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Frequency of Anemia in Hospitalized Children Ages 0-12 Years and Associated Factors: A Cross-Sectional Study

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Abstract

Background: Anemia affects the psychological and physiologic well-being of children worldwide. In Pakistan, anemia among children and its associated factors is scarcely studied and the available knowledge is not up-to date. This study aims to better understand the anemic burden among pediatric population in our country.

Methods: Cross-sectional study of 1 month was conducted from January to February 2020 comprising 299 children who were hospitalized in a tertiary care hospital with ages from 1 month to 12 years, located in Lahore. Analysis of different demographic data, breast feeding duration, age, nutritional status, gender, iron supplementation, solid food introduction, disease of diagnosis and other background parameters in association with hemoglobin level is done in this article. We performed chi-square analysis and logistic regression to assess anemia with related factors.

Results: Overall percentage of non-anemic and anemic children were 56.9% and 43.1% respectively among whom male children were 62.4% and female were 37.6% anemic. Among anemic patients, 26.7% and 45.5% of children who were admitted suffered from mild and moderate anemia, respectively. The most affected age group was 6-59-month-old. There was a 9 times higher risk of anemia among well-nourished children as compared to over nourished children.

Conclusion: The group mostly affected by anemia is of age between 6 to 59 months. To combat this crisis, certain measures are required as exclusive breast feeding for 6 months, weaning at age of 6 months and iron supplementation if iron requirements are not fulfilled by diet for children.

Keywords: Anemia, demographic data, prevalence, anemia in children, associated factors.

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Introduction

Anemia is a disorder in which there are not enough number of healthy red blood cells (RBCs) to carry sufficient oxygen to our body's tissues (1, 2). Prevalence of anemia in preschool children is 47.4% which is high and in school going children is 25.4% (3). In Pakistan, prevalence of anemia among under 5 years children was 58.80 as of 2016 (4). Worldwide, anemia currently affects 2million people out of whom mostly reside in low- and middle-income countries. Anemia can have long-lasting and irreversible effects on a child's development (5, 6) which includes complications such as socio-emotional, poor cognitive and psychomotor development (7, 8), even if the iron deficiency has been corrected (9). Risk factors associated with anemia in children include early use of the cow milk, premature birth or low birth weight, long term illnesses such as infections, kidney or liver disease, diet low in iron or some vitamins and minerals, absence of exclusive breast feeding (2). Socioeconomic factors also affect the prevalence of anemia in children including poor financial status, place of residence and sanitation facilities. (8, 10, 11). An individual is most susceptible to iron deficiency anemia when they are under the age of 5 years. This is because their young bodies are undergoing speedy growth and development and thus, have high iron needs. The child's red blood cells are increasing in number to support the respective growth which puts them at risk of anemia if they do not meet their increased iron needs (12). Iron deficiency anemia can be prevented by provision of iron-rich diet when the child under consideration begins solid food. The best source of iron is meat which is a difficult commodity to acquire for people of low- or middle-income socioeconomic background, which is why the countries, most significantly affected from anemia are developing countries like Pakistan. Treatment of iron deficiency anemia is rather simple and straight forward which includes the provision of iron supplements and iron fortified foods to the affected individual (13).

Data available on prevalence of anemia in Pakistan is very limited and not up to date. There is not much research available in Pakistan on factors associated with development of anemia among children.

The purpose of conducting this research is to cite the anemia prevalence among children and its

associated factors. This type of study has not yet been conducted in Pakistan. It will provide us with a distinct picture of anemia in children in Pakistan. Not much research is available in Pakistan on factors associated with development of anemia among children.

Methodology

Patients Selection:

The study was conducted in the form of a questionnaire in the selected hospitals of Lahore, including the children hospital Lahore, Mayo hospital Lahore, Sir ganga ram hospital Lahore, and Jinnah hospital Lahore, with written permission from these hospitals and oral consent was taken from the parents of the selected patients.

The data was collected from 299 children admitted to the hospitals between 25th January to 28th February 2020, aged from 1 month to 12 years. Patients having any kind of hemorrhagic disorder, intense bleeding, and immunodeficiency disorders, were excluded from the study.

