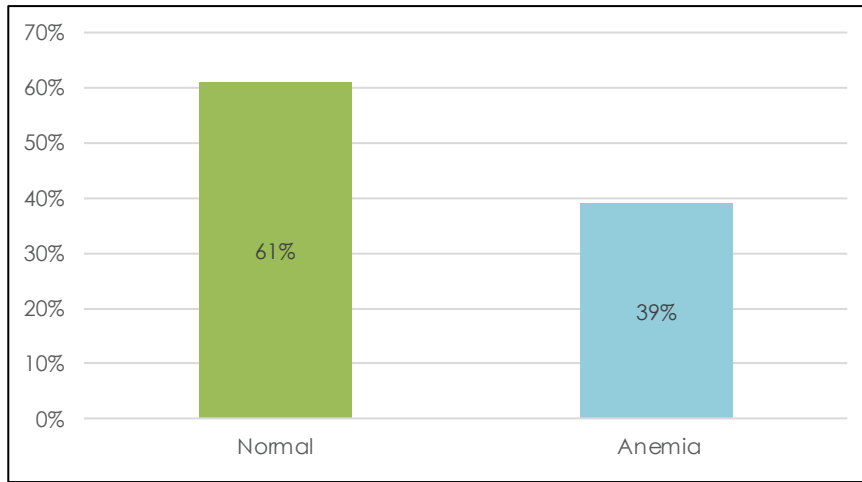
Figure 1: Frequency of anemia in school-going children.

Table 1: Socio-demographic characteristics of school children.

Variables	Frequency n (%)		
Gender	Male	Female	
	138(57.5)	102(42.5)	
Age	5-11	12-14	14
	128(53.3)	84(35.0)	28(11.6)
School	Rural	Urban	
	120(50.0)	120(50.0)	
Family Size	≤ 5	> 5	
	141(58.7)	99(41.2)	
Diet	Vegetarian	Non-vegetarian/Mixed	
	66(27.5)	174(72.5)	
SES	Class III	Class IV	Class V
	14(7.0)	181(74.5)	45(18.5)
Hygiene	Poor	Good	Satisfactory
	47(19.5)	60(25)	133(55.4)
Nutritional Supplements	Yes	No	
	76(31.6)	164(68.4)	
History of Infestation	Yes	No	
	118(49.1)	122(50.9)	

Among a total of 93 anemic children mild anemia was found to be present in 33 (13.7%) of children (Table 2) while moderate and severe anemia was reported in 48 children (20%) and 12 (5%) children respectively. The lower age group children (5-11) have moderate anemia while increasing age showed mild anemia (Table 3). Anemia was seen in 34.7% of males and 44.2% of females. The prevalence of anemia was more in girls than in boys (p=0.171) (Table 4).

Table 2: Prevalence of anemia according to the grading of anemia in children.

Grade	Reference Range	Total
Normal	(≥11.5gms/dl)	147 (61.2%)
Mild	(11-11.4gms/dl)	33 (13.7%)
Moderate	(8-10.9gms/dl)	48 (20%)
Severe	(<8gms/dl)	12 (5%)

Concerning the location, the rural areas children were more anemic i.e., 45.8% compared to the urban parts comprising 31.6% anemic patients with $p = 0.018$. Less proportion of anemia was reported in families having less than 5 members (36.1%) in comparison to those having more than 5 members. Regarding dietary habits (57.6%) vegetarian children were anemic ($p=0.021$). Most (66.6%) of the children belonging to lower socioeconomic groups (lower class) were anemic and highly significant ($p<0.001$). Children having poor hygiene had the most anemia percentage of 49.6% with satisfactory hygiene children having only 14.9% of anemia proportion ($p<0.05$). The percent of anemic children who takes nutritional supplements was (19.7%) and (47.5%) do not take nutritional supplements with a highly significant ($p<0.001$) value while, the percent of anemic children who had a history of worm infestation, was (51.6%) and (25.4%) showed no history of worm infestation ($p<0.001$).

Table 3: Categories of anemia based on gender and age.

Variable	Categories	Anemic			Non-Anemic n (%)
		Mild n (%)	Moderate n (%)	Severe n (%)	
Gender	Male	23 (16.6%)	21 (15.2%)	4 (2.8%)	90 (65.3%)
	Female	10 (17.6%)	27 (53.9%)	8 (15.6%)	57 (55.8%)
Age Group	5-11	9 (7%)	34 (26.5%)	7 (5.4%)	78 (60.9%)
	12-14	16 (19%)	11 (13%)	4 (4.7%)	53 (63.1%)
	14	8 (28.5%)	3 (10.7%)	1 (3.5%)	16 (57.1%)
		33 (13.4%)	48 (20%)	12 (5%)	
	Total	93 (38.75%)			147 (61.2%)

Table 4: Prevalence of anemia with different socio-demographic variables in children between 5 to 15 years.

