

Original Article

Prevalence of Iron Deficiency Anemia and Its Correlation with Nutrition Status Among Adolescent School Girls: Cross-Sectional Study

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Abstract

Objectives: The ultimate malnutrition consequence in adolescence is anemia. A cross-sectional study was conducted to evaluate dietary factors contributes to the anemia among girls.

Methodology: After taking ethical approval from the Institutional Ethical Board, a random sampling technique was used to enrolled 130 school girls aged 12-16 years as study group from District D.I.Khan, KPK, Pakistan. The informed written consent was obtained and blood samples were collected to perform whole blood counts for screening of anemic girls. The socio-economic, demographic and dietary information such as age, weight, height, family monthly income, education level, medicine intake, non-vegetarian or vegetarian, menstrual issues, junk food, were collected on a self-designed questionnaire. The statistical analysis was performed by using SPSS.

Results: The prevalence of anemia was 82% among urban and rural adolescent girls with statistical significant value $p=0.001$. The mild anemia 43.84%, whereas, severe anemia 13% was observed among girls of rural area aged among 15-16years. The majority of girls 70.7% were underweight and 93% had mix dietary pattern. The 86.1% girls were regularly taking junk foods and irregular menstrual pattern reported by 44.1% with > 5day menstruation duration in 87.6% girls. Family size of various students was ≥ 5 people and they were less consuming eggs and fish.

Conclusion: The anemia prevalence is a health issue especially girls residing in rural areas and the majority of them are unaware of iron rich diet. There is a needed to prepare public health system for anemia-related programs to create awareness and promote intake of iron rich foods by adolescents.

Keywords: Malnutrition, Anemia, Adolescents, Non-vegetarian, Underweight

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Introduction

Iron deficiency anemia is a serious nutritional public health issue which is affecting about 20% to 50% of population in developing as well as developed countries. According to WHO, the age between 10 and 19 years is defined as adolescence which is transitional phase period from childhood to adulthood.¹ During this period, adolescence have marked physical activities

and they require extra-nutritional supply for their behavioral, psychological and physical development. Previous studies have reported high prevalence rate of iron deficiency anemia in the adolescent group of developing countries due to inadequate diet, communicable diseases, low immunity, contaminated drinking water and poor sanitation.² Mostly adolescent

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girls of these countries, face more nutritional challenges which make them more susceptible to the anemia. Another important factor leads to development of anemia in adolescent is the deficiency of micronutrient in their diet. Though, these micronutrients such as folic acid and iron, are directly linked with proper physical growth of adolescents, but their deficiency due to parasitic infestations or malnutrition make them more vulnerable to anemia.³ The male can regain sufficient nutritional stores at the end of adolescence, but, female generally fails to regain adequate nutrient stores due to menstrual blood loss. These factor may contribute to occurrence of anemic conditions more in females as compared to male, moreover, the demand of micronutrients in females are also increased in pregnancy and lactation.⁴ It has been estimated that about one by fourth of population of developing countries is suffered from anemia. Previous research mentioned that anemic condition not only disturbs the normal physical growth of adolescents, but it also hinder to achieve their desired educational goals. It exerts significant negative impact on mental health and cognitive function that may lead to poor school attendance and decrease work capacity of adolescents.⁵

According to WHO, the low hemoglobin level than normal range is anemia which occur due to deficiency of certain essential nutrients which results in hemoglobin <12 g/dL level indicates anemia in male and female of adolescent ages. At adolescent ages, menstrual periods in girls depicts more nutritional requirement because there are susceptible to nutritional deficiency anemia.⁶ Previous studies have highlighted various factors contributed to development of anemia among adolescent girls such as low dietary diversity, parasitic infestation, menstruation duration, low BMI, low dietary iron intake, lack of Vitamin C rich diet, taking tea instantly after meal and underweight.⁷ Anemia due to iron loss from menstruation period in adolescent years must be treated by taking iron diet or iron supplements to achieve adequate iron status in this age group. Anemia has been reported as second most lead cause of maternal death in many Asian countries such as India, Pakistan.⁸ Anemic conditions in females is firmly associated with severe maternal birth outcome such as ante-partum haemorrhage, puerperal sepsis, post-partum haemorrhage or even maternal death. It is also responsible to exert significant effects on the baby health like low birth weight, premature births and increases perinatal mortality.⁹