Clinical Variables:

Clinical data (hemoglobin concentration) related to every patient was obtained through an interview with the consent of patient's care givers including demographic information i.e. sex of the patient, age of patient categorized as 1 month, 2 months, 3-5 months, 6-59 months, and above 60 months (up to 12 years) (12). Factors that are associated with the development of anemia in children are included in the study such as household characteristics including family size (less than 4, 4-5, more then 5), number of under 5 children (1,>=2), preceding birth interval (12-24 months,25-48 months,>48 months), residence (urban, rural). Other factors such as drinking water sources and toilet facilities were also included in this study. Source of drinking water was categorized as improved (a household water connection (piped), public standpipe, borehole, protected dug well or spring or rainwater collection) and unimproved (8). Toilet facilities were categorized as improved (flush toilets, ventilated improved pit latrines, traditional pit latrines with a slab, or composting toilets), unimproved (pit latrine without slab/open pit, bucket toilet, hanging toilet, flush not to piped sewer) and open defecation (8). Wealth index was also assessed and categorized as low, middle, and high.

The study also included parental characteristics such as parental status and parental education (illiterate or years of education) and maternal factors including her age. Nutritional parameters included were based on World Health Organization criteria that is Z-score with a cut-off point less than -2 SD. These include stunting (height for age) and wasting (weight for height). Child's nutritional status (weight for age) was assessed and categorized as underweight (less than -2 SD), normal (-2 SD to +2 SD) and overweight (more than +2SD) (14). World Health Organization set cut-off Hgb value for anemia in children aged 1,2 and 3-6 months is set at 10.7, 9.4 and 9.5g/dL, respectively. In children aged 6 to 59 months, above aged 60 months to 12 years is set as 11 g/dL. Health factors considered are hospitalization length, disease of diagnosis, catching disease in previous two weeks, diarrhea, fever, malaria, and iron supplementation. Other factors included were antenatal care visits, premature birth, birth order, delivery, place of delivery, breastfeeding duration, exclusive breastfeeding status, solid food introduction, frequency of complementary feeding.

Statistical Analysis:

Statistical analysis is done using The Statistical Package for Social Science Software, SPSS Inc. version 22. The descriptive statistics were executed and quoted as the number and percentage of categorical variables, while the mean and standard deviation for continuous variables. The world health organization standards were used to classify individuals into anemic and non-anemic groups. The World Health Organization's growth charts were put to use in order to accurately assess the wasting, stunting and nutritional status of the children. Any significant difference between the two groups was identified using the Chi-square test. Logistic regression was performed considering anemic cases (yes/no) as dependent variable and age (months), nutritional status, stunting, wasting infectious disease, breast feeding, solid food introduction (before 6 months), and iron supplement as independent variables to establish correlation. For all statistical analyses, the level of significance was set at $P < 0.05$.

Results

Socio-demographic and clinical characteristics of patients:

A total of 299 children were enrolled in the study. Clinical characteristics of the children are represented in Table 1. Male and female ratio, among the children, was 1.5:1 (males 60.2% females 39.8%). When considering the number of anemic patients, out of 299, 170 came out to be anemic (56.9%) while 129 were non-anemic (43.1%). The major age group affected was 6 to 59 months i.e., 58.9%. Nutritional status of the participants was also assessed, and the participants were categorized into malnourished, well-nourished, and over nourished categories. From 278 participants, about 140 (50.3%) were malnourished, 132 (47.4%) were well nourished and only 6 (2.1%) were over nourished. Most children were included in the other diseases category (70.6%) and respiratory tract infections (19.1%).

Among anemic patients, 26.7% and 45.5% of children hospitalized had mild and moderate anemia, respectively. 52.2% were exclusively breast fed as shown in Table 1. The major percentage of the mothers of the children were aged 20– 29 years (60.6%). Analysis of family size showed more than half had >5 members. Households with improved water sources were 92.6%, while 91.6% households had improved toilet facilities. The proportion of uneducated mothers was higher than the fathers. More (63.2 %) respondents were from the urban side and 71.2% of children lived in households of 'poor' (lower) socioeconomic class. The majority of children were given breastfeeding for more than 4 months (62.5%) and iron supplementation was done on 22.4% of the selected population as shown in Table 1. In stunted children, the prevalence of anemia was significantly higher at 63.6% as compared to non-stunted population that is 36.7%. The percentage of anemia among children who had fever in last 2 weeks was about 56.5% which is higher than others.

Table 1: Socio-demographic and clinical characteristics of 295 pediatric patients enrolled in the study.