Variable (N=240)	Category	N	Anemic n (%)	Non-Anemic n (%)	p-Value
Gender	Male	138	48 (34.7%)	90 (65.3%)	0.171
	Female	102	45 (44.2%)	57 (55.8%)	
Age	5-11	128	50 (39.1%)	78 (60.9%)	0.51
	12-14	84	31 (36.9%)	53 (63.1%)	
	> 14	28	12 (42.8%)	16 (57.1%)	
School	Rural	120	55 (45.8%)	65 (54.2%)	0.018 *
	Urban	120	38 (31.6%)	82 (68.3%)	
Family Size	≤ 5	141	51 (36.1%)	90 (63.9%)	0.256
	> 5	99	42 (42.4%)	57 (57.5%)	
Diet	Vegetarian	66	38 (57.6%)	28 (42.4%)	0.021 *
	Non-vegetarian/Mixed	174	55 (31.6%)	119 (68.3%)	
SES	Upper Class	28	11 (39.2%)	17 (60.7%)	< 0.001*
	Middle Class	167	57 (30.5%)	110 (69.4%)	
	Lower Class	45	25 (66.6%)	20 (44.4%)	
Hygiene	Poor	133	66 (49.6%)	67 (50.4%)	0.04 *
	Good	60	20 (33.3%)	40 (66.6%)	
	Satisfactory	47	7 (14.9%)	40 (85.1%)	
Nutritional Supplements	Yes	76	15 (19.7%)	61 (80.2%)	< 0.001*
	No	164	78 (47.5%)	86 (52.4%)	
History of Infestation	Yes	122	63(51.6%)	59 (48.3%)	< 0.001*
	No	118	30 (25.4%)	88 (74.5%)	

Significant p-value (chi-square test applied).

DISCUSSION

The exact prevalence of anemia in school-going children varies from location to location and study to study but anemia is accepted to be a serious issue in the school-going children age groups. Our study showed that among 93 anemic children, mild anemia was found to be present in 33 (13.7%) of children while moderate and severe anemia was reported in 48 children (20%) and 12 (5%) children respectively.

The current study findings are following the results of different other studies that are done in developing countries. The overall prevalence of anemia among participants according to our study was 38.7%. The frequency of anemia in our study is remarkably similar with a rate of 38% in Pakistan and 34.0% in district Karak[11]. While it is significantly higher than 25.4% globally and remarkably higher than 3.2% in developing countries. The percentage of anemia in children of Africa was 60 percent, in Latin America at 46%, in East Mediterranean at (63%), in South Asia at (49%) and in North America at only 7% [12].

A study conducted by Gutema et al. in South East Ethiopia showed the prevalence of anemia at 23.66%. Mild anemia was detected in 73.81% of the sampled children and moderate and severe anemia was detected in 25% and 1.19% of children, respectively. Low socio-economic status and intestinal worms were the associated factors that were detected in their study[13]. Another study conducted by Birhanu et al. identified 33.9% of anemia among 442 school-going children in Ethiopia. Risk factors identified in their study were illiteracy of mothers, Parasitic and malarial infections[14]. Our study showed 38% of anemia in school-going children and risk factors identified included rural areas, poor diet and a history of worm infestations.

Iron deficiency is the most common form of anemia in school-going children. Iron deficiency anemia is associated with low IQ levels in school children[15,16]. Agarwal conducted a study in which 26 % of children have iron deficiency anemia[17]. Our study reflected the same point and indicated that the majority of the children were having iron deficiency anemia.

According to our study, the frequency of anemia was more in female children due to the reason of cultural norms; most parents prefer to have male children and neglect female children, especially in food preferences. A female child is given food when a male child eats first. This is especially common in rural areas. These results are consistent with other studies showing more prevalence in female children 38.9% and 31.0% in males[17]. The prevalence of anemia is more in the lower age group 5-10 (39.1%) of our study because children in this particular age group are in more need of nutrition due to their physiological process of gain in height and weight. Proper strengthening of bones and muscles is very important in this age group and a physiological process taking place inside the body of children. The present study shows that lower age group children are more prone to anemia. This finding is in line with the other study in which the lower age groups group reported more anaemia[18,19]. The proportion of anemia in this study was higher in rural area children at 54.85% as compared to the urban area children. These findings are in-line with another study of Serbia in which the prevalence was highest among refugees 58% and followed by 28% in rural while least in the urban population[20]. The prevalence of anemia in families having less than 5 members is 36.1% and less than in families with more family members at 42.4% these results are again following the study of Ethiopia in which the anemia prevalence was more than 39.8% for a family size of >5 members[21]. The present study reported that in vegetarian children 57.6% developed anemia and in non-vegetarian or mixed dietary intake children the prevalence is low 31.6%. These findings are again consistent with the study of India in which the vegetarian intake children were 65.2% anemic and non-vegetarian were 44.7% anemic [22].

The percentage of anemia was high in lower class (66.6%) children followed by the middle class (30.5%) and upper class (39.2%) respectively. A study from India showed similar findings, in which children from the lower class shows high anemia rates[23]. The percent of anemic children who do not take nutritional supplements was (47.5%) while, the percentage of anemic children who had a history of worm infestation, was (51.6%) similarly findings were revealed in the study of India in which the main cause for the anemia was found as nutritional supplements and worm infestations by 48.68% and 17.69% respectively[24].

Some of the local studies in school-going children also showed a high prevalence of anemia. A study conducted by Sayab et al. in district Bannu of Khyber Pakhtunkhwa showed that among 200 school-going children, mild anemia was noted in (41.66%), moderate anemia in (37.5%) and severe anemia was detected in 20.83% of school going children[25]. Almost similar results were noted in the present study.

CONCLUSION

The current study showed that anemia is a major public health issue in school-going children. Female children are more prone to anemia. Effective public health strategies are needed specifically targeting school-age children.

AUTHORS' CONTRIBUTION
MS formulated a study and write a manuscript, SB analyzed the blood samples, KRK have done statistical analysis and final drafting, and BA, NH, and YH collected and finalized the data.

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