Section: Biochemistry

Original Research Article

ASSESSMENT OF SERUM IRON, FOLIC ACID AND VITAMIN B12 STATUS IN YOUNG ADULT WOMEN WITH ANEMIA IN SOUTHERN ODISHA

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Abstract

Background: Women of reproductive age (WRA) are a high-risk population for anemia and micronutrient deficiencies. Anemia is common in WRA and is associated with increased risk of maternal and infant mortality & morbidity. Iron deficiency anemia is still a condition of a major public health concern for researchers and policy makers. Period of adolescence is a significant phase of life as the physiologic growth spurt requires adequate nutrition in order to achieve healthy adulthood. During this period Iron deficiency anemia occurs because of poor intake and decreased absorption along with increased demand of iron.On the other hand, vit B12 & folic acid deficiencies are associated with megaloblastic anaemia. **Materials and Methods:** It was a community based cross-sectional study done in Sourthern districts of Odisha. A community-based survey was conducted by an independent trained field staff. During the survey total 885 adolescents (from 11 to 19 completed years) were surveyed and assessed for BMI and hemoglobin status. Serum ferritin, folates, and vitamin B12 were estimated among randomly selected 100 female adolescents with anaemia. Study participants were selected from study area using 30-cluster sampling technique, and the village was considered as a unit of cluster. From each cluster the estimated adolescents to be recruited were calculated by population proportion to size (PPS) method. Every cluster was hypothetically divided into four equal parts and study participants were recruited from each part for equal representation of cluster. **Result:** In the current study, maximum number of anemic patients (54.4%) belong to moderate category, 42.3% patients have severe anemia and only 3.3% cases belong to mild category. Our data indicates 55 (61.1%) patients were having microcytic hypochromic picture in peripheral smear, out of them 25 patients have iron deficiency and 03 having Thalassemia minor. 20 patients (22.2%) were having dimorphic picture. In dimorphic anemia 20 patients have macrocytic hypochromic and 10 having normocytic hypochromic picture. Aplastic anemia was causing 1.1% of anemia in study group. In our study shows that 24.4% patients having serum Iron level < 30 µg/dl while 60% patients having serum Iron level between 30- 60µg/dl. **Conclusion:** In this population-based biomarker survey of WRA, there was a high prevalence of anemia, vitamin B-12 deficiency, and RBC folate insufficiency. The substantial burden of anemia and micronutrient deficiencies in WRA in this setting suggests an opportunity for screening and prevention.

INTRODUCTION

Anemia is a major public health problem amongst adolescents in India.[1] Adolescents are at a high risk of iron deficiency and anemia due to accelerated increase in requirements for iron due to rapid pubertal growth with sharp increase in lean body mass, blood volume and red cell mass, which increases iron needs for myoglobin in muscles and haemoglobin in the blood. Adolescents, particularly girls, are vulnerable to iron deficiency anemia as there is a regular loss of

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12.5-15 mg iron per month or 0.4-0.5 mg iron per day in menstrual blood.[2]

The requirement for iron increases two to three folds from a preadolescent level (0.7-0.9 mg iron per day) to adolescent (Boys: 1.4-1.9 mg iron per day, Girls: 1.4- 3.3 mg iron per day).[3] Studies indicate that the incidence of anemia in adolescents tends to increase with age and corresponds with the highest acceleration of growth during adolescence. The highest prevalence is between the ages of 12-15 years when requirements of iron are at peak. DLHS-2 (District Level Household & Facility Survey) in India reported that the extent of mild and moderate anemia among adolescent girls diminished gradually with the age from 10-14 to 15-19, but the incidence of severe anemia increased with age.[4]

In India, the prevalence of iron deficiency anemia had been reported to be 55.8% among females and 30.2% among males in age group of 15–19 years.[5] The prevalence of anaemia among adolescent girls of 11–19 years across the state was found to be 90.0%, which was significantly more as compared to national level survey.[6] In addition to iron, haematopoiesis requires sufficient amount of other nutrients, like folic acid and vitamin B12.[7]