Clinical Parameters	Total number of patients	Categories	N	%
Gender	299	Male	180	60.2
		Female	119	39.8
Age(months)	299	1 month	16	5.4
		2 months	22	7.4
		3-5 months	44	14.7
		6-59 months	176	58.9
		≥60 months to 12 years	41	13.7
Anemic status	299	Anemic	170	56.9
		Non anemic	129	43.1
Anemia % acc to gender	170	Male	106	62.4
		Female	64	37.6
Severity of anemia (g/dL) in the children aged 0-12 years	299	Mild	48	28.2
		Moderate	88	51.8
		Severe	34	20.0
		None	129	100
Length of hospitalization	299	1 day	14	4.7
		2 days	38	12.7
		3 days	32	10.7
		4 days	45	15.1
		≥5 days	170	56.9
Nutritional status	278	Malnourished	140	50.3
		Well nourished	132	47.4
		Over nourished	6	2.1
Disease of diagnosis	299	Acute gastroenteritis	13	4.3
		Respiratory tract infection	57	19.1
		Urinary Tract Infections	18	6
		Asthma	0	0
		Other diseases	211	70.6
Catching disease in previous 2 weeks	299	Yes	247	82.6
		No	52	17.4
Diarrhea	299	Yes	71	23.7
		No	228	76.3
Fever	299	Yes	156	52.2
		No	143	47.8
Malaria	299	Yes	0	0
		No	299	100
Stunting	278	Yes	175	62.9
		No	103	37.1
Wasting	206	Yes	43	20.9
		No	163	79.1
Breast feeding duration	299	<1 month	13	4.3
		1-4 month	50	16.7
		>4 month	187	62.5
		None	49	16.4
Exclusive Breast Feeding	299	Yes	156	52.2
		No	143	47.8
Solid food introduction	299	<6 months	53	17.7
		>6 months	150	50.2
		None	96	32.1
Frequency of complimentary feeding	299	<3 months	112	37.5
		3-4 months	68	22.7
		>4 months	13	4.3
		None	106	35.5
Source of drinking water	299	Improved	277	92.6
		Unimproved	22	7.4
Iron supplements	299	Yes	67	22.4
		No	232	77.6
Delivery	299	Normal	161	53.8
		Cesarean	138	46.2
Place of delivery	299	Home	31	10.4
		Health facility	268	89.6
Premature birth	299	Yes	18	6.0
		No	281	94.0
Received Antenatal care	299	Yes	236	78.9
		No	63	21.1
Under 5 years children in the family	288	1	163	56.6
		≥2	125	43.4
Preceding birth interval	299	12-24	110	36.8
		25-48	92	30.8
		>48	34	11.4
		None	63	21.1
Birth Order	299	1	100	33.4
		2-3	134	44.8
		4-5	52	17.4
		≥6	13	4.3
Toilet facility	299	Improved	274	91.6
		Unimproved	20	6.7
		Open defecation	5	1.7
Parent's status	299	Both	290	97.0
		Only mother	2	0.7
		Only father	6	2.0
		Orphan	1	0.3
Mother's age	297	<20	2	0.7
		20-29	180	60.6
		30-39	97	32.7
		>40	18	6.1
Mother's BMI	297	Underweight	31	10.4
		Normal	155	52.2
		Overweight	109	36.7
		Obese	2	0.7
Family size	299	<4	58	19.4
		4-5	90	30.1
		>5	151	50.5
Residence	299	Urban	189	63.2
		Rural	110	36.8
Mother's education	298	None	102	34.2
		1-8	59	19.8
		9-12	98	32.9
		>12	39	13.1
Father's education	298	None	88	29.5
		1-8	68	22.8
		9-12	102	34.2
		>12	40	13.4
Wealth Index	299	Lower	213	71.2
		Middle	79	26.4
		Upper	7	2.3

Anemia percentage was found to be higher in children from poor class families that is 69.2% as shown in Table 4.

Stratification of anemia by age, gender, and severity:

Among patients, anemia was outlined based on cutoff values for hemoglobin explicit to each age group, as per the world health organization and American Academy of Pediatrics criteria into non-anemic and anemic groups (Table 2), and then further classified into mild, moderate, and severe in children aged 1 month and above as shown in Table 3. Chi-square analysis demonstrated no significant association between male and female children regarding their anemia status.

