ORIGINAL ARTICLE

Anemia among Hospitalized Children - A Study Based on Occurrence, Morphology and Associated Factors

Lubna Khan, Farhana Zafar, Mohammad Iqbal

Department of Pediatrics, Dr. Ziauddin Hospital (North Campus), Karachi, Pakistan.

ABSTRACT

Background: Anemia is a common health problem worldwide, affecting all age groups especially children under five years. Besides causing significant morbidity and mortality, it devastatingly affects physical growth and cognitive skills. Factors leading to anemia in developing countries are manifold. This study determined the frequency, morphological types and factors associated with anemia among hospitalized children aged 1-5 years in a tertiary care hospital.

Methods: This study was conducted among hospitalized children aged 1-5 years, at the Pediatric Department Ziauddin University Hospital, Karachi from September 2019 to March 2020. Total 333 admitted children aged 1-5 years were included. Data was accessed from hospital database. Nutritional factors and diet intake in the preceding week were recorded. The frequency, morphological types and severity of anemia were analyzed. Factors associated with anemia were compared by Chi-squared test for qualitative variables and t-test for numerical variables taking *p*-value ≤ 0.05 as statistically significant.

Results: Anemia was detected in 212 (63.7%) children, among which 170 (80.2%) had microcytic and 4.0 (1.9%) had macrocytic anemia. The frequency of moderate anemia was high 103 (48.6%) and severe anemia 18 (8.5%) was low. Factors significantly associated with anemia (*p*=0.001) were low birth weight, low maternal education, less household income, pica and non-consumption of meat/animal products.

Conclusion: More than half of the hospitalized children aged 1-5 years had Hb<11.0 g/dl. Microcytic anemia was the most common morphological type. Low birth weight, socioeconomic status, maternal education, malnutrition, pica ingestion and non-consumption of meat and dairy products were markedly associated with anemia.

Keywords: Anemia; Children; Low Birth Weight; Malnutrition; Pica.

Corresponding Author:
Dr. Lubna Khan
Department of Pediatrics,
Dr. Ziauddin Hospital (North Campus),
Karachi, Pakistan.
Email: lubna_dr@hotmail.com
https://doi.org/10.36283/PJMD10-3/006

INTRODUCTION

Anemia is a common health problem worldwide, affecting all age groups especially children under five years. World Health Organization (WHO) estimated global prevalence of anemia is 1.6 billion, children of the pre-school age group being affected the most (47.4%)[1]. The reason behind the high prevalence of anemia in preschool children is the increased requirement of iron for rapid growth[2].

Besides causing significant morbidity and mortality anemia has a devastating impact on physical growth and cognitive skills[3].

According to the WHO 2015 report, childrenwere affected the most (46.2%). Its prevalence was 50% and 62.3% in Ethiopia and Africa respectively[3]. The highest prevalence of anemia in hospitalized children was 83.2% in Southern Tanzania and the lowest was 33.2% in Lebanon[1,4]. In developing coun-

tries, 39% of children under 5 years and 48% in 5-14 years were found anemic[5].

In Pakistan, anemia prevalence in children under the age of 5 years was 58% in 2016 with the highest rise of 70% in 1990 and the lowest decline of only 56% in 2006[6]. According to a community-based study from Karachi, Pakistan, mild-moderate and severe anemia in under-five children was observed as 17.6%, 57% and 15% respectively[7].

The common reason for anemia in children is a replacement of breastfeeding with meals poor in micro and macro-nutrients (iron, folic acid, vitamin B12 and retinol), intestinal helminths, pica and malaria[8,9]. Iron deficiency anemia (IDA) can cause long-term disturbance of cognitive and motor functions in children of pre-school age[10,11]. Most of the deaths in children less than five years are caused by malnutrition and deficiency of iodine, zinc, iron, folic acid and vitamin A[12]. A study conducted in Bangladesh in 2016 showed that chronic malnutrition, age of child, maternal anemia status, and monetary condition of the family are factors significantly associated with childhood anemia[13].