Folic acid is a water-soluble vitamin involved in nucleic acid, blood cell, and nervous tissue synthesis. It is widely distributed in green leafy food items "foliage" and its deficiency will lead to megaloblastic anemia due to prolongation of synthesis phase of red blood cells and retarded maturation of germ cells in bone marrow. In addition to folic acid, vitamin B12 deficiency is the second common cause for megaloblastic anemia. Vitamin B12 is required for two important transmethylation reaction, one of which closely associated with folate in DNA synthesis and haematopoiesis. Not plants, but non vegetarian food items are the source of vitamin B12.[8] Low level of vitamin B12 has been considered to affect reproduction and can cause recurrent abortion, infertility, and preterm abortion among pregnant mothers.[9] Limited studies reported that there is coexistence of folic acid and vitamin B12 deficiency along with iron deficiency anemia.[10] This coexistence was also observed among adolescent girls.[11]

Iron, folic acid, and vitamin B12 deficiency is expected among adolescents with poor nutrition status. Their deficiency is of concern in India, as undernutrition was observed among about 60.0% of female and 45.0% male adolescents.[12,13] Also, surveys have also observed significant prevalence of iron deficiency anemia among adolescents.[14] Understanding their possible interrelationship and global concern due to their deficiency and limited evidence from country, a rapid assessment was done to study the prevalence of iron, folic acid, and vitamin B12 deficiency among adolescent females of Sourthern Odisha. Majority of study population of the study area is consuming mainly vegetarian diet. Cereals, pulses, and rice are consumed daily by almost all the families of studied adolescents (females).

MATERIALS AND METHODS

It was a community based cross-sectional study done at Sourthern Odisha for a period of two years (July 2021-July 2023). A community-based survey was conducted an independent trained field staff. During the survey total 885 adolescents (from 11 to 19 completed years) were surveyed and assessed for BMI and hemoglobin status. Serum ferritin, folates and vitamin B12 were estimated among randomly selected 90 female adolescents.

The study protocol was reviewed and approved by the Institutional Ethical Committee(IEC). A Complete Blood Count (CBC) is a common blood test that provides valuable information about the different components of blood. It helps in diagnosing a wide range of medical conditions and assessing overall health.

Hemoglobin was assessed at 540 nm by spectrophotometer. For serum ferritin, folates, and vitamin B12 blood samples were centrifuged for separation of serum at the collection site and transported to laboratory for assessment. Ferritin, folates, and vitamin B12 were analyzed at COBASe411(Chemiluminescent enzyme immunoassay) with control run in the Regional Diagnostic Center of MKCG Medical College & Hospital.

Standard diagnostic criteria were used for low hemoglobin (female: <12g/dL), low ferritin (<12ng/mL), vitamin B12 (<200pg/mL), and folates (<2.7ng/mL) levels [15]. Degree of deficiency was assessed as severe (female: <7.0g/dL), moderate (female: 7.0–10.9g/dL), and mild (female: 11.0–11.9g/dL).

As used in National family Health Survey (NFHS-4), the Body Mass Index (BMI) was categorized as moderate/severe thin (BMI < 17.0kg/m2), mild thin (BMI 17.0–18.4kg/m2), normal (BMI < 18.4–24.9kg/m2), overweight (BMI 25.0– 29.9kg/m2), and obese (BMI > 30.0kg/m2).[3]

Statistical analysis

Statistical analysis was done by using Epi info 3.2.5 version (CDC), Chi square($\chi 2$), and unpaired student *t*-test was used to compare the proportions and means, respectively.[16]

RESULTS

Above [Table 1 and 2] shows that maximum number of anemic patients (54.4%) belongs to moderate category, 42.3% patients have severe anemia and only 3.3% cases belong to mild category.

From this [Table 3] it is clear that most frequent symptoms were weakness and easy fatigability (100%), decreased work performance (80%), breathlessness on exertion (60%), other important

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presenting symptoms were swelling over body (40%), pain in abdomen (40%).