Table 2. Difference between numbers of male and female patients with anemia enrolled in the study.

Age	Hb cut-off	Total		Males		females		p-value
		N	%	n	%	n	%	
1months	<10.7	7	43.8	5	41.7	2	50.0	0.771
2months	<9.4	7	31.8	6	40.0	1	14.3	0.228
3-5 months	<9.5	9	20.5	7	26.9	2	11.1	0.201
6-59 months	<11	122	69.3	73	72.3	49	65.3	0.323
60month-12years	<11.5	25	61.0	15	57.7	10	66.7	0.570

Table 3. Severity of anemia categorized in children aged 6 months and above.

Age	Severity	Hb range(g/dl)	number	%	p-value
0-59 months	Mild	10-10.9	42	29.0	0.000
	Moderate	7-9.9	74	51.0	
	Severe	<7	29	20.0	
	None	-	0	0	
60month-12year	Mild	11-11.4	6	24.0	0.000
	Moderate	8-10.9	14	56.0	
	Severe	<8	5	20	
	None	-	0	0	

Table 4. Frequency of anemia stratified according to gender, age, length of hospitalization, nutritional status, disease of diagnosis, and other associated factors.

Clinical parameters	Total number of patients	Categories	Anemic status				P- value
			Anemic		Non anemic		
			N	%	N	%	
Gender	299	Male	106	62.4	74	57.4	0.383
		female	64	37.6	55	42.6	
Age	299	1 months	7	4.1	9	7	0.000
		2 months	7	4.1	15	11.6	
		3-5 month	8	4.7	35	27.1	
		6-59 month	122	72.2	54	41.9	
		60 month-12yr	25	14.8	16	12.4	
Length of hospitalization (days)	299	1 day	10	5.9	4	3.1	0.759
		2 days	22	12.9	16	12.4	
		3 days	16	9.4	16	12.4	
		4 days	25	14.7	20	15.5	
		≥5 days	97	57.1	73	56.6	
Nutritional status	278	malnourished	72	45.3	68	57.1	**0.009**
		Well-nourished	86	54.1	46	38.7	
		Over-nourished	1	0.6	5	4.2	
Stunting	278	Yes	100	63.3	75	62.5	0.892
		No	58	36.7	45	37.5	
Wasting	206	Yes	24	19.8	19	22.4	0.662
		No	97	80.2	66	77.6	
Disease of diagnosis	299	Acute gastroenteritis	8	4.7	5	3.9	0.352
		Respiratory tract infection	37	21.3	20	15.5	
		Urinary tract infection	12	7.1	6	4.7	
		Asthma	0	0	0	0	
		Other diseases	113	66.5	98	76.0	
Catching disease in previous two weeks	299	Yes	144	84.7	103	79.8	0.272
		No	26	15.3	26	20.2	
Diarrhea	299	Yes	48	28.2	23	17.8	**0.036**
		No	122	71.8	106	82.2	
Fever	299	Yes	96	56.5	60	46.5	0.088
		No	74	43.5	69	53.5	
Malaria	299	Yes	0	0	0	0	0
		No	170	100	129	100	
		<1	5	2.9	8	6.2	
Breast feeding Duration	299	1-4	27	15.9	23	17.8	0.306
		>4	113	66.5	74	57.4	
		none	25	14.7	24	18.6	
EBF	299	Yes	96	56.5	50	46.5	0.088
		No	74	43.5	69	53.5	
Solid food	299	<6	34	26.6	19	25.3	**0.007**
		>6	94	73.4	56	74.7	
		None	42	24.7	54	41.9	
Frequency of Complementary	299	<3	78	61.4	34	44.7	0.000
		3-4	36	28.3	30	39.5	
		>4	10	7.9	3	3.9	
		None	45	26.5	61	47.3	
Source of drinking Water	299	improved	157	92.4	120	93	0.826
		Unimproved	13	7.6	9	7	
Iron supplements	299	Yes	43	25.3	24	18.6	0.169
		No	127	74.7	105	81.4	
Delivery	299	Normal	98	57.6	63	48.8	0.130
		caesarean	72	42.4	66	51.2	
Place of delivery	299	home	18	10.6	13	10.1	0.886
		Health facility	152	89.4	116	89.9	
Premature birth	299	Yes	11	6.5	7	5.4	0.707
		No	159	93.5	122	94.6	
received ANC	299	Yes	134	78.8	102	79.1	0.959
		No	36	21.2	27	20.9	
Under 5y children in the family	283	1	89	54.3	69	58.0	0.534
		≥2	75	45.7	50	42.0	
Preceding birth Interval	299	12-24	60	41.4	50	44.6	0.926
		25-48	54	37.2	38	33.9	
		>48	19	13.1	16	14.3	
		none	37	21.8	26	20.2	
Birth order	299	1	54	31.8	46	35.7	0.758
		2-3	77	45.3	57	44.2	
		4-5	30	17.6	22	17.1	
		>=6	9	5.3	4	3.1	

