

## IRON DEFICIENCY ANEMIA AND ITS ASSOCIATION WITH THYROID DYSFUNCTION IN SCHOOL GOING ADOLESCENT GIRLS OF SCHEDULED TRIBES IN UDAIPUR

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### ABSTRACT

**Background:** Scheduled Tribe people being about 8% of the total population in India and 13 per cent of total population of Rajasthan form a distinct group compared to other populations and is the most underprivileged section of society. The people especially women and adolescent girls are at a higher risk of under-nutrition and micronutrient deficiency leading to iron deficiency anemia. A depleted iron status may largely affect the thyroid function of tribal females and this still remains unexplored. **Materials and Methods:** The present study conducted in adolescent school going girls of local tribal community. Their blood samples were tested for various parameters like hemoglobin, serum iron, iron binding capacity and Throtropin stimulating hormone (TSH). **Results:** The investigation hereby reports anemia in 79.5% of girls. Among anaemic 47.05% were mildly anaemic and 22.5% were moderately anaemic and 9.8% of the total girls were found to suffer from severe anemia. A significant reduction in iron status confirmed anemic conditions due to iron deficiency. Significantly increased TSH levels were observed in moderate and severely anemic girls. **Conclusion:** A reduced iron status may result in clinical or subclinical hypothyroidism in adolescent girls.

**Keywords:** Anemia, Scheduled tribes, adolescent girls, hypothyroidism

### INTRODUCTION:

The prevalence of anaemia in developing countries is relatively high ranging from 33 percent to 75 percent (1). In India, anemia is classified as a major public health problem as 52% of non pregnant women of reproductive age are estimated to suffer from this condition (2). Various studies conducted in India further confirm the high prevalence of anemia among adolescent girls and women due to micronutrient deficiency and anaemia trends remain strongly correlated with iron-deficiency (3-6). The low dietary intake of iron and folic acid coupled with poor bio-

availability of iron is the major factor responsible for very high prevalence of anemia in the country (7).

Scheduled Tribe people constitute about 8% of the total population in India and 13 per cent of total population of Rajasthan, with varying proportions in different states. They live in unique physical, socio-economic and cultural environment, isolated from general population. They form a distinct group compared to other populations and is the most underprivileged section of society (8). The tribal population is at a higher risk of under-nutrition,

because of the socio-cultural, socio-economic and environmental factors influencing the food intake and health seeking behaviour. Iron-deficiency anemia is widespread yet the most neglected micronutrient deficiency disorder among children, adolescence girls, and pregnant women of scheduled tribes (9-11).

Many studies suggest that hypothyroidism should be suspected in patients who have anemia with an unknown aetiology. It has been shown in various studies that for adequate functioning of thyroid hormone various minerals and trace elements are considered to be important. Iron is one of such element that is required in metabolism of thyroid hormone (12) as it acts as a co-factor in catalyzing the activity of some important biological enzymes including thyroid peroxidase TPO (13). TPO, a membrane bound enzyme is reported to be responsible for the oxidation of iodide and binding of iodine to tyrosin residue of thyroglobulin (14). A lower iron status may decrease the efficiency of TPO and thereby affect the overall thyroid hormone metabolism (15).

The female population of tribal community is likely at increased risk for iron deficiency, since there is a high prevalence of anemia. The effects of depletion of iron status may largely affect the thyroid function of tribal females and this still remains unexplored. The main goal of this study is to better understand the relationship between iron status, as measured by hemoglobin, serum Iron, total iron binding capacity (TIBC) and thyrotropin stimulating hormone in adolescent females attending schools. Thus the study was conducted to find out the proportion of hypothyroidism in both anemic and non-anemic school going girls of age group 12-18 years of tribal area of Southern Rajasthan specifically Udaipur. Our study aims to determine the association between iron deficiency anemia and hypothyroidism, if any.

## MATERIALS AND METHODS:

**Study area :** Unfortunately, prevalence of anemia and its effect on thyroid function in adolescent school going girls of tribal community has been the least explored area of research, particularly in Southern Rajasthan. This community-based study was

undertaken to assess the iron deficiency anemia and its correlation with hypothyroidism in adolescent school going girls of local tribal community residing in Udaipur district.

Informed oral consent was obtained from the children's teachers and families. Ethical approval for the study was obtained from the Institutional Ethical Committees of Geetanjali University, Udaipur. In the first step, subjects who fulfilled all of the inclusion criteria were chosen for the study. A total of 102 girls of tribal community (with or without iron-deficiency) were enrolled from 8<sup>th</sup> standard to 12<sup>th</sup> standard.