Burden of anemia in developing countries is still high. Identifying the factors associated with anemia will not only help to reform the national policy but will also help inearly recognition of susceptible children. This is of utmost importance toensuretimely treatmentand prevention of the consequences associated with the problem. There are various factors causing anemia in developing countries that need to be identified. This study was designed to find the frequency, morphological types and factors associated with anemia among hospitalized children aged 1-5 years in a tertiary care hospital.

METHODS

This cross-sectional study was conducted among hospitalized children aged 1-5 years, at the Pediatric Department Ziauddin University Hospital, Karachi from September 2019 to March 2020 (ERC#1280719LKPED). Admitted 333 children aged 1-5 years were consecutively enrolled after obtaining signed informed consent. Children with active bleeding, a history of bleeding disorder, surgery and blood transfusion in the last two months were excluded. Factors influencing the health conditions like household characteristics, maternal education, father's employment status and monthly income in rupees were noted. Age (in years), gender, birth weight, breastfeeding, pica ingestion, the dietary history of the child included drinking tea, frequency of consumption of grains, vegetables, meat and eggs were taken into account.

Height and weight were measured using standard

methods. Children were categorized as "stunted" if length for age < -2 z score and "malnourished" if weight for length< -2 z score using the WHO standard. Height instead of length was used for children > 2years of age. Using the National income Tax slab 2016; the children were grouped into "low-income group" (monthly income ≤35,000 PKR/month). 2ml of venous blood was drawn for a complete blood picture. Hemoglobin less than 11 g/dl was taken as anemia. The severity of anemia was labeled mild, moderate and severe anemia on the hemoglobin of 10.0-10.9mg/dl, 7.0-9.9mg/dl and < 7.0mg/dl respectively, based on WHO criteria for children 6-59 months of age. Anemia morphology was classified as microcytic, macrocytic and normocytic based on erythrocyte size and shape.

Statistical data analysis was done using SPSS version 23. Descriptive statistical analysis was performed for qualitative and quantitative variables and reported as frequency and percentages and mean±SD respectively. Factors significantly associated with anemia in children were compared by Chi-squared test for qualitative variables and t-test for numerical variables taking p-value ≤ 0.05 as statistically significant. Confounding and effect modification were assessed by stratification of data on age groups, gender, parental education and consanguinity.

RESULTS

Anemia was detected in 212/333 (63.7%) children. The mean hemoglobin level was 10.17±1.8. Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were 73.9±11.1, 24.3±4.7 and 32.2±2.1 respectively. Microcytic anemia was the commonest morphological type. In our study 80.2% of children had microcytic, 17.9% and 1.9% had normocytic and macrocytic anemia. Furthermore, 42.9%, 48.6% and 8.5% of children had mild, moderate and severe anemia respectively (Figure 1).
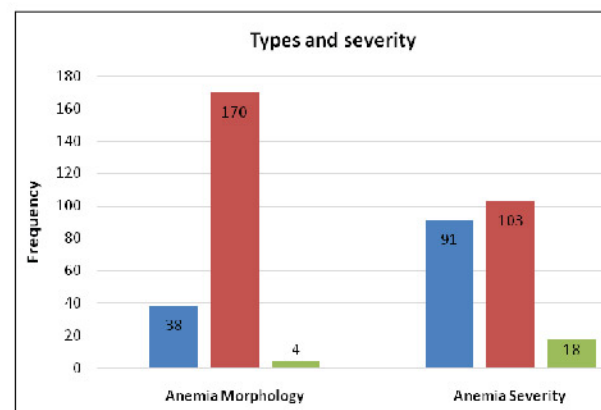

Figure 1: Frequency of types and severity of anemia.

Participants' mean age was 2.6 years (range 1-4.9). Males constituted 53% (n=177) with mean height and weights were 89.7cm and 11.6kg respectively. Overall, 26.1% of children had birth weight <2.5kg and significantly higher frequency in the moderate type of anemia. Frequencies of maternal education and monthly household income were significantly different according to severity of anemia (p <0.001, p<0.001 respectively) (Table 1).