In anemia condition, oxygen-carrying capacity of red blood cell become very low which results in reduced oxygen supply to vital organs. Although the major cause of anemia is iron deficiency, but in various cases deficiency of vitamins A, riboflavin, B12, and folate are the underlying causes of anemia.¹⁰ Anemia is also occurred in various known chronic diseases such as tuberculosis, malaria, thalassemia, cancer and acquired immunodeficiency disease. Previous literature mentioned infections and chronic diseases are major causes of anemic condition due to iron and micronutrients deficiency. It has been established that erythroid progenitor cells are damaged by elevated production of free radicals and proinflammatory cytokines levels in patients affected with bacterial, viral, parasitic infection, autoimmune diseases, cancer and gastrointestinal ulceration.¹¹ The female's vulnerability to anemic is highest because of consuming poor iron rich food, or less animal source food utilization and current trend of excessive junk food consumption.¹² With this background information, the study was conducted to evaluation the prevalence of anemia, and to assess its correlation with dietary pattern and habits of adolescent school going girls.

Methodology

This cross-sectional study was conducted on school going adolescent girls in the months from November–December, 2022 at Gomal Medical College, D.I.Khan, Kp. The total 130 subjects from eight public high schools were enrolled by random sampling method in the study with age between 11 and 16 years. The study inclusion criteria comprised on adolescent girls who were volunteered to participate in the study and gave consent, while exclusion criteria consist of those girls which were not willing to enrolled in the study and not given consent.

The peripheral blood samples were drawn from each subject via venipuncture and collected into EDTA tube which was labelled with subject identification code. The estimation of Hb was done by using the cyanmethemoglobin method. A self-developed questionnaire was used for collection of information about socio-economic, demographic and nutritional status of adolescents' girls.

WHO (World Health Organization) classification was used to assessed anemic status and adolescent girls having Hb value less than 12.0 g/dL were considered as anemic. The anemic status of girls was further categorized as mild anemia having HB value between

10 to 12 g/dL, girls having Hb values in ranges between 07 to 9.9 g/dL were considered as moderate anemic, while, severe anemic girls have Hb values less than 7.0 g/dL.

The statistical analysis of obtained data was performed by using SPSS software. The descriptive analysis was performed to present results in graphs, table, percentages and frequencies. The statistical significance was determined by considering $P < 0.05$.

Results

In present study, total 130 adolescent girls from public schools of urban and rural area of District D.I.Khan, were recruited for estimation of prevalence of anemia. The study group was divided into three groups on the basis of their ages [11-12, 13-14 and 15-16 years]. The study results revealed that as per BMI-results, the majority of enrolled adolescent girls (70.7%) were underweight and (93%) have mixed (Vegetarian + Non-vegetarian) dietary pattern. Although, (44.1%) of participants reported irregular pattern of menstrual period, but (87.6%) of girls mentioned that duration of menstruation is more than 5 days. The study results showed that 106 (81.5%) girls were anemic out of 130.

The maximum prevalence of anemia (36%) was found in girls with age from 13 to 14 years, followed by (35%) in girls with age from 15 to 16 years. The maximum percentage (24%) of anemia was observed in 10th and 7th standard class students. (Table I) It was found that majority participants were consuming mixed diet such as cereals, pulses, nuts, fruits, vegetables, and meat. The diet habits data revealed that (63.8%) of girls were consuming eggs and only (49.2%) girls were eating fishes. All urban and rural participants were using milk products. The (86.1%) of participants were constantly using junk foods at schools as well as at their homes. (Table II)

The study data revealed that most of (43.84%) of adolescent girls have mild anemia with (Hb < 10-11 gm/dL), whereas, (13%) of participants with age 15-16 years have showed severe anemia (Hb < 8 gm/dL). (Table III) Among urban and rural area girls, high prevalence of anemia was observed in 15 to 16 year age rural area adolescent school girls, followed by 13-14 years age girls. Though, slightly less anemia prevalence has been observed in urban school girls, but severe anemic condition has been detected in 15-16 years adolescent school girls. Likewise, high

Table I: Based on socio-economic and demographic characteristics distribution of 130 adolescent school-going girls as participants of the study. (n=130)

Variables	N	%	
Age (years)	11-12	38	29%
	13-14	47	36%
	15-16	45	35%
Class	6 th standard	20	15%
	7 th standard	31	24%
	8 th standard	25	19%
	9 th standard	23	18%
	10 th standard	31	24%
Diet Behavior	Mix	121	93%
	Vegetarian	09	6.9%
BMI (kg/m ²)	Normal	38	29.2%
	Underweight	92	70.7%
Occupation of Mother	House Wife	103	79.2%
	Working	27	20.7%
Family size	< 5 family member	67	51.5%
	> 5 family member	63	48.6%
Mother Education	Illiterate	19	14.6%
	Informal Education	28	21.5%
Menstrual pattern	Regular	83	63.8%
	Irregular	47	36.2%
Duration of menstruation (days)	Regular	72	55.3%
	Irregular	58	44.1%
Exercise habits	< 5 days	16	12.3%
	> 5 days	114	87.6%
Exercise habits	Regular	23	17.69%
	Sometimes	38	29.23%
	Never	69	53%