**Inclusion criteria:** Adolescent school girls, aged 12-18 years, unmarried, not on hormonal therapy, no history of anemia or hypothyroidism, with no history of any autoimmune disease, not taking any vitamin or iron supplementation were included.

**Exclusion criteria:** Male participants, females above 18 years, married, females on hormonal therapy, or on vitamin or iron supplementation, with a history of anemia, hypothyroidism or any other chronic or autoimmune disease were excluded.

**Biochemical analyses:** 5 ml fasting venous blood samples were drawn from the arm. Blood was collected in two different test tubes; 2 ml were placed in the EDTA tube for measurement of hemoglobin and 3 ml in another tube for determination of serum iron, TIBC, thyrotropin stimulating hormone (TSH). Anemia was diagnosed according to WHO guidelines (16) (Demaeyer, 1985) (Table 1). The quantitative measurement of serum iron, and total iron binding capacity (TIBC) was performed. Transferrin saturation was calculated as follows: (serum iron/TIBC) ×100. The quantitative measurement of thyroid stimulating hormone (TSH) was done using chemiluminescence immunoassay.

**Data analysis:** The master chart was prepared by using the EXCEL 2007 software. Mean values and standard deviations were presented. The data which were obtained were analyzed statistically by using online student t-test calculator. P value less than 0.005 was considered as a

## RESULTS:

### 1. Prevalence of anaemia according to the severity of anaemia:

In the present study, of the 102 adolescent girls, 21 (20.5 %) girls were having normal Hb (>12gms/dl) and 81 (79.5%) were anaemic. Among anaemic 48 (47.05%), were mild anaemic and 23 (22.5%) of the girls were moderately anaemic having mean Hb. 10 (9.8%) of the total girls were found to suffer from severe anemia Table 2.

### 2. Iron status of anemic and non anemic girls

There was significant reduction in serum iron level in moderately and severely anemic girls as compared to that of non anemic girls. No significant correlation was observed in mildly anemic girls. Further, a significant increase in all anemic females was observed as compared to girls having normal hemoglobin levels. Transferrin saturation percentage less than 16% depicts iron deficiency, moderately and severely anemic girls were found to have severe iron deficiency (Table 3).

### 3. Correlation of iron deficiency and TSH

Significantly increased TSH levels were observed in moderate and severely anemic girls. There was not significant increase in mild anemic girls (Table 3).

## DISCUSSION

This is the first study report prevalence of anemia and its correlation with thyroid dysfunction in adolescent school going girls of local tribal community of Udaipur. In females, adolescence marks the beginning of the menstrual cycle or reproduction. Adolescents gain 30% of their adult weight and more than 20% of their adult height between 10-19 years, which is mentioned as growth spurt (17). Adolescent girls are at a high risk for anaemia as there is increased iron requirement because of growth and menstrual loss. Malnutrition and inadequate nutrition during adolescence may result in serious consequences throughout the reproductive years of life and beyond (18).

The data from the District Nutrition Project (Indian Council of Medical Research) in 16 districts of 11 states of India including Rajasthan, on the prevalence of anemia in non-pregnant adolescent girls (11-18 years) in year 2002, also demonstrated anemia as high as 90.1% out of which 7.1% of the girls were reported to suffer from severe anemia i.e. Hemoglobin <7 g/dl (19). It has been further reported by Indian Institute for Population Sciences and Ministry of Health and Family Welfare in 2006, that in India, 98 percent of adolescent girls have any anemia. Twenty two percent of them are mildly anemic, 49 percent are moderately anemic and 27 percent are suffering from severe anemia. Severely anemic adolescent girls are highest among Scheduled Tribes as compared to other castes vide DLHS, 2002-2004 (20).

According to Vyas and Choudhary (2005) 93.7 per cent school children were reported to suffer from different forms of anaemia confirming high prevalence of anaemia in the tribal school children of Udaipur region (8). Our study conducted during 2014-15, in adolescent school going girls of local tribal community hereby reports anemias, in the studied group of girls upto 79.5%. 47.05% of girls were having mild anemia, 22.5% were moderately anemic and 9.8% were severely anemic. A very high prevalence of anaemia in our study could be attributed to lower socio-economic status and nutritional deficiencies found in adolescent girls of tribal population, as similar results were reported in adolescent girls of certain slum areas (21). Respective transferrin saturation percentages were also observed below the normal levels depicting lower iron status.

Studies have shown that anemia is an indicator of poor nutrition and poor health, with major consequences on the human health as well as on the social and economic development.

According to the WHO, if the prevalence of anemia at the community levels is more than 40%, it should be considered as a problem of high magnitude (22) The present study thus brings out the fact that the problem of anemia is related to a wider population than the traditionally considered groups of the non pregnant adolescent females. Our study further confirmed that the anemia in studied population is

due to reduction in iron status. Significant changes in TIBC and Serum iron confirmed that anemic condition in these females is due to iron deficiency.