Table 1: Demographic and household factors concerning anemia severity.

Characteristics	Overall (N=333)	Mild Anemia (n=91)	Moderate Anemia (n=103)	Severe Anemia (n=18)	p-Value
Age (years) mean ± SD	2.64 ± 1.3	3.01±1.2	2.5±1.2	2.5±1.1	0.012[a]
Gender: *Male* n(%)	177 (53.2%)	46 (50.5%)	56 (54.4%)	14 (77.8%)	0.17[β]
Height (cm) mean ±SD	89.7± 11.4	91.6±12.4	87.7±11.0	86.3±9.3	0.053[a]
Weight (Kg) mean ± SD	11.62 ± 2.6	12.4±2.7	10.7±2.5	10.6±2.7	<0.001[a]
Birth weight, < 2.5 kg	87 (26.1)	31 (34.1)	40 (38.8)	06 (33.3)	<0.001[a]
Parent's consanguinity: *Yes* n(%)	106 (31.8%)	30 (32.9%)	39 (37.8%)	07 (38.9%)	0.18[β]
Maternal education n(%) Illiterate Primary Middle Matric Intermediate Graduate and above	14 (4.2%) 40 (12.0%) 14 (4.2%) 74 (22.2%) 96 (28.8%) 95 (28.5%)	4.0 (4.4%) 11 (12.1%) 7.0 (7.7%) 22 (24.2%) 34 (37.4%) 13 (14.3%)	3.0 (2.9%) 15 (14.6%) 6.0 (5.8%) 35 (34.0%) 26 (25.2%) 18 (17.5%)	3.0 (16.7%) 2.0 (11.1%) 1.0 (5.5%) 3.0 (16.7%) 7.0 (38.9%) 2.0 (11.1%)	<0.001 [β]
Father employment: *No* n(%)	8 (2.4%)	3 (3.3%)	5 (4.8%)	0 (00)	0.10[β]
Monthly household income: ≤ 35,000 n (%)	118 (35.4%)	38 (41.7%)	57 (55.4%)	7.0 (38.9%)	<0.001 [β]

Statistical test applied - [a] – ANOVA   [β]- Chi-squared test; p-value criteria ≤ 0.05 taken as significant

Overall, 32.4% of children were malnourished with significantly higher frequency in severe anemia (p<0.001). Factors like stunting, pica, tea drinking, never intake of grains consumption/week and never intake of meat consumption/week were significantly different to severity of anemia (p = 0.001, <0.001, 0.03, <0.01, 0.002 respectively) (Table 2).

Table 2: Nutritional and dietary factors concerning anemia severity.

Nutritional and Dietary Influences	Overall (N=333) n(%)	Mild Anemia (n=91) n(%)	Moderate Anemia (n=103) n(%)	Severe Anemia (n=18) n(%)	p-Value
Malnutrition	108 (32.4%)	24 (26.4%)	55 (53.4%)	13 (72.2%)	<0.001
Stunting	40 (12.0%)	12 (13.2%)	16 (15.5%)	6 (33.3%)	0.001
Breast feeding	276 (82.9%)	75 (82.4%)	85 (82.5%)	17 (94.4%)	0.61
History of pica ingestion	66 (19.8%)	8 (8.8%)	43 (41.7%)	15 (83.3%)	<0.001
Deworm in last 6 months: *No*	274 (82.3%)	79 (86.8%)	84 (81.5%)	16 (88.9%)	0.38
Tea drinking	170 (50.1%)	57 (62.6%)	49 (47.6%)	11 (61.1%)	0.03
Vegetable consumption/week: *Never*	182 (54.7%)	50 (54.9%)	63 (61.2%)	10 (55.5%)	0.23
Grain's consumption/week: *Never*	69 (20.7%)	22 (24.2%)	33 (32.0%)	6 (33.3%)	<0.01
Egg consumption/week: *Never*	71 (21.3%)	19 (20.9%)	30 (29.1%)	4 (22.2%)	0.19
Meat consumption/week: *Never*	121 (36.3%)	34 (37.4%)	49 (47.6%)	10 (55.5%)	0.002

