ORIGINAL ARTICLE

Prevalence of Anemia and Dietary Iron Intake Among Female Adolescents (Grade 8-12) in Lahore

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ABSTRACT

Objectives: To assess the magnitude and status of anemia in adolescent girls and calculate their dietary iron intake through food frequency records to compare it with the dietary standards.
Study Design: The study is cross-sectional.
Place and Duration of Study: Three female institutions namely, Crescent Model Girls section, Government College of Home Economics and Lahore College for Women University were randomly selected.
Materials and Methods: The parameters for study included the information about age, height, body weight, socioeconomic status, information about anemia status and oral consumption of various iron containing pills. A 24-hour recall method was applied to calculate total iron intake. Food Frequency questionnaire were used to assess the consumption of typical iron containing foods. 450 adolescent girls aged 12-19 years were selected. A probability sampling technique was applied. Later on the sample was stratified according to their severity of anemia.
Results: The overall prevalence of 43%, 24%, and 28% was found among adolescent girls for severe, moderate and mild anemia respectively. Hemoglobin level varied from less than 8 mg/dl to more than 12 mg/dl. Dietary consumption of iron was much below the intake level recommended by WHO for the given age (from <8mg-10mg/day among 84% population).
Conclusion: The appearance of symptoms of anemia are not enough to detect the problem. Blood tests are required. More intervention is required to improve awareness. Malpractices leading to less bio-availability of iron need to be corrected.

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INTRODUCTION

Iron deficiency anemia is known to be the most common nutritional deficiency worldwide. A large segment of world population (1.62 billion), which corresponds to 24.8% of the total strength are affected by anemia[1]. Nearly 49% of the population in Southeast Asia aged 13-39 are anemic. In Pakistan 50% of the females of reproductive age suffer from iron deficiency, while in the urban Punjab 21.8% of the females aged 9-29 are having mild to severe anemia[2].

Adolescence is the period of increased physiological needs including micronutrients such as iron. Adolescent girls are more susceptible to dietary lack of iron due to increased requirements. An additional stress of blood loss through menstruation further aggravates the problem[3].

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The grim consequences of iron deficiency anemia include low working capacity and impaired exercise, low potential, breathlessness on mild exertion and tachycardia[4]. Physiological complications including functional alteration of the small bowel may also arise as a systemic condition[5,6]. Alteration of behavior and cognitive performance have also been observed in severely anemic young adults. Adolescent girls are at a stage when most of them are going to enter the family life cycle. With depleted iron stores they are not able to withstand the load of fetus development. Anemia among these girls not only affect their physical working capacity but they also have some neurologic effects.

It may also bring a change in the reproductive physiology. A global prevalence of anemia of more than 55% among woman aging 20 years or less have been recorded. Much work to be carried out to control this problem[7].

MATERIALS & METHODS

The participants for the study were selected through probability sampling from three institutions in the city

of Lahore, names have been mentioned above in the abstract. A total of 450 adolescent girls aged 12-19 years studying in grades 7-12 classified as having anemia (Hb <11.0 g/dl). Adolescent girls having symptoms for iron deficiency anemia were taken as participants for blood tests.

Questionnaire was structured to collect information for study variables, including age, height, body weight, hemoglobin level and socioeconomic status. Information about parental education, status of menstruation and awareness about anemia were also undertaken for the study.

BMI was calculated by dividing the weight with height m^2. The participants having a BMI<18.5kg/m^2 was considered as underweight, those having a BMI between 18.5 and 24.9kg/m^2 were regarded as normal weight and those with a BMI above 25kg/m^2 considered as overweight[8,9].

Anemia was diagnosed by estimating the hemoglobin concentration in the blood with the use of cyanmethemoglobin method[10.11]. Consent was obtained in writing from the subjects prior to the collection of blood sample after explaining the purpose of the study. A hemoglobin concentration of less than 11mg/dl was considered to be indicative of anemia. The anemic girls were categorized according to the status of hemoglobin lack. Severe anemia was found to be present in girls having a hemoglobin concentration of less than 8mg/dl. Moderate anemia was diagnosed among girls with hemoglobin between 8-10mg/dl. While a hemoglobin concentration between 10-12mg/dl was found to be indicative of mild anemia[12].