Toilet facility	299	Improved	156	91.8	118	91.5	0.085
		unimproved	9	5.3	11	8.5	
		Open defecation	5	2.9	0	0	
Parent's status	298	Both	166	98.2	124	96.1	0.538
		Only mother	2	1.2	4	3.1	
		Only father	1	0.6	1	0.8	
		Orphan	1	100	0	0	
Mother's age	297	<20	0	0	2	1.6	0.357
		20-29	100	59.2	80	62.5	
		30-39	58	34.5	39	30.5	
		>40	11	6.5	7	5.5	
Mothers BMI	297	Underweight	21	12.4	10	7.8	0.307
		Normal	88	52.1	67	52.3	
		Overweight	58	34.4	51	39.8	
		obese	2	1.2	0	17.2	
Family size	299	<4	31	18.2	27	20.9	0.485
		4-5	48	28.2	42	32.6	
		>5	91	53.5	60	46.5	
Residence	299	Urban	111	65.3	78	60.5	0.391
		Rural	59	34.7	51	39.5	
Mothers' education	298	None	59	34.9	43	33.3	0.429
		1-8	38	22.5	21	16.3	
		9-12	53	31.4	45	34.9	
		>12	19	11.2	20	15.5	
Fathers' education	298	None	49	29	39	30.2	0.761
		1-8	36	21.3	32	24.8	
		9-12	62	36.7	40	31.0	
		>12	22	13.0	18	14.0	
Wealth index	298	lower	117	69.2	96	74.4	0.524
		middle	47	27.8	31	24.0	
		Upper	5	3.0	2	1.6	

Prevalence of anemia and associated factors:

The chi-square analysis showed no association of anemia proportion with gender, as there was no statistically significant difference between the number of anemic patients and gender, the percentage of anemic patients being 62.4% males and 37.6% females. There was found to be an association of the proportion of anemic and non-anemic patients with age groups, providing evidence that the anemic status is affected by age. Notably, there was found statistically a significant association between the anemic status and nutrition status of the children, where the chi-square analysis revealed the p-value of 0.009.

The severity of anemia is associated with the length of hospitalization, as predicted by Garlo et al. (15) Conversely in our study, there was no statistically significant association between anemia and length of hospitalization (p-value: 0.759). Further, the anemic status was found statistically associated with diarrhea, solid food introduction, and frequency of complimentary feeding. All other groups were found to be not statistically associated with the anemic status. The multivariate analysis discovered that there was a 9times more risk of anemia among well-nourished children as compared to over nourished children (p-value =0.044, PR=9.348). Moreover, a lower risk of anemia was found among children of ages 2 months to 5 months as compared to the children of age 60 months to 12 years.

Distribution of children in relation to hemoglobin levels:

The graph shows the distribution of hemoglobin level among children. Overall, there was a 56.9% prevalence of anemia and the average value of hemoglobin was 10.4g/dl. Moderate anemia was discovered in 51.8% of children and the mild form was found in 28.2% children.

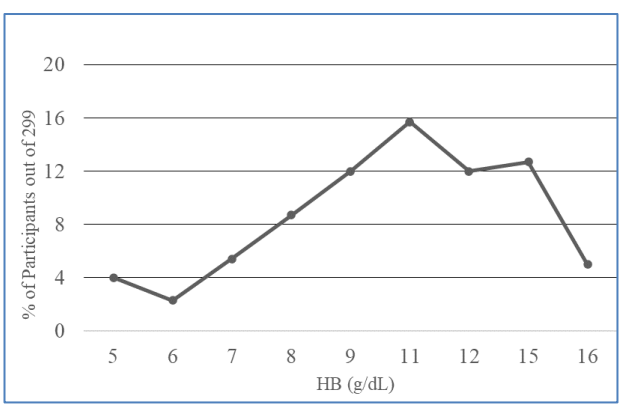

Figure 1: Distribution of hemoglobin concentration among children

Discussion

This research was conducted in tertiary care hospitals of Pakistan and considered 299 hospitalized children admitted with various medical conditions. Anemia prevalence was found to be 56.9%. According to the World Health Organization's classification of anemia based on severity, the threshold percentage is 40% for countries with severe anemia status such as in some African and Asian countries. In Australia, America and many European countries, the incidence of anemia is less than 15% (16, 17).