Statistical test -Chi-squared test; p-value ≤ 0.05 taken as significant

Birth weight < 2.5 kg had six times higher risk of developing anemia (OR with 95% CI - 6.33 (3.1-12.8), $p< 0.001$). Parental consanguinity had 1.7 times higher risk of anemia (OR with 95% CI 1.7 (1.02-2.79), $p=0.04$). Similarly, monthly income < 35,000 (OR with 95% CI 8.85 (3.9-19.8), $p<0.001$), moderate (OR with 95% CI 4.61 (2.5-8.5), $p< 0.001$) and severe malnutrition (OR with 95% CI 10.5 (1.34-82.1), $p=0.025$), tea consumption (OR with 95% CI 1.58 (1.01-2.48), $p=0.046$), never consumption of grains (OR with 95% CI 4.78 (2.02-11.3), $p<0.001$) and meat (OR with 95% CI 2.69 (1.25-5.79), $p=0.011$) were significant factors associated with development of anemia. Risk of anemia influenced by the maternal education is also shown in the Table 3.

Table 3: Factors associated with Anemia among hospitalized children 1-5 years of age.

Characteristics	Anemia (n=212) n(%)	No Anemia (n=121) n(%)	Odds ratio (95% CI)	p-Value
Birth weight, < 2.5 kg	77 (89.5%)	9.0 (10.5%)	6.33 (3.1-12.8)	<0.001
Parent's consanguinity, Yes	76 (71.7%)	30 (28.3%)	1.7 (1.02-2.79)	0.04
Maternal education				
Illiterate	10 (4.7%)	04 (3.3%)	4.7 (1.4-16.1)	0.014
Primary	28 (13.2%)	12 (9.9%)	4.4 (1.9-9.7)	0.000
Middle	14 (6.6%)	00 (00)	-	-
Matric	60 (28.3%)	14 (11.6%)	8.1 (3.9-16.5)	0.000
Intermediate	67 (32%)	29 (24.0%)	4.3 (2.4-8.0)	0.000
Graduate and above	33 (15.6%)	62 (51.2%)	1 (Ref)	-
Monthly household income ≤ 35,000	102 (86.4%)	16 (13.6%)	8.85 (3.9-19.8)	<0.001
Malnutrition				
Moderate	80 (84.2%)	15 (15.8%)	4.61 (2.5-8.5)	<0.001
Severe	12 (92.3%)	1.0 (7.7%)	10.5 (1.34-82.1)	0.025
Tea intake, Yes	117 (68.8%)	53 (31.2%)	1.58 (1.01-2.48)	0.046
Grain's intake, Never	61 9(88.4%)	08 (11.6%)	4.78 (2.02-11.3)	<0.001
Meat intake, Never	93 (76.9%)	28 (23.1%)	2.69 (1.25-5.79)	0.011

Statistical test -Chi-squared test; p-value ≤ 0.05 taken as significant

DISCUSSION

Anemia is a worldwide prevalent health issue[14]. In this study, frequency of anemia was 63.7%, a closer frequency of 62.3% was reported by Habib et al. among children in Pakistan between 6 to 60 months[15].

In our study, the predominant type of anemia was microcytic i.e., 80.2%. The causes of microcytic anemia are iron deficiency, thalassemia, anemia of chronic disease and sideroblastic anemia[16]. Iron deficiency could be the cause of microcytic anemia in our participants because of the underlying malnutrition. Normocytic anemia was 17.9%. The causes of normocytic anemia are malaria, hemoglobinopathies such as hereditary spherocytosis and early iron deficiency anemia[16]. Macrocytic anemiawas seen in 1.9%. It is infrequent in children; causes include deficiency of folate and vitamin B_{12}, aplastic anemia or myelodysplasia and hypothyroidism[17].