Table 1: Percentage of anemia prevalence in different socio-economic strata

n (%)	Underweight	Normal weight	Overweight	Obese	P value
Age (years) (%)					
11-13	18	15	2	1	< 0.001
14-16	13	13	1	2	
17-19	11	11	2	1	
Residence					
Urban city	27	23	3	3	0.03
Rural city	15	16	2	1	
Socio-economic status					
Low	22	21	3	2	0.39
Medium	14	14	1	1	
High	6	4	1	1	
Education					
Low	21	23	2	2	0.002
Medium	17	13	2	1	
High	4	3	1	1	

Table 2: Severity of Anemia (according to Hb %)

Grade of Anemia	Female	
	No	%
Mild	03	3.3
Moderate	49	54.4
Severe	38	42.3
Total	90	100

Table 3: Distribution according to presenting symptoms

Symptoms	No of patients	Percentage
Weakness & fatigability	90	100
Decreased work performance	72	80
Breathlessness on exertion	54	60
Swelling over body	36	40
Pain in abdomen	36	40

Table 4: Distribution according to Signs

Sign	No of patients	Percentage
Pallor	88	97.8
Nail changes	54	60
Tongue changes	36	40
Edema	36	40
Hepatomegaly	36	40
Tachycardia	36	40

This table depicts important physical findings. Most common finding was pallor of conjunctiva (97.8%), 60% have some form of nail changes, out of which 30% have typical koilonychias, edema, Hepatomegaly and tachycardia present in 40% cases.

Table 5: Distribution Anemia according to Red Cell morphology in peripheral smear

Morphology	No of patients	Percentage	Remark (No of patients)
Microcytic Hypochromic	55	61.1	Iron deficiency-25, Thalassemia minor-03
Dimorphic	20	22.2	Macrocytic hypochromic-20, Normocytic hypochromic-10
Megaloblastic	10	11.1	Vitamin B12 deficiency-15 Folic acid deficiency-04 Both -01
Normocytic Normochromic	05	5.6	Sickle cell anemia-04 Aplastic anemia-04 Others-04
Total	90	100	

This table shows 55 (61.1%) patients were having microcytic hypochromic picture in peripheral smear, out of them 25 patients have iron deficiency and 03 having Thalassemia minor. 20 patients (22.2%) were having dimorphic picture. In dimorphic anemia 20 patients have macrocytic hypochromic and 10 having normocytic hypochromic picture.

Table 6: Classification of Anemia.

Type	No. of Patients	Percentage
Nutritional Anemia	76	84.4
Hemolytic anemia	06	6.7
Due to chronic blood loss	06	6.7

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Aplastic anemia	1	1.1
Other	1	1.1
Total	90	100%

This table depicts etiological classification of anemia. 84.4% patients were having Nutritional anemia, followed by 6.7% having hemolytic anemia, 6.7% having anemia due to chronic blood loss. Aplastic anemia was causing 1.1% of anemia in study group.

Table 7: Serum Iron Analysis

Serum Iron (µg/dl)	No of patients	Percentage
<30	22	24.4%
30-60	54	60%
>60	14	15.6%
Total	90	100%

[Table 7] shows that 24.4% patients having serum level < 30 µg/dl while 60% patients having serum Iron level between 30- 60µg/dl.

Table 8: Distribution of Vitamin B-12

Vitamin B-12	No of patients	Percentage
201-300 pg/ml	17	18.8%
<200 pg/ml	73	81.2%
Total	90	100%

[Table 8] shows that 18.8% patients having Vitamin B-12 between 201-300 pg/ml while 81.2% patients having Vitamin B-12 Less then <200 pg/ml.

Table 9: Distribution of Folic Acid

Folic Acid	No of patients	Percentage
2-20 ng/mL	19	21.1%
<2ng/mL	71	78.8%
Total	90	100%

[Table 9] shows that 21.1% patients having Folic Acid between 2-20 ng/mL while 78.8% patients having Folic Acid Less then <2ng/mL.