Considering the association of anemia with gender, our results unveil great difference in percentages of anemia in male and female patients (62.4% of males and 37.6% of females); which is quite similar to results reported by many authors that anemia is more prevalent in boys in contrast to

girls. This anomaly could be due to the faster growth of pre-school boys as judged against girls, triggering a high iron requirement. In some studies, girls were shown to have a higher prevalence of anemia, specifically iron deficiency anemia. This was found to be as a consequence of the fact that girls were married off at an early age, had a lack of formal education and did not have access to high iron foods like meat (18). Nevertheless, to better demarcate gender factor relationship to anemia, it is necessary to conduct more researches on the matter (19).

While analyzing the prevalence of anemia among age groups, we found the highest prevalence of anemia in the children of age group 6-59 months (72.2%), which found to be close to the result reported by Santos et al. in 2011, where a prevalence of 56.6% was found in the children of similar age group (20). According to some studies, the key indicators of high prevalence of anemia in this age group are poor iron intake, breastfeeding (low exclusive and full breastfeeding time), sources of drinking water, mother's education, habits like milk consumption after meal and childhood malnutrition (21-23).

The results of our analysis revealed that the nutrition status of children is significantly associated with the prevalence of anemia, as we found a 9 times higher risk of anemia among well-nourished children as compared to over nourished children. These results are well comparable to the findings given by Rocha et al. that predicts that the z-scores (weight for age and height for age) are related positively to the prevalence of anemia (24). Also, Engle-Stone et al. reported the weight for age as the predictor of anemia in preschool children (25) which also supports our results as well as other studies (26).

Interpreting the association of anemia with hospital length of stay is difficult. It depends upon the reason or disease of diagnosis for admission to the hospital, type of medical care and sample randomization also affects the length of hospitalization (27). Anemia is associated with hospitalized children with acute heart failure as evidenced by Goldberg J.F. et al. (28). They state that normocytic anemia (the size of red blood cells is normal but there is a smaller than normal amount of said cells in one's blood) came out to be the most common of all anemias that were reported in the cohort of children with acute heart failure. But in our study, there was no association of hospital length of stay with anemia. In our study, anemia was more common in children suffering from diseases other than our categories i.e., 70.6% and the second most common cause was respiratory tract infections as shown by percentage i.e., 19.1% (because increased respiratory effort requires greater hemoglobin utilization). To better grasp this, we need to call to mind the numerous functions of hemoglobin. Oxygen pressure in the tissues is maintained by hemoglobin which is how it acts as a tissue oxygen buffer. One may also recall that hemoglobin is the key factor responsible for moving oxygen from lungs to tissues for energy metabolism and is also in charge of removing carbon dioxide from the tissues and transporting it back to the lungs. It also deactivates nitric oxide and carries it through the blood vessels. Gastrointestinal diseases lead to loss of blood in form of vomits and stool. A very common cause of gut diseases is Helicobacter pylori infection which is difficult to diagnose. As reported by Russo, Helicobacter pylori were found to be positively related to the development of anemia among children and adults. Russo and colleagues observed that treating their patients for Helicobacter pylori led to normalization of the said patient's red blood cell count. Anemic status was found statistically associated with diarrhea (29).