None of studies have yet reported the relationship between anemia and thyroid dysfunction in adolescent girls in India till date. Though such kind of relationship has been demonstrated by Eftekhari and coworkers in iron-deficient adolescent Iranian girls (23-24). Normal thyroid status is dependent on the presence of many trace elements e.g., iron, iodine, selenium, and zinc for both the synthesis and metabolism of thyroid hormones (12, 25). Iron is very intricately connected to thyroid hormone metabolism. Therefore, estimation of serum iron and total iron binding is of great significance in thyroid dysfunction. Our study clearly addressed the association of iron status with hypothyroidism by estimating Hb level, serum iron, TIBC, transferrin saturation and serum TSH levels. The estimation of serum TSH the is single best screening parameter for hypothyroidism therefore only serum TSH was measured which is increased in primary hypothyroidism (26).

Our study demonstrates that TSH levels were significantly higher in all the girls of tribal community having moderate and severe anemia as compared to non anemic girls. Our results are in accordance with other studies which demonstrated increased levels of TSH and low levels of thyroid hormones in associated with reduced body iron status (25). It has also been suggested in one of the study conducted in Nepalese children that anemic and iron deficient subjects have high risk of hypothyroidism as they are reported to have higher TSH than non-anemic subjects (27). Similarly, a development of secondary and subclinical hyperthyroidism in a significant portion of patients with iron deficiency anemia has been reported in a clinical study conducted in adults with iron deficiency anemia (28).

The present study is the first report to associate iron deficiency anemia with hypothyroidism in adolescent school going girls of local tribal community in Udaipur. The study do have limitation of small sample size, less number of parameters tested and the data of non school going girls of same age group. It is

suggested that routine monitoring of thyroid function test and iron deficiency anemia in adolescent girls along with appropriate iron supplementations may reduce adverse pregnancy outcomes and mother mortality in their later life.

## CONCLUSION

A considerable proportion of adolescent school going tribal girls had iron deficiency anemia. Nearly two-third girls were anaemic (Hb < 12 g/dl); anaemia was significantly more in girls belonging to bigger family size. All severely anemic girls were found to have thyroid dysfunction. Thus, there is a need for closely monitored implementation of intervention strategies and methodologies for tribal areas, as per the local socio-cultural context. An effort would be required to promote consumption of iron rich foods for long-term gains in iron status of the adolescent tribal girls. Various Interventions for anemic adolescent tribal girls may raise their iron stores and sustain their hemoglobin at normal levels. This will not only improve their physical and mental capacity, but also subsequently help in reducing the incidence of low birth weight of infants and maternal mortality rates. The results further indicated a need for longitudinal studies with larger sample size to be undertaken in different parts of the Southern Rajasthan to assess the magnitude of iron deficiency anemia and associated thyroid dysfunctions amongst school going adolescent girls of tribal community.

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“Table 1: Classification of anaemia according to severity proposed by WHO”

S.No	Degree of anemia	Cut-off points of Hb(gm/dl)
1	Normal (non anemic)	≥ 12.00
2	Mild Anaemia	10.00 – <12
3	Moderate Anaemia	7.00 – <10.00
4	Severe Anaemia	< 7.00

“Table 2: Prevalence of different grades of anaemia in adolescent school going girls of tribal community”

Haemoglobin levels(g/dl)	Grade of anaemia	Hb gm%	% (n=102)
< 7	Severe Anaemia	6.4±0.9	9.8 (10)
7 - 10	Moderate anaemia	9.44±0.46	22.5(23)
10 - 12	Mild anaemia	10.78±1.12	47.05(48)
> 12	Normal	12.8± 0.69	20.5(21)

Values in parenthesis denote the number of girls

“Table 3: Correlation of Thyroid Stimulating hormone with degree of anemia and iron status”

Groups	Normal	Mild Anaemia	Moderate anaemia	Severe anaemia
<b>Hb</b>	> 12	10.78±1.12	9.44±0.46	6.4±0.53
<b>TIBC</b>	315.48±11.5	407.26±9.87*	442.86±10.2*	499.5±14.9*
<b>Serum iron</b>	68.34±4.3	64.93±7.6	56.46±5.5*	23.07±8.22*
<b>Transferrin saturation (%)</b>	21.6	15.94	12.7	4.62
<b>TSH</b>	2.01± 1.82	2.91±1.9	17.56±4.1*	23.39±3.3*

\* denotes p value less than 0.005 as compared with non anemic group.