The 24-hour recall method was applied to register total dietary intake. While tables of food composition were consulted to determine dietary iron intake[13]. In addition a food frequency questionnaire[14] containing foods typically rich in iron was also consulted in order to improve awareness among study participants. Information was gathered and recorded for one week. The practice of having tea or coffee after meals was undertaken for study. Use of dark green leafy vegetables was recorded and assessed. Information was provided for the use of these vegetables as source of iron. Subjects were assessed for their socioeconomic status. They were made aware regarding the symptoms of their disease. The participants were informed about the consequences of a severe iron deficiency and effects of having beverages like tea or coffee with meals.

Statistical Analysis: Statistical analysis were performed by using the program statistical package for social sciences (SPSS) for window version IBM statistics 20.The demographic, socioeconomic, health data and status of anemia were analyzed. Data were checked for normal distribution by applying various tests of normality (normality plots with tests). Before parametric testing data was objectively checked for normality by numerical testing, and it was again explored for subjective judgement (graphic interpretation) as sample size was not very large[15]. The descriptive statistics were calculated particularly that of mean, standard deviation (SD) and the proportion (%) of numeric values. Data was assessed for the relationship between menarche, nutritional status, dietary iron intake and status of anemia. It was carried out by applying cross tabulation and chi-square tests. The hemoglobin measurements were used as primary outcome variables. The disease intensity was categorized for severe, mild and moderate anemia according to the hemoglobin concentration in blood. This classification was adapted from the WHO (2014) prescribed hemoglobin definitions[16]. The descriptive statistics have been applied to find out the relationship between variables.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

RESULTS

A comparison of hemoglobin level with the dietary iron intake shows that a majority (68.9%) of the study sample are having 8-10 mg of dietary iron a day (Table1). Their hemoglobin level is 9-10 mg/dl. Another 13.6% of the adolescent girls are having less than 8mg of iron a day which is insufficient to compensate for the menstrual losses.

The severity of anemia was assessed through the concentration of hemoglobin in blood, which showed a prevalence of severe anemia among 43% of the participants and a majority out of these (36%) belonged to low and middle income class. Cumulative prevalence of severe anemia was 63.1% (no=303). The association between the level for hemoglobin and dietary iron intake displays more considerable findings (Table 2).

More than three hundred of the respondents (72%) are having iron intake quite less than the required level. The severity of anemia is evident through the hemoglobin level which is below 10mg/dl. Statistically significant differences were observed in the percentage of girls classified as having severe anemia with the lower iron intake ($p < 0.01$).

Table 1: The Level of Iron Intake as Compared to Hemoglobin Level

Iron Intake, Haemoglobin Level

Iron Intake		Haemoglobin Level				Total
		< 8mg/dl	> 12 mg/dl	11-12 mg/dl	9-10 mg/dl	
< 8 mg/day	Count	0	0	0	31	31
	% within Haemoglobin Level	0.00%	0.00%	0.00%	13.60%	6.90%
10-12 mg/day	Count	22	0	23	40	85
	% within Haemoglobin Level	59.50%	0.00%	16.90%	17.50%	18.90%
12-18 mg/day	Count	10	0	0	0	10
	% within Haemoglobin Level	27.00%	0.00%	0.00%	0.00%	2.20%
8-10 mg/day	Count	5	49	113	157	324
	% within Haemoglobin Level	13.50%	100.00%	83.10%	68.90%	72.00%
Total	Count	37	49	136	228	450
	% within Haemoglobin Level	100.00%	100.00%	100.00%	100.00%	100.00%
						p=<0.05

The probability of being anemic, as evident through concentration of hemoglobin level in blood varies significantly with the variation level of independent variable (intake of iron): p=<0.05.

Table 2: BMI of Anemic Females and Their Iron Intake

Haemoglobin Level, Iron Intake, BMI

BMI		Iron Intake				Total
	Haemoglobin_Level	< 8 mg/day	10-12 mg/day	12-18 mg/day	8-10 mg/day	
< 18	< 8mg/dl		2	10	0	12
	> 12 mg/dl		0	0	24	24
	11-12 mg/dl		8	0	25	33
	9-10 mg/dl		1	0	34	35 (8%)
	Total		11	10	83	104 (23.1%)
18-24	< 8mg/dl	0	20		5	25
	> 12 mg/dl	0	0		18	18
	11-12 mg/dl	0	15		74	89
	9-10 mg/dl	31	36		75	142
	Total	31	71		172	274 (61%)
24 & Above	> 12 mg/dl		0		7	7
	11-12 mg/dl		0		14	14
	9-10 mg/dl		3		48	51
	Total		3		69	72 (16%)
Total	< 8mg/dl	0	22	10	5	37
	> 12 mg/dl	0	0	0	49	49
	11-12 mg/dl	0	23	0	113	136
	9-10 mg/dl	31	40	0	157	228
	Total	31	85	10	324	450

The corresponding levels of BMI as calculated through weight/height m^2 of the respondents reflects an inverse relationship with the severity of anemia (the greater the BMI the less the severity of anemia).