There are various causes of microcytic anemia involving: thalassemia hemoglobinopathies, iron deficiency, anemia of chronic disorders (ACD), and chronic lead intoxication. Anemia of chronic disorders is not unusual, but diagnosis of microcytic anemia for the distinction between iron deficiency anemia and ACD is extremely important particularly for further treatment on basis of pathogenesis (30, 31). In order to illuminate these possible etiologies, one needs to consider the patient's medical record, the mean corpuscular volume (MCV) and the RBC distribution width (RDW) which differs in regarding age (32). Against anemia, during the first year of rapid growth early iron supplementation is a protective factor. However, in our study children who received iron supplementation and were non-anemic were only 18.5%. Anemic status was found statistically associated with solid food introduction and complementary feeding (33). Several studies have pointed out that if solid food is introduced later than 6 months of life, there is an increased chance of the development of anemia. This could be because after 6 months, the infants iron needs increase to 11mg/day and much of the stores of iron in the baby's body have depleted. So, more iron is needed via diet as only breast milk is not sufficient enough to meet these higher needs. The Institute of Medicine recommends that this surplus iron should be provided from iron rich complementary foods along with breast milk.

There are some limitations to our study which consist of: small sample size, short period study (cross sectional). Furthermore, the lack of information on specific blood tests restricts us from finding the source of anemia. Patient files did not have complete anthropometric records. In addition, there might be recall bias in answering other child characteristics. Despite these limitations, our findings clarify the prevalence and risk factors for anemia among children of 6-59 months of age and will facilitate in designing and implementing a program to reduce the burden of anemia.

Conclusion

Anemia is a major and common health concern in Pakistani children. A major group of children affected is of age between 6 to 59 months. Anemia, inappropriate dietary practices, can cause developmental delays and behavioral problems in children. To reduce this problem, certain measures need to be put in place. Firstly, infants should be exclusively breastfed for the first six months. The introduction of solid food should occur after 6 months of age. Complementary feeding including foods rich in iron is recommended. Iron supplementation in form of syrups can be used if iron requirements are not fulfilled by diet for children.