DISCUSSION

The present study focussed on the often-overlooked population group in our area at risk of anemia, namely adolescent girls.[16] The present study found that the prevalence of anemia was 30.5% and 62.8% among adolescent girls, respectively. The prevalence rate of anemia was more pronounced among girls and witnessed a rise in wave-2 for girls.[17]

Nevertheless, extant studies predominantly suggested anemia to be expected in children, adolescent girls, and young pregnant women, considering them a high-risk group in developing countries.[18] Moreover, we found that increasing age was statistically associated with an increased likelihood of anemia, especially among girls. It indirectly indicates the occurrence of menarche, followed by high menstrual losses in later stages of puberty, increasing the risk of anemia.

In developing countries like India, anemia is primarily due to nutritional problems in the adolescent age.[19] Panagiotou JP et al found that there are more underweight adolescent boys (66.8%) compared to girls (56.8%), and the prevalence of thinness was also higher in boys (22.5%) than in girls (12.2%). These estimates indicate a dramatically different level of nutritional status for adolescents in Bihar and Uttar Pradesh.[20]

In contrast, the prevalence of anemia remains unchanged with girls' increasing underweight status and thinness. Earlier studies on other Asian countries with comparable nutritional indicators suggested similar findings.[20] The iron requirement is accelerated for growth needs and development.[21] Lack of iron often leads to severe anemia in this age group and has been an indicator of long-term adverse impact on overall health due to increased vulnerability to infections and weak immunity.[22] To control and prevent the prevalence of anemia, the government of India launched a weekly iron folic acid (IFA) supplementation program (WIFS), which instructed adolescents to consume iron folic supplements once a week.[23] Interestingly, the consumption of IFA tablets had no significant difference in the prevalence of anemia in adolescent girls.[24]

In our study represent that 18.8% patients having Vitamin B-12 between 201-300 pg/ml while 81.2% patients having Vitamin B-12 Less then <200 pg/ml. In addition, study shows that 21.1% patients having Folic Acid between 2-20 ng/mL while 78.8% patients having Folic Acid Less then <2ng/mL.

The prevalence of Vitamin B-12 and Folic Acid is consistent with findings from studies in other parts of India where the reported prevalence of Vitamin B-12 ranged from 28% were 201-300 pg/ml and the prevalence of Folic Acid <2ng/mL were 72. The

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substantial burden of anemia, vitamin B-12 deficiency, and RBC folate insufficiency in this population suggests an opportunity for anemia and birth defects prevention through interventions such as the fortification of staple foods.[25]

In line with a few studies showed that education strongly correlates with anemia as adolescents with a higher level of education are more open to new information on personal hygiene and healthy nutritional practices.[25] In the present study, anemia prevalence is unevenly distributed in all socioeconomic groups. It is found to be highest among adolescents in the poorest wealth quintile, which is in line with most of the past studies as the risk of anemia among them depends on various factors such as availability and affordability of food high in iron, folic and vitamins, which highly contributes to the problem.[26] The finding of our study was not in concordance with previous studies, as middle and richer wealth quintiles were also at high risk of anemia.[27] It explains that unhealthy nutritional practices (junk food consumption) among adolescents in the higher wealth quintile might also increase the prevalence of anemia.[28]

CONCLUSION

We found that anemia was a severe public health problem among adolescents aged 10–19 years in Sourthern Odisha. Nutritional anaemia in adolescents is mainly determined by low intake of iron, folate & vit B12. Supplementation not only with iron but also with Vit B12 & folic acid is required through national programms. The World Health Assembly targets to reduce anaemia in India by 2025.[29] Anaemia Mukt Bharat Stratergy launched in 2018,[30] aims in providing iron & folic acid supplementation to adolescent girls to break the intergenerational cycle of anaemia. However efforts are needed to strengthen the supply & periodic training at all levels for effective implementation of all programs.

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