Table 3: Socioeconomic Status of Participants In Comparison To Intensity of Anemia

Socio Economic Status, Iron Intake, Intensity

Intensity			Iron_Intake				Total
			< 8 mg/day	10-12 mg/day	12-18 mg/day	8-10 mg/day	
Mild	Socio Economic Status	High Income	5	12	6	20	43
		Low Income	0	8	0	9	17
		Middle Income	5	29	1	31	66
	Total		10	49	7	60	126 (28%)
Moderate	Socio Economic Status	High Income	8	1	1	55	65
		Low Income	1	12	0	2	15
		Middle Income	4	13	1	11	29
	Total		13	26	2	68	109 (24%)
Normal	Socio Economic Status	High Income	7	0		0	7
		Low Income	1	6		0	7
		Middle Income	0	4		3	7
	Total		8	10		3	21 (5%)
Severe	Socio Economic Status	High Income			0	29	29
		Low Income			1	0	1
		Middle Income			0	164	164 (36%)
	Total				1	193	194 (43%)
Total	Socio Economic Status	High Income	20	13	7	104	144
		Low Income	2	26	1	11	40
		Middle Income	9	46	2	209	266
	Total		31	85	10	324	450

Information denotes that the probability of being mildly, moderately or severely anemic in the relevant category of explanatory variable (income status of respondents) is significantly different for the reference category of independent variable that is iron intake.

The prevalence of anemia was found to be high among majority of the study participants (68.9%). Prevalence of mild anemia was found among 28% of the study population and most of them (no=66) belonged to middle income class. Table 2 describes the distribution of sample for the level of hemoglobin and intake of dietary iron for BMI <18 kg/m^2. The consumption of iron among respondents is much below the recommended level of intake prescribed by WHO. More than hundred participants in the study (23.1%) have a BMI <18 kg/m^2. They have statistically significant differences in anemia classification ($p<0.01$). Over weight girls having a BMI >24 kg/m2 have a lower prevalence of any degree of anemia as compared to the normal weight and underweight girls. The percentage of girls who appeared to be anemic was lower (8%) for those having a BMI <18 kg/m^2. The maximum number of participants with anemia {(274 (61%)} have a BMI from 18-24kg/m^2 which supports the findings of having anemia more prevalent among under nourished population. For severe anemia the highest prevalence were observed among 16.4% adolescent girls who were consuming less than10 mg of iron in a day. The lowest dietary iron intake was observed in 31 adolescent girls who were consuming less than 8 mg of iron daily.

The differences in the prevalence of anemia are related to socioeconomic class (table 3), educational level of the parents (awareness), BMI and dietary iron intake. Statistically significant differences among status of anemia as evident through severity are based upon dietary factors. These are indicated by chi-square testing. The group of girls with the higher standard of living are having reduced risk of prevalence ($p <0.01$), while the cumulative prevalence was high among all income groups. The subjects were evaluated on the frequency intake of iron rich food. A regular use of green leafy vegetables has been observed among 22.5% of the respondents. Practice of having tea or coffee after meals is common among 13% respondents which entails less bio-availability of dietary iron. Respondents who were reported for having dark green leafy vegetables on daily basis were less likely to be anemic than those who were reported for having vegetables less than daily or not at all. In addition the respondents with a BMI less than 18.5 kg/m^2 were observed to be more likely to be anemic (61%) than those with a normal BMI (16%). The BMI variable also reduced the significance of standard of living index variable.

The intensity variation of anemia prevailing among adolescent girls has been described in relation to their

iron intake and the socio economic class to which the family belongs. Severely anemic respondents are 194 (43%) in number and a majority out of these (36%) belong to middle income class.

DISCUSSION

The present study addressed the massive prevalence of anemia among young females and its consequences on the health and productivity.