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References

1. Simbauranga RH, Kamugisha E, Hokororo A, Kidenya BR, Makani J. Prevalence and factors associated with severe anaemia amongst under-five children hospitalized at Bugando Medical Centre, Mwanza, Tanzania. BMC Hematol. 2015;15:13.
2. cedars-sinai. Anemia Overview los angeles: cedars-sinai; 2020 [Available from: https://www.cedars-sinai.org/health-library/diseases-and-conditions/o/overview-of-anemia.html.
3. Bruno de Benoist EM, Ines Egli, Mary Cogswell. Worldwide prevalence of anaemia 1993–2005 switzerland: WHO; 2005 [Available from: https://www.who.int/vmnis/anaemia/prevalence/summary/anaemia_data_status_t2/en/.
4. WHO. Prevalence of anemia among children (% of children under 5) 2016 [Available from: https://www.indexmundi.com/facts/pakistan/prevalence-of-anemia.
5. Gupta PM, Perrine CG, Mei Z, Scanlon KS. Iron, Anemia, and Iron Deficiency Anemia among Young Children in the United States. Nutrients. 2016;8(6).
6. Gosdin L, Martorell R, Bartolini RM, Mehta R, Srikantiah S, Young MF. The co-occurrence of anaemia and stunting in young children. Maternal & child nutrition. 2018;14(3):e12597.
7. Melku M, Alene KA, Terefe B, Enawgaw B, Biadgo B, Abebe M, et al. Anemia severity among children aged 6-59 months in Gondar town, Ethiopia: a community-based cross-sectional study. Ital J Pediatr. 2018;44(1):107.
8. Khan JR, Awan N, Misu F. Determinants of anemia among 6-59 months aged children in Bangladesh: evidence from nationally representative data. BMC Pediatr. 2016;16:3.
9. da Silva LLS, Fawzi WW, Cardoso MA, Group EW. Factors associated with anemia in young children in Brazil. PLoS One. 2018;13(9):e0204504.
10. Gebrie A, Alebel AJAHS. A systematic review and meta-analysis of the prevalence and predictors of anemia among children in Ethiopia. 2020;20(4):: 2007-21.
11. Andriastuti M, Ilmana G, Nawangwulan SA, Kosasih KAJIJoP, Medicine A. Prevalence of anemia and iron profile among children and adolescent with low socio-economic status. 2020;7(2):88-92.
12. Salami A, Bahmad HF, Ghssein G, Salloum L, Fakih H. Prevalence of anemia among Lebanese hospitalized children: Risk and protective factors. PLoS One. 2018;13(8):e0201806.
13. Mantadakis E, Chatzimichael E, Zikidou P. Iron Deficiency Anemia in Children Residing in High and Low-Income Countries: Risk Factors, Prevention, Diagnosis and Therapy. Mediterr J Hematol Infect Dis. 2020;12(1):e2020041-e.
14. WHO. Definitions of indicators for child anthropometry: WHO; 2010 [Available from: https://www.who.int/nutrition/nlis_interpretation_guide.pdf.
15. Garlo K, Williams D, Lucas L, Wong R, Botler J, Abramson S, et al. Severity of anemia predicts hospital length of stay but not readmission in patients with chronic kidney disease: a retrospective cohort study. Medicine. 2015;94(25).
16. Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995–2011: a systematic analysis of population-representative data. The Lancet Global Health. 2013;1(1):e16-e25.
17. De Benoist B, Cogswell M, Egli I, McLean E. Worldwide prevalence of anaemia 1993-2005; WHO Global Database of anaemia. 2008.
18. Chalise B, Aryal KK, Mehta RK, Dhimal M, Sapkota F, Mehata S, et al. Prevalence and correlates of anemia among adolescents in Nepal: Findings from a nationally representative cross-sectional survey. 2018;13(12):e0208878.
19. Dos Santos RF, Gonzalez ES, de Albuquerque EC, de Arruda IK, Diniz Ada S, Figueroa JN, et al. Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. Revista brasileira de hematologia e hemoterapia. 2011;33(2):100-4.
20. Santos RFd, Gonzalez ESC, Albuquerque ECd, Arruda IKGd, Diniz AdS, Figueroa JN, et al. Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. Revista brasileira de hematologia e hemoterapia. 2011;33(2):100-4.
21. André HP, Sperandio N, Siqueira RLd, Franceschini SdCC, Priore SE. Food and nutrition insecurity indicators associated with iron deficiency anemia in Brazilian children: a systematic review. Ciencia & saude coletiva. 2018;23:1159-67.
22. Kawo KN, Asfaw ZG, Yohannes N. Multilevel Analysis of Determinants of Anemia Prevalence among Children Aged 6-59 Months in Ethiopia: Classical and Bayesian Approaches. Anemia. 2018;2018:3087354.
23. Dutta M, Bhise M, Prashad L, Chaurasia H, Debnath PJCE, Health G. Prevalence and risk factors of anemia among children 6–59 months in India: A multilevel analysis. 2020;8(3):868-78.
24. Rocha Dda S, Capanema FD, Pereira Netto M, Franceschini Sdo C, Lamounier JA. Prevalence and risk factors of anemia in children attending daycare centers in Belo Horizonte--MG. Rev Bras Epidemiol. 2012;15(3):675-84.
25. Engle-Stone R, Aaron GJ, Huang J, Wirth JP, Namaste SM, Williams AM, et al. Predictors of anemia in preschool children: Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia (BRINDA) project. Am J Clin Nutr. 2017;106(Suppl 1):402s-15s.
26. Asresie MB, Fekadu GA, Dagnew GWJAiPH. Determinants of anemia among children aged 6–59 months in Ethiopia: Further analysis of the 2016 Ethiopian demographic health survey. 2020;2020.
27. Travassos C, Noronha JCd, Martins M. Mortalidade hospitalar como indicador de qualidade: uma revisão. Ciência & Saúde Coletiva. 1999;4:367-81.
28. Goldberg JF, Shah MD, Kantor PF, Rossano JW, Shaddy RE, Chiou K, et al. Prevalence and severity of anemia in children hospitalized with acute heart failure. Congenital heart disease. 2016;11(6):622-9.
29. Russo-Mancuso G, Branciforte F, Licciardello M, La Spina M. Iron Deficiency Anemia as the Only Sign of Infection withHelicobacter pylori: A Report of 9 Pediatric Cases. International journal of hematology. 2003;78(5):429-31.
30. Bruno M, De Falco L, Iolascon A, editors. How I diagnose non-thalassemic microcytic anemias. Semin Hematol; 2015: Elsevier.
31. Metzgeroth G, Hastka J. Iron deficiency anemia and anemia of chronic disorders. Der Internist. 2015;56(9):978-88.
32. Muncie Jr HL, Campbell JS. Alpha and beta thalassemia. American family physician. 2009;80(4):339-44.
33. Hipgrave D, Fu X, Zhou H, Jin Y, Wang X, Chang S, et al. Poor complementary feeding practices and high anaemia prevalence among infants and young children in rural central and western China. European journal of clinical nutrition. 2014;68(8):916-24.