Most of the children had anemia of moderate severity (48.6%). A study by Latif et al. on severity of anemia showed that moderate anemia was common in children aged 6-50 months[5]. Jain et al. also reported that anemia of moderate severity was the commonest[18]. Factors significantly associated with anemia were birth weight, socioeconomic status (maternal education and household income), and malnutrition, consumption of pica and tea and inadequate utilization of animal and vegetable products. Stunting was present in 12%. The distribution of stunting was significantly higher in anemic group ($p=0.008$). Habib et al. observed 33.2% of children had iron deficiency and stunting and household food insecurity was associated with it[15]. Pakistan is amongst one of those developing countries, with the highest prevalence of childhood malnutrition[19]. Tekile et al. documented that anemia was 1.2 times and 1.5 times more in stunted and wasted children[20].

Anemic children mostly live in the areas with high food insecurity. Complementary feeding in children is usually delayed and when initiated it is nutritionally inadequate adding to the risk to develop anemia.

Anemia was significantly associated with diet factors like those that increased tea intake, non-ingestion of grains, eggs and meat as well as pica ingestion. Similar results were shown from Northwest Ethiopia, where 58.6% of children were anemic, 51% had moderate anemia which was positively related to parasitic infection, non-ingestion of meat and animal products[3]. El Kishawi et al. demonstrated that tea consumption with sugar was related to high risk of childhood anemia[21]. Polyphenols in tea impairs iron absorption. For instance, Kejo et al. observed that low birth weight, non-ingestion of meat, vegetables, fruits, and drinking tea were significantly associated with childhood anemia[22]. Study conducted in Brazil also showed low birth weight was significantly associated with anemia[14].

In our study, maternal education was significantly different in anemic and non-anemic children. Anemic children significantly belonged to the category of lower monthly household income. Quality, as well as the availability of complementary feeding, is markedly affected by less family income. Similar results were of study from Sudan, anemia was significantly associated with low maternal educational and low family income[23]. Anggraini et al. also noticed that anemia in children under-five was inversely affected by maternal educational ($p= 0.024$) and family income ($p= 0.044$) [24].

Our study showed that low birth weight, low socio-economic status, maternal education, malnutrition, pica ingestion and non-consumption of meat and animal products were markedly associated with anemia. Early detection of anemia is of paramount importance. We recommend routine screening of all children for anemia at 9 months of age. This policy should be incorporated with the existing national immunization program. As the first, few years of life are important for development in children. This strategy will improve their neurodevelopment and prevent poor outcomes in adulthood.

CONCLUSION

Most of the hospitalized children aged 1-5 years had Hb < 11.0 g/dl. Anemia of moderate severity was observed the most. Most of the factors associated with anemia are preventable. Low birth weight, socioeconomic status, maternal education, malnutrition and pica ingestion were markedly associated with anemia. Reinforcement of micronutrient supplements, nutritional education, promptly addressing the underlying cause of anemia are fundamental strategies in all age groups.

ACKNOWLEDGMENTS

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ETHICS APPROVAL

Ethical review board of Ziauddin University Hospital Karachi approved the study with a Reference code: (1280719 LKPED).

PATIENT CONSENT

Verbal and written informed consents were taken from the parents.

AUTHORS' CONTRIBUTION

All authors contributed equally in this original research write-up.

REFERENCES

1. World Health Organization. Global anaemia prevalence and number of individuals affected [Internet]. Geneva; 2008 [cited 20 November 2020]. Available from: http://www.who.int/vmnis/anaemia/prevalence/summary/anaemia_-data_status_t2/en/
2. World Health Organization. Iron deficiency anemia assessment, prevention and control. A guide for programs managers [Internet]. Geneva; 2001 [cited 20 November 2020]. Available from: http://www.who.int/nutrition/publications/micronutrients/anaemia_iron_deficiency/WHO_NHD_01.3/en/
3. Enawgaw B, Workineh Y, Tadesse S, Mekuria E, Addisu A, Genetu M. Prevalence of anemia and associated factors among hospitalized children attending the University of Gondar Hospital, Northwest Ethiopia. EJIFCC. 2019;30(1):35-47.
4. 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):1-11.
5. Latif M, Ayaz SB, Manzoor M, Ishaq M. Frequency and severity of anemia in children less than 15 years of age at Gwadar development authority hospital, Gwadar, Baluchistan. Pak Armed Forces Med J. 2018;68(5):1088-1092.
6. World Health Organization. Global Health Observatory Data Repository/World Health Statistics. [Internet]. Geneva; 2016 [cited 20 November 2020]. Available from: http://apps.who.int/gho/data/node.main.1?lang=en
7. Hussain A, Iqbal R, Azam I, Janjua N, Rizvi S. Is high availability of fruit and vegetable beneficial for children with anemia? A cross-sectional study in two peri-urban communities from Pakistan. Int J Biomed Public Health. 2020;3(2):35-41.