Table II: Dietary characteristic of adolescent Urban and Rural school-going girls (n=130)

Variables	Response	N	%
Cereals	Yes	130	100%
	No	0	0%
Pulses	Yes	125	96.1%
	No	5	3.8%
Legumes and nuts	Yes	93	71.5%
	No	37	28.4%
Vegetables	Yes	127	97.6%
	No	3	2.3%
Fruits	Yes	119	91.5%
	No	11	8.4%
Meat	Yes	121	93.07%
	No	9	6.9%
Poultry	Yes	121	93.07%
	No	9	6.9%
Eggs	Yes	83	63.8%
	No	47	36.1%
Milk and Milk product	Yes	130	100%
	No	0	0%
Junks	Yes	112	86.1%
	No	18	13.8%
Fish	Yes	64	49.2%
	No	66	50.7%

prevalence of mild anemia was found in 11-12 years rural area school girls as compared to urban school girls. The prevalence of anemia in study population was statistically significant high with $p < 0.001$. (Table IV) It was observed that out of 130 urban and rural adolescent school girls, 106 (82%) of participants were suffered from mild, moderate and severe anemia, which depicts the highest anemia prevalence among girls, while, 24 (18%) of participants were non-anemic.

Table III: Distribution of anemia into mild, moderate and severity among Urban and Rural areas adolescent school-going girls (n=130)

Severity of Anemia	Hb (gm/dl)	N	%
Severe	<8	17	13%
Moderate	8-9.99	32	24.61%
Mild	10-11.99	57	43.84%
Total		106	81.5%

Discussion

In Pakistan, anemia prevalent rate is almost equal among non-pregnant and pregnant females. Although, sufficient literature is available on anemia prevalence in women, but fewer studies on anemia in subpopulation (adolescent girls) are present which are more vulnerable to deficiency of micronutrient.¹³ Anemia is one of the major health problem that exert significant negative effects on normal body growth and birth outcomes of adolescent girls. Anemia in adolescent ages causes poor cognitive performance, delay psychomotor development, and impaired immunity and reduce working capacity.

The present study can help to determine the anemia prevalence and will make basis to make suitable interventions for anemia among adolescent girls in Pakistan.¹⁴ Therefore, this cross sectional study was designed to investigate the prevalence of anemia by measuring haemoglobin concentration in adolescent school girls of aged 11–16 years and to evaluate its correlation with dietary factors. The current study results found significant anemic conditions among

adolescent girls, but severe anemia was observed in participants with aged 15–16 years of 9th and 10th standard school classes. Similar finding has been reported by Mahajan et al., that they noticed 45% of anemia prevalence in adolescent girls of aged 14–18 years.¹⁵ The finding of our study revealed higher percentage of mild anemia in adolescent girls of aged 11-14 years because participants had also reported irregular menstrual cycle pattern that is associated with excessive loss of blood. Likewise, Gebreyesus et al. (2019) reported that susceptibility of development of anemic condition in early adolescence age girls is more than late adolescence age.¹⁶ In present study, in comparison to urban adolescent school girls, higher percentage of moderate to severe anemia prevalence was detected in rural area girls.

Previous study has also been mentioned the higher incidence rate of moderate to severe anemia among late adolescent girls due excessive consumption junk food than fruits and vegetables and lack of exercise.¹⁷ Several studies conducted on anemia prevalence in rural and urban areas of different under-developing and developed countries and they found high prevalence of severe anemia among females of rural areas than urban areas because of poor micronutrients availability in rural girls due to consumption of less diversified food which make them more susceptible to anemia.¹⁸ Another important reason of high anemia risk in girls of rural areas is poverty, lack of awareness, poor health care services and early age marriages. Moreover, the deficiency of proper nutritional status or diversified diets in adolescent girls of rural areas may also attribute to severe anemic conditions. In our study, we also observed lack of diversified diets among the adolescent girls of rural areas, however, high consumption of junks was noticed in participants of urban areas. It was also observed that (70.7%) adolescent girls were underweight according to BMI and most of the girls reported the lack of consumption of eggs and fish in their diets. Among these girls, majority of participants were belonged to rural areas. Previously available literature mentioned that poverty is positively linked