The population of Pakistan is more than 18 crore and fertility rate is above replacement level. Such a large prevalence may be interpreted in the economic and sociocultural context as a majority of the study sample belongs to middle and low income class. Similar findings have been observed in another study carried out by Bardosono[17]et al, where a large prevalence of anemia is attributed to the lack of availability of iron rich food.

Health status of adolescent girls reflects gender discriminations right from their birth. This fact has already been described in other studies carried out on maternal health care, where the reason for anemia among these women is lack of equitable distribution of health resources[18]. There has also been found some social and biological vulnerability among women within household and society. Same kind of analysis have been derived in a study on iron deficiency among school aged children, they discovered some effects of low hemoglobin on the cognitive ability of children[19].

Improvement in the nutritional status of anemic females has been less impressive as most of the intervention programs do not reach the vulnerable people[20]. The reason may be less exposure of these people to such programs. There may also be lack of interest as it has already been described by Griffiths[21] through the work on prevention of anemia in young girls.

Significant health and diet variables included use of tea or coffee after meals and the consumption of green leafy vegetables. Their effect on the absorption of iron was undertaken in the present study. About three fourths of the study population (77%) did not have green vegetables in their diet. While those who used to have vegetables on regular basis (22%) had a hemoglobin level from10-11 mg/dl. Consequently the practice of having tea or coffee along with regular meals was observed among the participants (no=168) who were having a hemoglobin level less than10 mg/dl. Participants not having this practice after meals were less likely to have anemia.

Parallel to the findings of the present study another study contributes these facts as barriers to maternal health care. The situation is further complicated in the presence of social barriers which do not allow health facilities reach these women. As a result the disadvantaged undernourished women are more likely to be anemic which gives rise to health disparities[22,23].

Other risk factors identified in the present study such as low BMI and absence of iron rich foods in the diet of these young adolescent girls would be helpful for planning more intervention programs to prevent anemia among future mothers. The prevalence has been found to be generally high among girls in all these groups regardless of their socioeconomic class.

The prevalence of severe anemia (43%) has been found to be much higher as compared to overall malnutrition among teenage girls (41.9%) found after assessment of nutritional status[24]. The prevalence ratio found in the present study is lower as compared to the one reported in another study, carried in Vadodara[25]. They found 36% prevalence for severe and 22% and 18% prevalence for moderate and mild anemia respectively. Investigations for the assessment of nutritional status showed after analysis that low hemoglobin level in blood is accompanied with low intake of protein and energy nutrients[26]. The findings of the present study devised that nutritionally inadequate diet is the most common factor among these anemic adolescent girls. Creed et al highlighted in their concluding paragraph that diet is the most important factor. Population belonging to most vulnerable groups need to have a wholesome diet[27]. Through their work they emphasized that an effect of dietary iron lack on neurotransmitter receptors is observed which reflects the work efficiency including motor activity. These findings supplement the findings of Rajaratanam[28]. They worked with the rural community. Their findings were on causes of iron and zinc deficiency. They give information regarding the intake, absorption and bio-unavailability of dietary iron.

According to Soekarjo et al socioeconomic status and puberty are the root line cause for anemia among adolescent girls and boys[29]. Another study carried out by Kumar devised the use of supplements for prevention and treatment of anemia by adding them in the food already being taken[30].

CONCLUSION

Strong correlations between dietary habits, socioeconomic status and prevalence of anemia have been found. Some prophylactic measures have to be applied for careful intervention among school and college students. The grim consequences of a large prevalence of anemia include reduction in the physical

activity and low productivity. These adolescent girls are soon going to enter into the family life cycle. With the depleted iron stores they will not be able to withstand the stress of fetus development. Anemia is endemic among these adolescent girls, the fact highlights the need for a more comprehensive intervention program based on strategies to control anemia.

Assessment of the nutritional status of adolescent girls and other vulnerable groups may be carried out intermittently. Trained staffs have to be appointed for detection of prominent symptoms of anemia. The suspected cases among children and adolescents may be screened for the hemoglobin level before puberty.

Efforts must be made to improve awareness regarding the intake of iron-rich sources of food. The administration of medicated oral iron and folic acid tablets must be encouraged for supplementation. In addition the -use of beverages like tea or coffee after meals should be discouraged to avoid suppression of iron absorption. The most commonly used and well-liked foods may be fortified with iron, folic acid and vitamin B 12.

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