8. Jangid RK, Kumar A, Mahapatra C, Yadav M, Singhal S, Laxminarayan K. To study the prevalence and types of nutritional anemia in under-five children with severe acute malnutrition. Indian J Child Health. 2020;7(6):270-273.

9. Onyeneho NG, Ozumba BC, Subramanian SV. Determinants of childhood anemia in India. Sci Rep. 2019;9(1):1-7.

10. Lozoff B, Beard J, Connor J, Felt B, Georgieff M, Schallert T. Long-lasting neural and behavioral effects of iron deficiency in infancy. Nutr Rev. 2006;64(suppl_2):S34-S43.

11. Mousa SO, Higazi AM, Saleh SM, Ali HA. Cognitive function and school achievement in adolescent Egyptian girls with iron deficiency and iron deficiency anaemia. Ment Health Fam Med. 2016;12:289-294.

12. Kotecha PV. Micronutrient malnutrition in India: Let us say "no" to it now. Indian J Community Med. 2008;33(1):9-10.

13. 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(1):1-2.

14. Santos RF, Gonzalez ES, Albuquerque EC, Arruda IK, Diniz AD, Figueroa JN, et al. Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. Rev Bras Hematol Hemoter. 2011;33(2):100-104.

15. 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):1-13.

16. Adu-Amankwaah J, Allotey EA, Kwasie DA, Afeke I, Owiafe PK, Adiukwu PC, et al. Prevalence and morphological types of anaemia among children under-five years in the Volta regional hospital of Ghana. Open Access Libr J. 2018;5(2):1-10.

17. Janus J, Moerschel SK. Evaluation of anemia in children. Am Fam Physician. 2010;81(12):1462-1471.

18. Jain S, Chopra H, Garg SK, Bhatnagar M, Singh JV. Anemia in children: early iron supplementation. Indian J Pediatrics. 2000;67(1):19-21.

19. Asim M, Nawaz Y. Child malnutrition in Pakistan: evidence from literature. Children. 2018;5(5):1-15.

20. Tekile AK, Woya AA, Basha GW. Prevalence of malnutrition and associated factors among under-five children in Ethiopia: evidence from the 2016 Ethiopia Demographic and Health Survey. BMC Res Notes. 2019;12(1):1-6.

21. El Kishawi RR, Soo KL, Abed YA, Muda WA. Anemia among children aged 2–5 years in the Gaza Strip-Palestinian: a cross sectional study. BMC Public Health. 2015;15(1):1-8.

22. Kejo D, Petrucka PM, Martin H. Prevalence and predictors of anemia among children under 5 years of age in Arusha District, Tanzania. Pediatric Health Med Ther. 2018;9:9-15.

23. El–Hag AE. Prevalence of anemia in under five children and related factors in Algalaa Area, Singa Locality, Sennar State, Sudan [Internet]. 2015 [cited 20. November 2020]. Available from: http://repo.uofg.edu.sd/handle/123456789/1348.

24. Anggraini Y, Salimo H, Tamtomo D. Effect of birthweight, illness history, and dietary pattern, on the incidence of anemia in children under-five at Tasikmadu Health Center, Karanganyar, Central Java. J Matern Child Health. 2017;2(3):200-212.