Table IV: Cross-distribution of anemia, non-anemia and p-Value between urban and rural adolescent school girls

Area	Age Groups	Anemia		Total	Non-Anemic		Total	Total Participants	P value
		N	%		N	%			
Urban	11-12 years	11	8.4%	49	5	3.8%	12	130	0.001
	13-14 years	18	13.8%		4	3.0%			
	15-16 years	20	15.3%		3	2.3%			
Rural	11-12 years	15	11.5%	57	6	4.6%	12	130	0.001
	13-14 years	19	14.6%		3	2.3%			
	15-16 years	23	17.6%		3	2.3%			

with risk of anemia among adolescents because wealth reduces the chance of occurrence of anemia. The adolescent who are belonged to rich households usually have good diversified nutritional status which is negatively associated with risk of anemia.¹⁹ In rural areas, girls are commonly married in early adolescent ages and become anemic mothers that not only exposed them to higher risk of maternal mortality but also increases the frequency of low birth weight, premature delivery and perinatal mortality.²⁰ Furthermore, studies have highlighted the housing hygiene condition, education level and socio-economic factors may also contribute significantly in the risk of anemia.²¹

Additionally, Dey et al., (2010) has reported a statistically significant positive relationship between female education level with prevalence of anemia. The importance of education in preventing anemia is also acknowledged by numerous studies, as they not only emphasized on adolescent's education, but their parent education reported to be equally important for reducing anemia.²² Education provides sufficient information to adolescents about their dietary habits, nutrition and micronutrients which can help in preventing anemia.¹³ In current study, it was observed that majority of adolescents mothers were housewife, which were either illiterate or have some basic education. The ratio of illiterate mothers was high in rural areas. We also found the (48.6%) participant have family size > 5 family member which may exert adverse impact on nutritional status of family. Previous studies have described negative association of family size with food allocation of per family member and they also reported that probability of adolescent girls for anemia is almost two times in family size ≥ 5 as compare to girls from small family size.²³

A survey based study results indicated the household's level are effectively improved in small size family by several ways such as adequate food available for all family members, the quality foods possess essential nutrient to meet the requirements of RDA (Recommended Dietary Allowance) and overall health of a family is improved.²⁴ Recently, studies have successfully established the relationship between BMI and anemia. Those study participants (adolescent girls) having low BMI are found to be 3.2 times more vulnerable to develop anemia.²⁵ In contrast, other studies have mentioned a significantly association between prevalence of anemia and higher BMI.²⁶ However, in our study, we found the high prevalence of

anemia in those participant of rural and urban areas having low BMI, while some of adolescent girls had normal BMI. In the present study, smaller average body weight of girls has been observed and its most probable cause could be that adolescent's girls try to maintain ideal weight by controlled diet which adversely affect the intake of micronutrient in the body. Established literature suggested that junk food consumption by adolescents than leafy vegetables and fruit and snacking habit leads them to micronutrient deficiency that ultimately results in iron deficiency anemia in more girls than boys.²⁷ Hafeez et al., (2016) conducted anemia prevalence study among adolescent students in University of Sindh Jamshoro, and also attempted to evaluate their dietary habits. The findings of their study revealed 32.23% anemia prevalence among students of the University and students were not taking breakfast regularly and the majority of them was unaware of proper healthy dietary habits.²⁸

Conclusion

The one of the major public health concern is prevalence of anemia among adolescent school going girls of urban and rural areas. The current study found higher prevalence of mild to moderate anemia among adolescent girls. Also, severe anemia was observed among late rural adolescent girls. Their nutrition status showed lower intake of fish, eggs and heme rich diet that can serve as markers of developing anemia among adolescents. To reduce the incidence rate of anemia among adolescents, iron status must be improved by using strategies such as intake of leafy vegetables, fruits, meat and other iron rich foods. The higher prevalence of severe anemia among girls belonging to poor families and rural areas, must be addressed by public health policy. It is further recommended that Government should provide school-based supplementation of folic acid and iron to improve anemia condition of adolescent girls and to reduce burdens of anemia in Pakistan.

Limitation: This study was limited to establish an association between the deficiency of specific micronutrient and anemia. The current study also did not evaluate the type of anemia or its linkage with any disease conditions.

Recommendation: It is recommended that further studies are needed to detect specific nutritional risk factor related with anemia and their awareness of knowledge among adolescent school going girls of urban and rural areas.

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